

Urban planning, environment and health



From evidence to policy action
- Meeting report -



ABSTRACT

Environmental conditions of urban settings are a major issue both for individual residents and for local and national governments. However, little is known on the practical mechanisms and local restrictions in ensuring adequate environmental conditions in cities.

This report presents the results of an expert meeting to develop policy advice on urban planning, environment and health which was convened in the context of a larger project co-funded by DG Sanco (grant agreement 2006WHO01, "Enhanced policy advice on environment and health in Europe"). This project included a work package on environmental health challenges in urban planning which had the objective to review – based on contributions from scientific experts and urban planners and practitioners – the impact and effectiveness of current regulatory frameworks and European Directives that affect urban planning and urban environmental conditions. The perspective of local authorities as the implementer of urban planning was used for the discussion and case studies on environmental health dimensions of urban planning were prepared by two cities.

This meeting report provides (a) the summary notes of an expert meeting held in fall 2008, (b) an evidence review on the urban planning impacts on environment and health, and (c) summary reports of two case study cities on their local priority challenges.

In conclusion, the challenges faced by local authorities in daily urban planning practice are highlighted and associated with the regulatory frameworks on international level. Various suggestions are being made to equip local authorities with better frameworks and resources to make urban settings healthier.

Keywords

CITY PLANNING
ENVIRONMENTAL HEALTH
URBAN HEALTH
EUROPE

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Context and objectives

With ongoing urbanization, the environmental and health-related conditions of urban living become a major issue both for individuals and for local and national governments. However, little is known on the practical mechanisms and challenges to ensure adequate environmental conditions.

Therefore, the overall objective of the expert meeting was to review – based on contributions from scientific experts and urban planners and practitioners – the impact and effectiveness of selected EC Directives that affect urban planning and urban environmental conditions. The meeting was a central element to an urban planning work package of a larger project co-funded by DG Sanco (grant agreement 2006WHO01) aiming at the generation of “Enhanced policy advice on environment and health in Europe (PAVEL)”.

The PAVEL project aims at strengthening the capacity to respond to concerns or controversies in environment and health arising in European countries more promptly, effectively and in a consistent manner. It benefits from WHO/Europe’s expertise across different environmental health areas.

The work package on the environmental health challenges of urban planning focused on the review of local implementation and added value of EC Directives. This choice was made because urban planning by default is a mandate of local authorities, and therefore any discussion and advice on urban planning would have to target the local level and not the European Commission. However, the Commission has developed – and will continue to do so – a number of regulations, decrees and Directives that affect the urban planning mechanisms and force local authorities to comply with certain standards and procedures. It is therefore a stakeholder in the urban planning process as it tries to steer and orient urban development processes into certain directions. The main question dealt with by the meeting therefore was whether these Directives have an added value for urban planning, and whether the Commission is successful with this strategy.

The implementation of the work package on urban planning was based on an expert meeting convened in Bonn on 24-25 November 2008 (see Annex 1 for the list of participants) bringing together academics and scholars on urban environments and health, practitioners from the field of urban planning, and representatives of local authorities. For being able to compare theoretical knowledge from literature and scientific publications with the experiences made by local practitioners of urban planning, in-depth work with two selected local authorities also lead to the provision of two case studies on urban planning challenges in relation to environment and health.

The expected outcomes of the meeting were:

- Identification of local challenges in urban planning in relation to environment and health (based on an evidence review, case studies and local authority representatives` experiences)
- Evaluation of EC directives and guidance papers in the field of urban environmental issues
- Conclusions and strategic recommendations towards including environment and health information into urban planning policies

Supporting the discussions at the meeting, a set of background documents had been made available to reflect the work package objectives:

- a review of evidence on the associations between urban planning, environmental risks and health (see Annex 2)
- risk profiles on environmental exposures from two cities (Rennes and Torino, see summary reports in Annex 3 and 4).

Introductory speeches and case studies

The meeting was opened by WHO describing the wider context of the PAVEL project and the work package on urban planning, which was to provide advice on dealing with environmental health issues in relation to urban planning. Recognizing the relevance of the practices and challenges of planning on the municipal level, the floor was then given to the city delegations from Rennes and Torino as local case studies.

The city of Rennes reported on its urban planning priorities and challenges which were especially related to urban growth and space consumption, mobility, air pollution and noise (environmental footprint), as well as waste management and water supply. The urban planning tools, distinguishing between local, national and international scale, were introduced.

The city of Torino described its historic development as an industrial city followed by deindustrialization and the related urban challenges, mainly reorganization of urban mobility, urban transformation and environmental regeneration. Key issues from environmental perspective were considered to be noise, air pollution, and green space provision next to the waste and water management.

Both cities provided a set of urban data on a variety of environmental risk parameters (urban risk profiles) and a short summary report (Annex 3 and 4). Both were used as background document to the expert meeting.

Following the presentation of urban examples, a key note speech was given by Michael Depledge (United Kingdom) of the Royal Commission on Environmental Pollution who presented the Commission report on the Urban Environment. The report itself considers the main issues surrounding environmental policy for the urban areas and concludes with a number of recommendations.

Its presentation was assessed as a contribution to the understanding of the local challenges in European cities in relation to urban planning and environment and health. The British examples were considered a valuable addition and suggested that many of the problems associated with the urban environment are complex and inter-dependant. This means that addressing the problems must be implemented in a coordinated way. Failure to recognize the complexity will result in the implementation of solutions that will possibly trigger unintended negative outcomes.

A second key note speech was delivered by Pierre Laconte, President of the International Society of City and Regional Planners (ISOCARP). Laconte pointed out that urban planning has a substantial potential to positively affect physical, mental and social well-being, and to enhance social inclusion, thus contributing to decreasing health inequalities. To achieve such a supportive urban environment, intersectoral collaboration needs to be actively promoted, in line with the conclusions of the EU Thematic Strategy on the Urban Environment. This should involve urban planners, public and environmental health professionals, other relevant sectors, and administration at different levels. Citizens should also be engaged in this process.

With particular reference to urban built environments, the following dimensions were suggested by Laconte as a suitable framework for action:

- the regional dimension, recognizing and appreciating regional differences between cities in historical, climatic and cultural terms;
- the design dimension, recognizing the importance of diversity in the quality of built and green spaces in order to strengthen identity and loyalty to locale;
- the technical dimension, by optimising access to, and use of natural resources through efficient ventilation, solar access, and health-oriented design;
- the social dimension, by 'ownership' training for all stakeholders in order to overcome environmental neglect and develop responsibility for sharing health resources.

Key challenges of urban environmental management for local authorities

The following discussion, drawing from both the practical case studies and key note speeches, particularly emphasized the need for an integrated approach to tackling urban priorities including the need for transport planning, and the recognition that health can be improved by proper planning of the urban environment. It recognized the need for broader understanding of the natural urban environment and the added value of the environment to promote health and well-being. Urban planning should be considered with a view to its value to the health of the community. The idea of an 'Environmental Contract' was used to

depict the need to work towards a stronger model of collaboration of interests between central and local government and partnerships with the community.

The possible economic savings to health care services of a more integrated approach to urban planning and environment and health were considered as an important factor to inform the process of bridging the distance between evidence and action. However, a problem for developing policy on the basis of scientific evidence was identified to be the wide variety of methods and standards of studies on urban conditions and health and well-being. Robust intervention studies are important in order to find out the benefits of healthy urban conditions and must be conducted in order for policies to be implemented. Specific interaction between the respective actors ('Science meets policy') may be one mechanism for overcoming the barrier between scientific recommendations and policy action and achieving an integrated process.

Moreover, in order to achieve the goal of integration between science and policy in the specific field of urban planning, there needs to be greater collaboration between different policy fields such as between health, environmentalists and architectural planners.

Planning needs to be more preventive rather than reactive to problems. The economic costs/benefits are especially important to consider in terms of predictive forecasting and preventive measures rather than awaiting impacts or problems to occur; usually at a stage when the situation is more costly to rectify. However, current practice seems to often follow a more reactive model of action. Part of the reason why reactive rather than preventive action is favoured is due to the political aspect of the interests of central as well as local governments, which tend to seek short-term rather than long-term results. The environment and health results and benefits of urban planning are usually long-term. Thus, there exists a conflict between efforts to improve environment and health for communities and the political agenda of policy-makers.

In conclusion, the meeting participants agreed that there is a need for a holistic and long-term approach rather than the short-term consideration of isolated of variables and single factors when identifying cause-effect relationships.

EC Directives (working groups)

Environmental Noise Directive

The Environmental Noise Directive (END) issued by the European Commission aims at mapping noise exposure levels at busy streets in European accumulations. It comes with quite some work burden for the affected local authorities, that have to undertake measurements or develop exposure models, and for national governments that need to report the data on a national scale. The implementation of the Directive was associated with a certain degree of insecurity about methods to be applied and was not supported with European funds. Although all

participants agreed that the identification of noise exposure levels and hot spots is necessary to develop targeted mitigation action, the group felt that local authorities are somewhat left alone with the burden of END implementation and the associated unsolved questions. Especially, it was pointed out that currently it is not clear whether there will be an evaluation of the added value of the Directive and its implementation, especially in relation to health outcomes. Such evaluations are difficult to be done for local authorities and thus national or international actors, possibly the Commission itself, would be responsible for carrying out such an evaluation to assess the impact of the Directive on noise reduction in urban settings.

For local use, it was indicated that the value of the noise maps in guiding local authorities and urban planners must be more clearly outlined. Clear guidelines values need to be set in combination with a list of action steps and interventions that can be carried out to reduce noise without affecting local transport too much. It was also suggested that noise scenarios need to become a natural part of any municipal development project related to infrastructural or industrial investments.

In summary, the END was considered a valuable tool for noise reduction in general but the instruments, mechanisms and tools to translate better exposure measurement into successful noise prevention campaigns have still to be developed and are not part of the Directive. The direct applicability of urban planning and health prevention is therefore rather limited.

The following remarks and recommendations were developed by the working group in relation to application and further improvement of the noise Directive:

- 1) The Noise Directives/guidelines have been very helpful in agenda setting as they did make the development of noise maps a priority. However, every city has its own situation in terms of priorities, timing, network of different departments and technical experience. The implementation of the END therefore often takes more time than planned.
- 2) The compulsory character of the noise maps to be established is considered very useful. However, there are problems of methodological nature as local authorities frequently request guidance and explanation of national governments regarding the implementation.
- 3) More attention should be devoted for combined noise exposure (as fit for the area). The END focuses too much on individual noise sources. Also, the END should be somehow combined with the air quality Directive as in many cases transportation emissions are the key source for both air pollution and noise.
- 4) The END is useful to identify problems. However, the Directive itself leaves the local authorities alone regarding the solution of the challenges. The provision of good practise examples would be desirable.
- 5) The method basis needs to be further developed and better facilitated to make results consistent. Especially the status of noise exposure data from social surveys is to be clarified. Examples and case studies showing adequate implementation are required.

Ambient Air Quality Directive

The Ambient Air Quality Directive has set quantitative levels for exposure to particulate matter and NO₂ and dictates a maximum number of exceedances of these limits per year. For many larger cities, the levels have proven extremely difficult to comply to and it has had severe effects on local transport in many cities. Cities have responded in different ways to reduce the pollution levels but rarely successful and acceptable solutions have been found to reduce the root cause which is mobility. Environmental protection zones, regulating the type of cars that are allowed to enter the zone based on their emissions, have been developed but large-scale evaluations on their impact on exposure reduction and health impacts are still to be carried out.

One criticism to the Directive was that it has not addressed all aspects of air quality. Furthermore, it is unclear whether the focus of evaluation is or should be on exposure peaks and exceedances of the standard values, or on general background pollution. As well, the Directive addresses only the outcomes (air pollution) of urban activities but does not address or target the producers of air pollution, mainly transport and industry (marginally also households). A similar problem is thus seen as for the END as local authorities are forced to identify their priority challenges but are then left alone regarding the potential solutions.

Another criticism was that the Directive – as much as the END – should have been produced within a more holistic context of urban environmental pollution and be linked with similar activities for other environmental goods. The development of sectoral Directives for noise, air, and other environmental dimensions was not considered ideal and it was suggested for the Commission to consider developing an overall framework guiding the development of such Directives. At current stage, the Thematic Strategy of the Urban Environment was not considered an adequate contextual framework.

The problem of the difficulty of complying with the limits applies to almost all cities covered by the Directive and therefore it should be considered what, if any, measures should be enacted in such instances to promote adherence to the defined limits. In this context, it is unclear what the *incentives* are for cities to comply with the Directive; instead of using sanctions for road users or businesses in case of non-compliance. In order to deal with this issue, research should be conducted to gain comparative knowledge on how cities are implementing the Directive and potentially achieve staying below the respective exposure levels. Cases of best practice should be highlighted as a model for other cities to make reference to.

The following remarks and recommendations were developed by the working group in relation to application and further improvement of the air quality Directive:

- 1) Create more clear and consistent guidance on selecting measurement sites. Ensure that data is gathered in the most appropriate sites. There is a strong need to ensure that health inequalities are not exacerbated due to missing or poor data from areas mostly inhabited by vulnerable groups.
- 2) There is a need to ensure that people who deal with the mitigation of air pollution are able to feed their experiences into urban planning mechanisms– e.g. master plans, development plans and transport plans.
- 3) The limits used for the Directive have been strongly under debate and even adapted to meet the city's needs. It is not certain that they will remain (or even will be further reduced) in the future. This undermines the connectivity between environmental policies and major public health issues. Uncertainty on the long-term validity of the limit values makes it very difficult for long-term investors and discussions with planners on the standard to be achieved and the equipment and solutions to be used. It also compromises the local government position.
- 4) Action on the prevention of air pollution is necessary everywhere and also in municipalities not covered by the Directive. It is important that policy-making is equal but the Directive does not treat all residents the same as they will benefit only if living under specific exposure circumstances and in larger cities. Other population groups may be (at least) as much exposed to air pollution but may not benefit from the Directive. Pollution abatement measures should therefore not be exclusively associated with the results obtained through the implementation of the Directive.
- 5) Citizens should have the legal right to demand that local plans adhere to the limits provided by the Directive.
- 6) National governments should ensure that the evidence base on air pollution is linked with morbidity in local areas. This association will help to assess the impact of the Directive on pollution levels, and on health.
- 7) It may not be in all councils' short term interests to identify whether they have an air pollution problem in certain areas. The system needs to be able to tackle the risks this poses to vulnerable populations, and at the national level there needs to be sufficient motivation schemes to help local authorities deal with the issue.
- 8) Limit values should be modified based on most recent health-based evidence, and not based on what cities can actually comply with.

Quality of Life and Environmental Health and Cities

A third group was established upon request of the participants in order to deal with more general principles and strategies beyond the mandate of specific Directives. The group chose to discuss on the quality of life in urban settings and discussed issues related to the EU Thematic Strategy on the Urban Environment.

The need for community and local authority participation in defining problems and solutions was identified as a central factor with a view to achieving equitable opportunities for enjoying clean environments and being in good health for all urban inhabitants.

The creation of a 'master plan' as the backbone of any urban planning process does necessarily require political consensus and in consequence, there is great difficulty in achieving the adequate inclusion of all appropriate strategies which would first have to all be accepted and agreed upon.

Any master plan or strategy must be appropriately adapted to fit to the local circumstances and uniqueness of different cities. The ultimate goal must be to provide the maximum of comfort, health and safety for the citizens. There must thus be adequate flexibility for modification of form and style of application of any master plan in order that single strategies not matching the local conditions are not imposed upon heterogeneous cities facing diverse problems.

It was argued that Health Impact Assessment (HIA) and Environmental Impact Assessment (EIA) must be conducted in a more integrated manner. This would pertain to the necessity of approaching urban planning in a holistic way that accounts for the complexities and interlinked nature of environmental factors and health effects. The value of integrating HIA and EIA in urban planning was reinforced by the identification that health and environmental elements in the urban environment are arguably always interlinked, whether directly or indirectly.

The following remarks and recommendations were developed by the working group in relation to quality of life and environmental health in cities:

1. The fate of the Urban Environment Thematic Strategy is disappointing – it was first meant as a Directive, then as a recommendation, and eventually became a communication. In consequence, there is no EU Directive on urban issues in more general context.
2. It is necessary to address the growing urban inequity between countries and within communities. Bottom-up participatory processes are needed and need to be installed through adequate national and measures as a reaction to leadership by the EU. Promoting awareness and giving proper information to citizens is as important and needs to be promoted by the EU as well.
3. Local Authorities should be the direct interlocutor of the EU in the field of urban strategies. The decisive question is how the EU can help build successful processes on local scale through a pan-European effort while acknowledging the varying needs of the communities.

4. Drafting guidelines and recommendations is a very useful task to start with. However, they must be implemented. In urban planning, the contrast between guidance and application is considerable but there is no stakeholder to evaluate whether recommendations are applied. Deviation from good practice is most often not leading to any consequences.
5. Any urban planning tool developed must integrate public participation as a priority. However, it is acknowledged that it will remain difficult to expect citizens to distinguish between their individual necessities and a strategic vision for the city.
6. The natural environment needs to be more considered in any future strategic document on urban planning.
7. Health Impact Assessment and Environmental Impact Assessment should be always integrated in urban planning approaches and therefore need to become essential parts of future strategies as well.

Methodological approaches to measuring the environment and health performance of cities

The session on methods and approaches to measuring and assessing the environmental health performance of cities was based on a short description of various approaches to quantify and evaluate selected environmental risk factors in urban settings. Presentations were provided on

- Healthy Cities: Urban Indicators (Grant, United Kingdom)
- URHIS: Urban Health Indicator System (Welteke, Germany)
- ENHIS: Environmental Health Information System (Gapp, WHO)
- European Environment Agency: Urban Environment Indicators (Hicks, WHO)

and showed various functional ways to develop indicators and assessment tools focusing on slightly different aspects of the urban environment. Comparing all approaches, the individual presentations indicated that it is a very difficult task to identify indicators and parameters that will work across all ranges of settlements and local situations irrespective of size and context.

A fundamental difference was, however, in the application of data sources which can be based on local surveys, national reporting, EU data, and many other sources. Comparing to the four examples, Matthias Braubach (WHO) then showed how the data provided by the case study cities of Rennes and Torino could inform urban policy-making as a means based on exclusively locally sourced data. The key message of the case study review that local authorities have a variety of data allowing them to

- assess the magnitude and partial distribution of environmental exposures within the city;
- identify priority areas for action in technical terms;
- evaluate the impact of interventions carried out.

However, it seems rare to link environmental data with health statistics on local level and therefore, the health dimension of urban and environmental planning may often be underestimated.

The methodological approaches developed by the different examples were then used as background information for the working groups devoted to developing and discussing, for a variety of environmental health topics, the most suitable indicators to be applied for describing adequately the "status quo" of cities in relation to environmental health risks and concerns.

Urban EH risk profiles: Key parameters of urban environments

The meeting participants were then subdivided into several working groups to discuss the indicators presented before, and choose or develop suitable indicators for a variety of environmental risk factors. The following suggestions were made by the individual working groups:

Noise parameters

The noise group first discussed some method-related issues and stated the following principles:

- it is necessary to distinguish clearly between the internal and external types of noise exposure. In many studies and projects, noise is considered as an overall exposure parameter, leading to high exposure values but little information on what type of noise exactly is to be tackled (first).
- noise exposure must be assessed as a measurable parameter in relation to health and well-being in order to provide reliable and valid results. The integration of "noise annoyance" is suggested for discussion.
- Next to focusing on the noise exposure as a risk factor, it would be interesting to also identify quietness or tranquillity as indicators to be identified. Such indicators could help to locate the peaceful and quiet places within a city as a means to provide restoration and health resources.

In relation to suitable parameters that could be used to assess the noise situation in urban settings, the working group suggested the following parameters which relate to traffic-related exposures (justified by the large amount of citizens involved):

- Traffic flow/intensity and composition (ideally in combination with traffic speed)
- Percentage of people/houses exposed to levels >55 and >70dbA (alternatively: 50 and 65 dbA)
- Percentage of primary schools along busy roads or Percentage of schools exposed to levels >55 and 70dbA
- Composite indicator of noise exposure and air-pollution – specifically for vulnerable groups (elderly and children)
- Proportion of persons/households located in quiet and tranquil areas
- Percentage of people exposed to more than one noise source e.g. air and road, road and industry etc.

The group did intentionally not recommend parameters based on the use of medication or number of visits to the doctor (not specific enough) and the definition of the distance to the road (this information is only valid in combination with traffic intensity etc).

It was noted that specific EC documents exist that tackle directly the noise dimension:

- EC Directive 2002-49-EC on environmental noise

Transport parameters

The working group on transport stated that in general terms, encouraging alternative means of transportation is always good for the health of citizens and this should be done by default, irrespective of any data or data trends.

The group agreed that there are no standard solutions available. However, given the variety of transport networks and contexts, solutions must be adaptable to local context and situation.

Regarding key parameters, the group agreed that the following parameters would be useful for monitoring and assessment:

- Accessibility of transport networks across different groups of the population
- Efficiency and quality of service (only possible as qualitative parameters)
- Local initiatives and incentives to shift from using the car to public or physically active transport means (measured by local modal split percentages)
- Accessibility of urban facilities by cycling networks and public transport

- Differentiation of speed limits in different areas
- Existence of environmental zones with varying levels of restriction in relation to car emissions

It was noted that specific EC documents exist that tackle directly the transport dimension:

- Sustainable urban transport plans;
- Commission Recommendation 2004-345-EC on enforcement in the field of road safety.

Waste & waste management parameters

The working group addressing waste and waste management discussed the most crucial services to be provided in urban settings and developed a set of parameters based on this discussion. The potential parameters to monitor and assess the environmental health performance of cities in relation to waste and its management are:

- Recycling system:
 - Nothing
 - Recycling banks
 - Presence of a doorstep recycling service
 - Split bins in main public places
 - Household recycling centres/container yards
- Packaging and availability of waste bins in supermarkets for which disposal is the duty of the company
- Schemes to improve recycling by putting a value on packaging (eg.1€ on a bottle) and local return rates
- Special communications by the local authorities on waste issues
- "Flytipping" incidents (illegal dumping of waste in abandoned places)
 - Number of incidents per year per 100.000 population
- Litter/dog fouling covering green and public open space (as an indication of awareness and commitment of the local population as well as degree of control and maintenance carried out by authorities)
- Number of households within 1km of landfill site

- Existence of public schemes for green waste collection or treatment for composting
- Local waste management and treatment and technologies used to transfer waste into energy
 - Incineration
 - Biogas
 - Refuse Derived Fuel (RDF) technologies

It was noted that specific EC Directives exist that tackle directly the waste dimension:

- EC Directive 91-271 EEC on urban waste water;
- EC Directive 2006-12-EC on waste water;
- EC Directive 2000-76-EC on the incineration of waste.

Water and water treatment

The working group agreed on a basic understanding on which to develop the proposed parameters: water was considered as a basic good and public resource like air, although in practical terms it is mostly managed and treated by private companies. It was also agreed that in relation to the importance of safe water for health, its perception in urban planning and urban environmental discussion is relatively low.

For assessing and monitoring the urban performance in relation to water and water management, the following parameters were proposed:

- Existence and implementation of local flood risk management and production of flood risk maps followed by local mitigation actions
- Percentage of households with rainwater harvesting systems
- Water quality at the tap and frequency of exceedances of limit values
- Waste water treatment and annual environmental burden of discharges to rivers
- Leakage rates of potable water supply system and networks
- Capacity of local water treatment plans and type of cleaning (physical, biological, chemical etc.)
- Existence of water supply emergency plans or alternatives for water supply in crises or under drought conditions

- Use of bottled water by public services and private households (aiming at a reduction in use of bottled water in those municipalities with very good tap water quality)

It was noted that specific EC Directives exist that tackle directly the waste water dimension:

- EC Directive 91-271 EEC on urban waste water;
- EC Directive 2006-12-EC on waste water.

Recreational & green space parameters

The working group and especially the representatives of local authorities discussed the benefits and the challenges faced in relation to the provision of more green and public spaces. From local authority perspective, green spaces are always nice to include in planning schemes but it must be cautioned that these areas come with a certain degree of work and public cost due to the necessary maintenance work. In many cases, these costs are a crucial factor in the decision-making process.

Furthermore, open and green spaces have also problematic aspects as they tend to be hotspots for criminal activities and may – if not adequately serviced – turn into zones of fear avoided by many citizens. Such negative aspects therefore must be integrated into the planning in order to strengthen security through environmental design.

The working group suggested the following parameters for assessing the performance of cities in providing their citizens with adequate green and recreational areas:

- Green and recreational space in absolute figures (sqm) and in% of municipality surface, possibly% of change of green space proportion over the years
- Data on use and access to the green and recreational spaces (which groups use it for what need?)
- Availability of green and recreational areas on neighbourhood level (checking for inequities in access to such areas)
- Safety of green areas by number of incidents and crimes
- Maintenance of green areas by cost or staff involved
- Types of green spaces: public versus private green spaces

- Local campaigns or incentives for green space quality (competition among cities or neighbourhoods for being the most attractive city)

The group suggested that strong incentives (provided by national or international actors) similar to those for businesses and companies can be employed as tools to promote commitment and enhance competition to become a 'green city'. Furthermore, participation of the citizens in developing such green spaces is a promising way forward to identify needs, increase the feeling of ownership and potentially indirectly reduce maintenance costs based on an increased commitment of the community to keep such spaces in good shape.

Discussion and recommendations

The results of individual working groups were discussed in plenary and a number of relevant suggestions on potential solutions were identified. The suggestions for the way forward are broken down below according to the three expected outcomes of the expert meeting:

- 1) Identification of local challenges in urban planning in relation to environment and health (based on an evidence review, case studies and local authority representatives' experiences)

The discussion of the case studies, and the contributions of city representatives showed that local urban planning is always a very specific process depending on the local circumstances. The environmental health challenges of cities can be very different in detail although the main topics (air, noise, waste disposal, green space management, transport planning...) often are similar. As the best technical processes need to be selected at local scale, any advice on environmental health issues in urban planning thus needs to be on a general and strategic level, identifying the direction to take and the objectives to be achieved by the respective mechanisms.

The meeting participants agreed that there is a need for a holistic approach to policy-making in order account for the interlinked nature of the issues in urban planning in relation to the environment and health. While this statement is easy to make and probably acceptable to all stakeholders, the implementation aspect is more complex and challenging. The meeting discussions indicated that indeed there is a wealth of information on how urban planning should be applied in order to develop healthy and environmentally friendly cities supporting the individual needs of each citizen. It was impossible at this meeting to identify exactly where in the urban planning process the translation of that knowledge is failed but it was consensus that current urban planning still holds much potential for improving the healthfulness of cities.

In the end, the group agreed that the main challenge is lying in the implementation of urban planning, and the (potentially not sufficient) awareness of the fact that planning is done in sectoral and separate ways (green space plan;

transport plan; plans for locations of public services and businesses, noise maps, etc.) but in practical terms come together to shape one urban environment. The main challenge thus lies in carrying out these processes within one common context and with clear priorities in mind that are consistent for all technical planning processes.

2) Evaluation of EC directives and guidance papers in the field of urban environmental issues

Given the complexity of urban planning and its challenges, the European Commission (EC) is considered a very relevant stakeholder with a strong mandate to define the regulatory context and issue Directives, recommendations and communications affecting and orienting urban planning actions. However, there are some conditions that apply when considering the EC products as an added value:

- The mandate of urban planning is on local scale. The EC Directives etc. therefore need to be flexible enough to be applied to the local situation.
- Many EC Directives etc. request local authorities to make available (potentially significant) human and financial resources. In most cases, the work expected to be carried out by the local authorities is not matched by funds provided by the EC or the national government and thus implementation adds a burden on the municipal budget.
- EC Directives tend to focus on risk assessment and – where such risks are identified – require local authorities to take action. While this is very necessary from a public health perspective, and provides citizens with legal positions requesting action by their municipality, it creates a problem for the local authorities as they are forced into identifying problems without necessarily have an adequate solution at hand.
- EC Directives and all actions related to the urban environment and the urban planning process should by default include funds, programmes and campaigns that support and enable the identification and implementation of solutions to the problems identified. Local authorities cannot be left alone with the problems identified. National campaigns, case study collections, workshops on exchange of practice examples, and a clearinghouse providing adequate evidence and advice on practical implementation of mitigation and abatement measures would be necessary to be included. Such an approach would enable the local authorities affected by the Directives to not only act as a data provider, but also gain from the implementation of the Directive and improve their performance.

Given the future development of EC actions that include support activities to tackle and not only assess urban environmental problems, the meeting concluded that it is necessary to further extend the scope of the coverage of urban environmental aspects in the EC documents. While the Thematic Strategy was a very holistic

approach, identifying the urban environment as one entity, the Directives and legally binding approaches taken by the EC still tend to focus on sectoral issues. The meeting participants therefore recommended that the Directives would either be considered in association with each other (e.g. the air and noise Directives could go well together and be further merged with e.g. transport and mobility-related Directives and EC activities) or Directives and programmes be developed tackling the urban environment per se.

3) Conclusions and strategic recommendations towards including environment and health information into urban planning policies

The meeting reviewed a number of methodological approaches to assess the status quo of the environmental health performance of cities. Data is available for many aspects although in many areas more details, especially regarding the distribution of environmental risks and benefits, would be desired. However, both the case studies carried out in Rennes (France) and Torino (Italy) proved that cities are fully capable of assessing their own needs and defining the priorities for action accordingly.

Potentially preparing and paving the way for such developments, the working groups suggested a set of environmental parameters to be considered for a more holistic assessment of the urban environment. Case studies have shown that sufficient data is available irrespective of EC Directives, indicating that evaluative approaches on the urban environment are feasible. Naturally, well-targeted EC actions would provide further orientation and help in compiling more detailed data on local priorities, and would add to the objective.

Local budgets are considered a major restriction for many local authorities as any action in urban planning and maintenance comes at a certain cost and therefore, not everything that is desirable is also feasible. However, considering quality and adequacy of the urban planning mechanisms undertaken, the issue of implementation mostly is a question of political will, adequate planning and the application of integrated approaches to bridge individual and sectoral planning processes. Increased intersectoral work and the increase of health elements in urban planning education are thus considered suitable steps forward that do not come with additional financial burden but can be applied within existing frameworks and processes.

Conclusions

In conclusion, the EC is therefore requested to increase its activities on urban healthy environments by providing more general context regulations and communications on the ways forward, and supporting the independent implementation of these frameworks on local scale. For doing so, the meeting participants formulated the following requests to the EC in order to increase its effectiveness in shaping healthy urban environments in the EU:

- Establish direct communication mechanisms with local governments
- Develop models for integrating health aspects in urban planning education.
- Further develop models of implementing EIA and HIA concepts in the urban planning domain
- Consider urban environment as a setting instead of breaking it down into its technical dimensions
- Develop a binding regulatory framework (or a “white book”) on urban planning principles to be applied and followed by all technical planning processes.
- Provide funds and grants for local projects addressing the urban environmental challenges identified through EC directive implementation.

Furthermore, recommendations to WHO were to

- Increase communication and exchange with other professional circles in order to facilitate the health dimension of their work
- Share more knowledge with urban planners, not only with health related professionals, and increase the relevance of health in respective educational curricula
- Provide the evidence for health impacts of certain urban features that can be tackled by urban planning measures.

The relevance of the WHO Healthy Cities programme for further developing such approaches and networks was specifically emphasized.

Annex 1: List of participants

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REGIONAL OFFICE FOR EUROPE



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ВСЕМИРНАЯ ОРГАНИЗАЦИЯ ЗДРАВООХРАНЕНИЯ
ЕВРОПЕЙСКОЕ РЕГИОНАЛЬНОЕ БЮРО

**WHO expert meeting on Policy advice on urban planning,
environment and health**

Bonn, Germany, 24 – 25 November 2008

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Annex 2: Evidence Review on the Spatial Determinants of Health in Urban Settings



Evidence Review on the Spatial Determinants of Health in Urban Settings

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Acknowledgments

This report was prepared by University of the West of England, Bristol, and also features extracts from a working document prepared by the International Society of City and Regional Planners (ISOCARP) for the WHO expert meeting (Section 1, Section 8, Appendix 1 and 2; Boxes 1-4).

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Evidence Review on the Spatial Determinants of Health in Urban Settings

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Section 1

Introduction and historic context

In England in 1875, the passing of the Public Health Act was probably the first effective response by a national government to the growing demand for decent standards of health and hygiene for workers in the newly-industrialized urban areas of that country. If there was a link between health and urban planning it was not immediately recognized or explored: rather was the focus on more fundamental issues such as the structural stability of houses, the prevention of fire, and the provision of adequate water supplies, sanitation and ventilation. The improvement of building standards rather than estate layout or urban design was the immediate target of the health reformers of the day.

A few enlightened industrialists in Britain, Germany and elsewhere had a different but complementary agenda. Their central concern was to maximize productivity and profit; and for that to be achieved it was vital that their workers could enjoy good health and reasonable living conditions close to the workplace. Cadbury in Bournville, Krupp in Essen, and Lever in Port Sunlight were three such entrepreneurs who translated ideas into reality by building small 'garden villages' for their employees. Almost by accident, good health and good urban planning became bed-fellows.

Today, there is international acceptance of the general proposition that the provision of basic health care, potable water, fresh air, safe buildings, and proper waste management facilities are rights, not privileges – especially for city dwellers. When things go wrong, urban populations are usually the first to suffer. Individuals as well as communities – perhaps even entire neighbourhoods or the city itself – can pay a high price for failures in the supply and delivery of health services and the municipal infrastructure, which support them. Recognition of this reality has given birth to the concept of environmental health – a condition, which (like personal health) can be observed, diagnosed and treated in accordance with agreed protocols. The important point to be made here is that the environment is seen as having attributes, which can be managed through social intervention with the aim of enhancing the overall well-being and "health" of the entire system.

It is mainly in the cities where this process of environmental management has been adopted by governments. It is in the cities where public and environmental health standards are commonly set and maintained at the highest possible levels, commensurate with local resources. And it is within the field of city and municipal governance that we find an increasing involvement in the wider and more complex field of activities, which goes under the generic title of 'urban planning'.

However, urban planning is a process that needs to reflect the local circumstances. No two cities are identical. City planning and governance systems vary widely. Within European cities, significant differences of climate and geography (both of which have health implications) are evident, along with the statistical complexities of demography and socioeconomic make-up. The review of evidence therefore aims at providing a general overview of the environmental factors that play a role for the urban planning process. Clearly, local action may address those factors to varying extent.

Section 2

Urban settings and health

Rapid, unplanned, unsustainable patterns of urban development and continuing urbanization of the population have always made cities in the developing nations focal points for many emerging environmental and health hazards (WHO, 2002a). The public health issues of waste disposal, provision of safe water and sanitation and injury prevention are familiar issues at the interface between urban inequalities, environment and health.

Economic development has often been part of the package of solutions to these problems. However, a new agenda of largely noncommunicable disease and seemingly intractable health risks is emerging from the urban settlements in developed nations. Obesity, asthma, health inequalities, mental illness and loss of social cohesion and support networks are becoming an increasing public health focus in urban areas.

Europe is one of the most urbanised continents. Approximately 75% of its population lives in urban areas; by 2020, this will be 80% (EEA, 2009a). Pressures for development in urban areas is becoming acute; but low density 'urban sprawl', occurring at the periphery of most urban centres, is re-shaping landscapes and affecting people's quality of life and the environment as never before. Urban planning is now high on the political agenda and the acknowledge by the European Environment Agency (2009a) as a critical challenge;

... today's trend of new, low-density approaches to urban development results in increased consumption of energy, resources, transport and land, thereby raising greenhouse gas emissions and air and noise pollution to levels that often exceed the legal or recommended human safety limits.

In the recently published report on the quality of life in European towns and cities (EEA, 2009b) they state that

... health, quality of life has deteriorated. For example, there have been marked increases in allergic reactions and lifestyle related diseases, such as cardiovascular disorders caused by obesity, physical inactivity or stress.

The challenges for health in European Cities have been a focus for the WHO Healthy Cities programme since its inception in 1998 and has recently been re-affirmed in the Zagreb Declaration for Healthy Cities (WHO, 2009), with the planning for healthy urban environments coming to the fore.

This review attempts to look at the determinants of health from a spatial planning perspective. The risks (and benefits) to health are viewed as being woven into the very fabric of our towns and cities; the way we plan, design and manage the territory of places, spaces, facilities and buildings of our urban habitat impacts on health from both a positive and negative perspective (RCEP, 2007). The review provides an overview of the evidence. It reviews the effect of land use patterns, transport, green space and local environments as they impact on five specific determinants of health. These are basic components of the urban environment and are all subject to sectoral

policies which spatial planning seeks to align and influence. The determinants of health examined are air pollution, noise, physical activity levels, social impacts and pathologies, and unintentional injuries. The way they are affected by the urban components varies in absolute terms and in their relative contributions to different subpopulations (CSDH, 2008). However, they all have a significant impact on quality of life and health for those living and working in the urban environment through influencing the potential for physical, mental, social and environmental well-being.

This review contributes to the agenda for frameworks and approaches as set out by the International Public Health Symposium on Environment and Health Research (WHO, 2008a) in helping to close the science-policy gap. In particular, the objective is to communicate the results of primary research and reviews of research with a high degree of synthesis, so capturing the complexity and interdependence of environment and public health issues in the urban realm. It is hoped that the form that this evidence review takes will support researchers and policy-makers in developing a better understanding and developing new programmes to address the health risks examined.

The main questions for the review are:

- How should we approach the understanding of health in relation to urban form?
- What urban components and determinants of health are most dominant?
- What evidence exists in terms of impact on the determinants of health?
- What urban planning solutions are being suggested in the literature?

Following this introduction, Section 2 'The urban environment as a system', provides an outline of the approach we need to take in gaining better insight into the relationships between urban spatial form and public health. The section also identifies the four main urban components which contribute to the urban setting and lists the five determinants of health under review. This section also describes the how evidence has been identified and selected. Section 3: 'The health risks and benefits in outline' then briefly describes each of the five selected determinants of health and discusses their risks and their benefits to health. Section 4, entitled 'The main urban components and their impact on the determinants of health', addresses in detail what evidence exists in terms of the urban components impacting on the determinants of health.

No review of health in the urban setting can be complete without referring to the profound and adverse ways in which climate change will affect fundamental determinants of health (WHA, 2008). However, it lies beyond the scope of this report to deal adequately with a topic where the science and the policies are fast developing, and which is being covered more comprehensively in other quarters. Neither can this review fail to mention climate change, as this would be an obvious omission. This potential dilemma is addressed in Chapter 5 through providing a short section outlining the main interactions between climate change and spatial planning, in particular the basis on which climate change interacts with the urban components and determinants of health factors dealt selected for inclusion in this report.

Finally section 6 'Challenges for healthy urban planning', explores the final question as to what urban planning solutions are being suggested in the literature and attempts to provide material to stimulate new insight and progressive approaches.

Section 3

The urban environment as a system

The urban environment is a complex and open system. As with any such system, sitting at the interface of an intricate human economic socio-cultural phenomena and the natural environment, it is dynamic, with many subsystems and displays emergent properties above and beyond those of its individual components.

Some of the recent studies reviewed come to this holistic viewpoint of a complex web of interactions (Lavin et al. 2006 p22; RCEP, 2007 p5-7). The evidence presented forms a picture whereby not only do the physical components have an impact but so can people's perceptions. It presents examples where impacts can stimulate the inception of their own reinforcing feedback loops. This can intensify health risk, as in the case with increases in road space begetting cars which then increases pressure for more road space (RCEP, 2007). Alternatively this can reduce health risk, as in the case where a well-designed park attracts people, this in turn attracts others, encouraging them to stay longer and undertake more activity (Lavin et al., 2006).

In its report on the urban environment, the Royal Commission on Environment Pollution observes that many of the urban challenges and problems have been diagnosed repeatedly by specialists over the years with a broadly similar range of solutions being proposed (RCEP, 2007). Solutions that do not acknowledge the systemic nature of action required give rise to tomorrow's problems. There is a need to encourage research based on the use of comprehensive ecological models that incorporate variables beyond basic demographic information (TRB, 2005); a need to use combined variables to better reflect the synergistic combination of a supportive environment, as hypothesised by theoretical ecological models of the environmental determinants of physical activity (Jones et al., 2007).

There have been a number of attempts to develop a systemic concept reflecting the wider determinants of health, from the work of Hancock though the 1980s (Hancock, 1993) in developing a 'mandala of health' to the wider determinants of health model of Whitehead and Dahlgren (1991). In the environmental health field there are also systemic models, such as those arising from the EU-funded project INTARESE and HEIMTSA (Briggs, 2008). This report does not add directly to the environmental health approach for studies of systemic risk in the urban environment. In taking a public health standpoint, it adds obliquely to that developing field, but takes a different path. Building on work of Whitehead and Dahlgren, Barton (Barton, 2005; Barton and Grant, 2006) has developed an ecosystem model of health determinants relating to the built environment (Fig. 1).

The *Settlement Health Map* articulates both the ecology of human settlements and the way the human habitat affects people's health and well-being. At the heart of the health map are people. People are the reason for settlements. People's lifestyles, community networks, job opportunities and activities (represented by the inner spheres of the map) are all affected by the urban environment that they inhabit. Those lifestyles, activities and the urban environment all impact on the natural assets of air, earth, water and energy, and the global climate. In turn all of these spheres – the environmental, the social and the economic – affect the health and well-being of

people. The health map has become widely accepted as a useful tool to help to understand the interactions between different facets of reality. It provides an holistic model of the relationship between people, their quality of life, and their local and global environment (Lavin et al., 2007;p6; SDC p6, 2008; Williams and Fisher, 2007 p32).

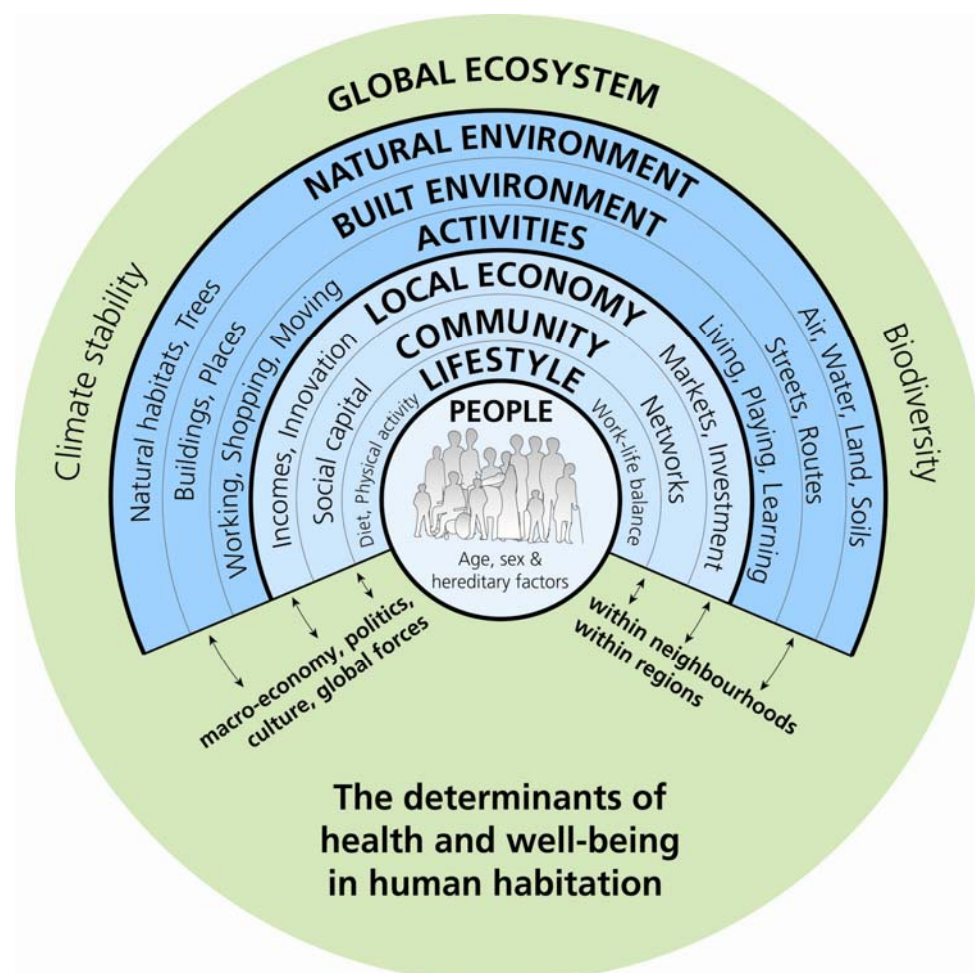


Fig. 1. The Settlement Health Map (adapted from Barton and Grant, 2006)

In terms of the health map, the focus of this report is the impact of the urban (or built) environment sphere on the central sphere, the people. The question always arises, what is the relative significance of the physical environment – as opposed to hereditary factors, broad economic, political and cultural influences – on health. The report does not attempt to answer that highly contested question. What it does attempt to do is recognize the interaction of the different facets: for example the impact of the urban environment on social and psychological variables, and thus indirectly on health.

3.1 Approaching the evidence

This review demonstrates, within its relatively narrow focus, the huge impact that the urban environment has on public health. Whilst concentrating on specific urban spatial components it has not reviewed well known health risks such as lack of access to good quality housing, lack of availability of employment and the basic environmental health concerns of good sanitation, food and water. Instead, the attempt is to contribute to a better understanding of the impact of spatial policies and

deliberate spatial patterning and layout on health. Within the constraints of its Terms of Reference, this report is not a full systematic review of the field or an exhaustive piece of work. It is designed to give policy-makers and others interested in this new subject area an orientation within a complex field of study and present some of the most relevant recent evidence. The review takes five selected determinants of health:

- Physical activity
- Social and psychological impacts
- Air quality
- Noise exposure
- Unintentional injuries

These five relate to different spheres of the settlement health map. Physical activity relates to the 'lifestyle' sphere; social and psychological to the 'community sphere; air quality to the natural environment; noise and unintentional injury to activities sphere. All are therefore concerned in one way or another with behaviour – how people, households, firms and institutions choose to use the built environment. Behaviour will be determined by factors – including cultural habits, incomes, fiscal signals, regulations as well as population characteristics and the urban physical environment – which vary widely between different countries and regions. For example, cycling is part of the culture, and reinforced by long-standing policy decisions, in the Netherlands, but not in the United Kingdom. The evidence presented in later sections normally comes from one country – some of it from the US, so in some cases transferability can be problematic. We have tried to minimise this by our research strategy, as explained below.

The five selected health determinants determine either the opportunities and choices of people themselves to lead a healthy lifestyle; or the impact (often with a health cost) of others on these choices. The spatial environment which influences these behaviours is described in terms of four components: land use patterns, transportation infrastructure, green space and local urban design. As shown in figure 2, these components are significant at different scales, and relate to the five determinants of health to varying degrees.

Determinant of health	Urban form			
	Strategic ←————→ Local			
	Land use pattern	Transport	Green space	Local urban design
Physical activity	X	X	X	X
Social impacts	X	X	X	X
Air quality	X	X	X	X
Noise exposure	X	X	x	x
Unintentional injuries	x	X	x	x

X = Major interaction **X** = Minor interaction O = Very little interaction

Fig. 2: Main interactions between the urban components and the health risks

The components of the urban environment both overlap in their extents and have a high level of interaction with each other in effect. The structure of the review has been designed to help avoid repetition; the components with most interactions appear earlier in the review and the evidence reviewed captures most of this interaction. At the highest level, the physical, economic and demographic geography of a region will determine a settlement's land use pattern. In its turn, the land use pattern determines location, size and connectivity of strategic green space and also interacts with transport infrastructure to determine viable and effective transport modes. At a more local level, residual impacts on the determinants of health are caused by local urban design.

In order to conduct research and add to knowledge, the empirical work on which this review is based breaks the real world down into more manageable subjects. In reviewing the evidence, this report has reflected this approach, focussing on naming and defining both urban components and health risks and benefits. This makes the complex task of understanding the urban system appear more manageable. Having laid bare some of the fragments, in the review, the important task for the reader is to add these fragments to help piece the system back together again. The concluding sections of the review present material which assists with this process.

3.2 Search Strategy

This review is based on selected recent published evidence. Due to the timeframe and resources available, it is not a systematic review of the literature, but seeks to provide a brief overview of the major health challenges and risks in urban settings. In the main, sources reviewed are meta-studies, reviews of the literature and reviews of reviews. Where particularly relevant seminal peer review articles and key national and international reports published by noted agencies in the field of health and the built environment have also been included.

The search strategy was a filtered snowball technique. Early searches advised later search decisions, searches were extended thought following citations until a point of saturation was reached when additional searches did not further enrich the literature already obtained. Filtering was applied such that literature relevant to health and the urban environment but without a spatial planning dimension was excluded, such as literature on (noise or air pollution) emissions from specific plant or processes. The initial search strategy was limited by the following:

- Years; 2005-2009
- Humans only
- Published in the English language
- Reviews and meta-studies only

Search terms; health, environment, transport, green space, urban design, urban servicing, air quality, air pollution water pollution, physical activity, social pathologies, mental health, air pollution, noise exposure, injuries and accidents, urban form and crime.

Primary data sources: CBA abstracts, Encyclopaedia of Life Sciences, Geobase, GreenFILE, Science Citation Index, Science Direct, Social Sciences, Citation Index and the Cochrane library.

Primary web sites for reports: Department of Health, United Kingdom, National Institute of Clinical Excellence, Department for the Environment, Food and Rural Affairs, South West Public Health Observatory, Department for Transport, United Kingdom and the World Health Organization.

Some material lying outside the search parameters, such as refereed articles, has been included where it has been cited by items recovered using the initial search items and it is relevant to the study.

Many existing studies shedding light on health risk in the urban environment do not meet the medical professions' requirements for robust clinical and quantitative evidence. This can result in a tendency to discount a range of in-depth and rich qualitative studies. Such research is important for analysing and explaining relationships in the urban system and has been included where relevant.

Additionally, a bibliography resource, related to the effect of the built environment on health, which is currently under development by the WHO Collaborating Centre for Healthy Cities, commissioned by the Department of Health, was used to identify key literature.

For reasons explained above, the climate change section was compiled as part of the main search strategy. It comprises a review of a number of topical documents on the subject as cited in the section itself.

Section 4

The health risks and benefits in outline

This report presents evidence with regard to five selected determinants of health. The evidence presented concerns the impact of spatial form on these determinants. As an introduction, it is this section which briefly describes each of the five determinants of health and then gives a short review of its associated health risks and potential benefits. The five determinants of health associated with the built environment included in the report are;

- physical activity
- social impacts
- air pollution
- noise exposure
- unintentional injuries.

Below, each health of these is briefly described together with its effect on health as an introduction and orientation to the five determinants. The evidence for the impact of urban form and spatial patterning on these determinants of health is not presented in this section, it can be found in the next section, Section 4.

The literature referring to these five health determinants is qualitatively varied, coming from different scientific disciplines. Data on physical activity is rapidly developing and a number of reviews, see section 4, bring the material together. The social and mental impacts of urban settings as a field of study is the least integrated of these health determinants. The environmental health science is well developed for air pollution and noise exposure, and population level epidemiology in terms of percentage of population affected and DALYS is reported for each respectively. Unintentional injury in the public urban setting has a rich history of research, mainly associated with road traffic incidents. The evidence will thus appear somewhat fragmented as it attempts to span such a wide range of disciplines, which have not as yet had the attention required to meld them into an integrated whole.

4.1 Physical activity

The benefits of physical activity, and the risks of physical inactivity, are receiving increasing attention due to the rising tide of obesity in many urbanised countries. Parameters in the urban environment such as presence of local facilities distance from home and quality of the public realm all influence the propensity to walk, cycle or take the car.

Physical activity is defined as: 'Any bodily movement produced by the contraction of skeletal muscle that increases energy expenditure above a basal level' (CDC, 2008). In terms of urban living this is an all-encompassing term that includes, in terms of increasing degrees of effort:

- every day activity such as walking, carrying and climbing stairs,
- health related physical activity such as gardening, cycling, dancing
- children's active play such as chasing, skipping, hopscotch, Frisbee
- exercise such as swimming, jogging, gym and exercise classes

- sport such as hockey, football and tennis.

This study focuses on everyday incidental activity. That is the energy expended by people going about their everyday work, shopping and leisure tasks. For example, this would include cycling, as transport and leisure but not as an organized sport. However, the degree to which the built environment may support planned recreational activity is noted where there is relevant evidence. Regular physical activity has multiple health benefits (Table 1); physical inactivity will result in the converse health risk.

Health Benefits of Regular Physical Activity

- Reduces the risk of dying prematurely from cardiovascular diseases e.g. coronary heart disease and stroke
 - Reduces the risk of developing non-insulin dependent diabetes
 - Reduces the risk of developing high blood pressure
 - Reduces hypertension in those already with hypertension
 - Reduces the risk of developing colon cancer
 - Reduces the risk of developing breast cancer
 - Reduces the development of osteoarthritis and osteoporosis
 - Reduces fall-related injuries among older adults
 - Helps maintain a healthy weight and reduces overweight and obesity
 - Helps build and maintain healthy bones, muscles and joints
 - Reduces feelings of depression, anxiety and promotes physiological and psychological well-being
-

Table 1: Health benefits of regular physical activity. DHSS, 1996, DHSS, 2002.

Across Europe, levels of moderate-intensity physical activity are generally low and fail to comply with recommendations (WHO, 2004a). Over 40% of adults in the 15 European member countries reported no moderate level of physical activity in the past week; only 18% reported participating in daily moderate level physical activity, the frequency WHO suggests is required to reduce cardiovascular disease (British Heart Foundation, 2005). Surveys that include both work-related and leisure time physical activity show that men in the lowest social class, including manual workers are more physically active than men in higher social classes, however, this difference does not persist in women. Physical activity levels decline with age. In developed countries females tend to be less active than males across all ages (DH, 2004).

A reduced all-cause and cardiovascular mortality has been observed in those who frequently cycle and/or use walking as a mode of active transport (Shephard, 2008). However, more information is needed regarding the weekly level of physical activity required through active commuting, to benefit health. Moreover, there is still a requirement to find better methods of encouraging a sedentary population to use active transport which should include changes to the built environment (Shephard, 2009).

Danish research (reported in KK, 2007) states that “Cycling has the same effect on health as other types of exercise and motion. Four hours of cycling per week or approx. 10 km of cycling a day is an adequate level [for recommended activity], which for many people is the equivalent of the daily cycle trip to and from work”.

4.2 Social and psychological impacts

Components in the urban environments can have both negative and positive social impacts. Negative social impacts can lead to a host of social, economic and psychological problems at the individual or community level which then can be detrimental to physical and psychological well-being.

Negative social impacts include what is often termed effects on social pathologies. These result from deviant social behaviours for including vandalism, crime, abuse, discriminatory behaviours, isolation and stigmatism. Whole communities can be affected by these pathologies and the associated fear and stress. These can also be direct social impacts from urban form such as community severance due to road building or heavy road traffic.

Positive impacts can also occur at both the individual and community level. For the individual the positive impacts are based on mental health, including reduced levels of stress and restorative and recuperative states of mind. They have all been associated with support for mental health and positive states of physiological well-being. A concept embodied in the concept of a salutogenic model of health as proposed by Antonovsky (1987; 1996). At the community level impacts are on social capital (De Silva, 2004) and social inclusion (SEU, 2004), often indicated by communities with more supportive social networks. There is a strong and well established link between mental illness and a lack of supportive social networks (Halpern, 1995).

The risk of injury associated with being a victim of crime, is outside the scope of this study. However fear of crime, which can be exacerbated in certain urban built forms, may have profound effects on mental health and well-being. Stafford et al. (2007) found that fear of crime was associated with poorer mental health, reduced physical functioning and lower quality of life. Often it is an individual's perception that these may occur or cause harm that impacts on health and well-being (Wilcox et al, 2003; Foster et al, 2008). Although risk perception of crime, for example, varies across neighbourhoods, the literature is consistent in showing that in developed nations, poverty, the proportion of a population that is non-white and residential instability are the most significant factors associated with risk perception (Wilcox et al, 2003; Whitley et al, 2005). Women, elderly people and those from ethnic minority groups report feeling more physically vulnerable compared to men, younger adults and white-Caucasians (Foster et al, 2008).

4.3 Air quality

Clean air is a basic requirement for health and well-being (WHO, 2005). However, the combination of outdoor, urban air pollution which is mainly from road transport, power stations and other industrial sources and indoor air pollution caused by the burning of solid fuels causes more than 2 million premature deaths each year (WHO, 2005). Over half of these deaths occur in developing countries. People with respiratory or cardiovascular disease, in particular coronary heart disease, are most at risk especially if they are elderly. The quality of our ambient air can also vary depending on the season and the relative altitude of the cities or towns in which we live in relation to the sources of air pollutants (Department of the Environment, 2002).

The effects of primary and secondary particles (mainly from anthropogenic sources) are such that as part of the Clean Air for Europe programme it has been found that (AEAT,2005):

Annual impacts across the EU 25 total an estimated 3.7 million years of life lost each year (based on the year 2000). This can also be expressed as 348 000 estimated premature deaths. Further to this, we calculate that there are 700 infant deaths each year from PM exposure (in 2000). The morbidity effects of PM range from around an estimated 100 000 cases of respiratory or cardiac hospital admissions (in the year 2000) to much larger numbers of less serious effects, for example an estimated 30 million respiratory medication use days, and several hundred million restricted activity days each year (p2).

The United Kingdom government in its work to support the 2007 United Kingdom Air Quality Strategy for England, Wales, Scotland and Northern Ireland estimated that particle pollution leads to an average loss of 7-8 months in life expectancy across the United Kingdom population in 2005 (Defra 2007). The European Union has established legislation which includes standards and objectives for the major air pollutants (Europa, 2008).

Emissions and population exposure is such that most impacts will occur in urban populations and will often be worst in deprived communities.

A number of different air-borne particulates are antagonistic to the sensitive lining of the airways and act as irritants, causing breathing difficulties and discomfort. Additionally, for those people with pre-existing respiratory disease(s) for example asthma and other chronic obstructive airways disease, these increase their risk of experiencing a respiratory exacerbation of their current condition.

Approximately 300 million people globally suffer from asthma and around 180,000 deaths per year are attributable to this chronic airway disease (Brahman, 2006). It has been suggested that rates are increasing globally by 50% every decade. The prevalence is high in developed and developing countries, with the most striking increase being amongst children. Although the reasons for this increase are largely unknown, it has been suggested that an increase in environmental influences along with exposure to micro organisms and pollutants both indoor and outdoor, diet and exercise are strong influencing factors (Brahman, 2006). However, our current definition of asthma seems to be more inclusive, capturing more people than previously.

Coronary heart disease is the leading global cause of death and ill health, accounting for around 17.5 million deaths per year (WHO, 2007). Coronary heart disease is one of the most common causes of death (British Heart Foundation, 2008). In 2005, it was the cause of 7.6 million deaths. It has been predicted that by 2015, almost 20 million people will die from cardiovascular disease and of these the majority will die from heart disease and stroke. People in lower social economic groups are most at risk, and there is little difference in the incidence of coronary heart disease between men and women.

There is a clear association between long-term exposure to particulate air pollution (PM_{2.5} and sulphate and sulphur dioxide) and a reduction in life-expectancy caused

by cardiovascular disease (DH, 2006). Two accepted mechanisms exist to explain the associations between particles and their effect on the cardiovascular system. (i) Air borne particles set up an inflammatory response in the lining of the lungs, which in turn increases the likelihood of a clot or the rupture of an athermanous plaque, (ii) a reflex reaction by the heart to the pollutants or secondary factors produced by the inflammatory response to the articles; which may in turn affect the autonomic control of the heart beat. Outdoor pollution is known to represent 2% of cardio-pulmonary disease mortality (WHO, 2007).

4.4 Noise exposure

Ambient or environmental noise is unwanted or harmful outdoor sound created by human activities. This includes noise created by road, air and rail transportation, industrial activities and urban life at home, in the streets and at leisure venues.

Noise is seen as a key quality of life issue in the urban environment (Mayor of London, 2007) and it is generally accepted that transport is the biggest contributor to environmental noise (Kavanagh et al., 2005) with industry being the other major contributor. Recently urban noise has moved from being a well-being issue to a health issue (WHO, 2007).

Excessive or persistent noise exposure from these sources can have a detrimental effect on health (WHO, 2007). The main impacts on health are on cardiovascular diseases, sleep disturbances, annoyance, which impacts on mental health, hearing impairment, tinnitus which can also affect mental health and disturb sleep and cognitive impairment (WHO, 2007). A recent United Kingdom review into this subject (Moorhouse, 2009) again confirms these finding and states that:

There is increasing evidence that environmental noise, from both aircraft and road traffic noise is associated with raised blood pressure and with a small increase in the risk of coronary heart disease. Evidence that environmental noise damages mental health is, on the other hand, inconclusive. (p3)

Based on a set of assumptions for Europe, which are described in the WHO report, the total burden of ischemic heart disease related to noise exposure was estimated to be 88,000 DALY¹s, for noise-related sleep disturbance, from 2,798,594 to 559,719 depending on the disability weight assigned; and for annoyance estimates in DALYs ranging from 139,087-1,669,041. Different estimations are found depending on whether a survey based approach was taken, for example using the Eurostat survey (2000) or an exposure based approach.

Evidence supports the role of environmental and non-occupational noise exposure impairing hearing and can induce tinnitus (WHO, 2007). Temporary shifts in hearing threshold and the inducement of tinnitus can occur with excessive and prolonged noise exposure, however, although exposure response levels are available for hearing impairment these are yet to be established for tinnitus.

Health consequences associated with cognitive impairment resulting from environmental noise include problems with reading, recall, recognition and attention.

¹ DALY stands for 'disability-adjusted life year'. It is a standard metric representing overall disease burden. It quantifies both the impact of premature death and disability in a population.

The effect on learning for both children and adults can be negatively influenced by noise exposure; however estimates for DALYs have yet to be calculated. Noisy outdoor environments (commonly traffic noise) can also affect the social inclusion component of social pathology risk factors. For example, intrusive traffic noise can make streets less conducive for social interactions. Intrusive urban noise from 'street life' or neighbours can also be a problem in certain urban configurations and building designs.

Furthermore, exposure to excessive, prolonged noise can also contribute towards exacerbating asthma. A report on the health effects of the built environment from Ireland found that city dwellers were unable to sleep with their windows open because of excessive noise (Lavin et al 2006).

4.5 Unintentional injuries

Unintentional injuries is a term that the WHO applies to what are commonly referred to as accidents. However the term is preferred by the WHO as it implies that there may be a non-accidental i.e. preventable element to the fatality or injury.

Many factors in the design and planning of urban settings influence the risk and likely severity of injury. The Manifesto for Safe Communities states that 'all human beings have a right to health and safety (Spinks et al, 2005).

In children aged 5-19 years, unintentional injuries are the leading cause of death, the majority of these being a result of road traffic collisions (Peden et al. 2008). In 2004, 42,000 children and young people aged 0-19 years died from unintentional injuries in the WHO, European Region (Sethi et al, 2008).

For all types of unintentional injury those in lower socioeconomic groups are at greater risk of mortality and morbidity from non-intentional injury (Sethi et al, 2008; Peden et al, 2008). Older children are at greater risk of death from an injury compared to younger children, with almost half of all deaths in those aged 15-19 years, being caused by an injury (Peden et al, 2008).

Included also within this health risk category are specific risks of disease where the evidence has attributed this to a named urban component for example specific evidence of risk of disease from certain wildlife species in urban habitats.

Section 5

The main urban components and their impact on the determinants of health

This section focuses on each of the five determinants of health described in section 3 in turn. For each, the evidence for health risks and benefits, present in urban settings, is described as mediated through the actions of spatial planning and urban design. The section is arranged into four parts, each dealing with a single component of urban planning:

- land use pattern
- transport
- green space
- urban design

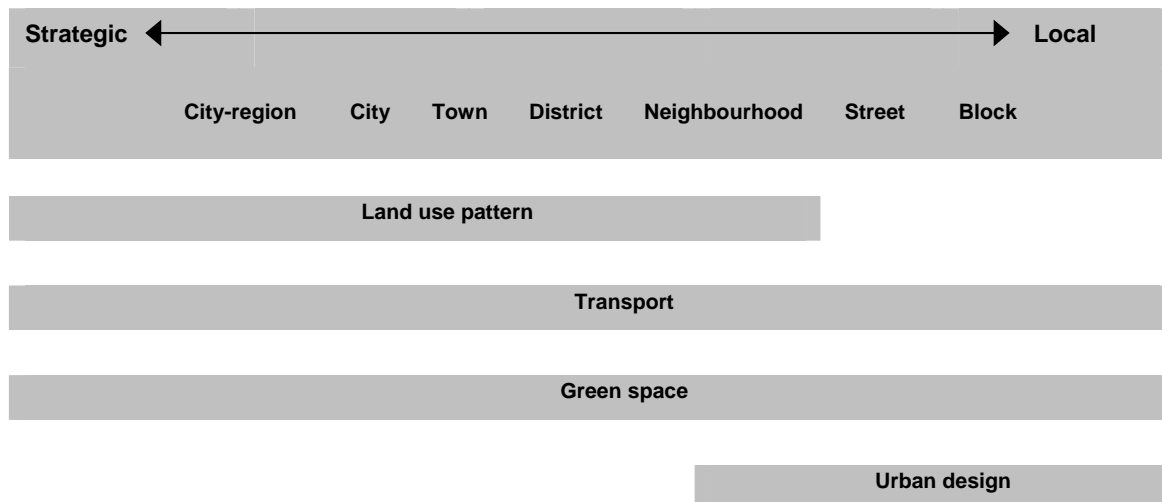


Fig. 3: Coverage of urban scale by components of the urban environment.

The section deliberately deals with these in a sequence designed to foster a better understanding of the interactions between spatial form and urban health. The urban environment is a complex system involving a web of connections (RCEP, 2007). It is the understanding of the importance of scale that can provide vital orientation in terms of gaining a better insight. As a group the four selected components range in scale from the strategic to the local (Fig. 3). As the review is concerned with spatial planning; parameters smaller than a block, which of course have health impacts, such as buildings and building materials are not included. Land use pattern is concerned only with the strategic scale, the scale of the city-region, city and towns, and also with the neighbourhood level. Transport and green space interact with health risk at all scales from the strategic to the street level, including the district and neighbourhood in the middle range. Urban design affects the local environments which has interactions with health risks at the scale of neighbourhood and also at the estate, street and block level.

Potentially these components can have negative and/or positive interactions with the main determinants of air pollution, noise exposure, physical activity levels, social impacts and unintentional injuries.

The structure and ordering of Section 4 arises from the nature of the spatial urban environment, the relationships between components and inherent hierarchies in the urban system. To a large degree, these four components interact and influence each other.

Strategic planning, or the absence of it, will determine components at the largest scale, that is the form of the built environment across the whole settlement or urbanised region, what we are calling the urban form. Urban form has been split into three strategic components and one local level component. Land use pattern includes the density, disposition and nature of different land uses. These parameters of land use pattern lay the foundations the movement and activity needs across the settlement and hence strongly influence the transport systems required to meet those needs. Transport includes all movement and infrastructure to support that movement from rail and road to cycling and walking. Strategic green space is the location for major recreational open space. It comprises both landscape features that remain undeveloped due to their natural character or cultural resonance, for example escarpments, woods, watercourses or historic parkland, deer parks and estates. It also comprises habitats, not always publicly accessible, that have evolved taking advantage of larger scale features such as railway, canal, or road corridors. Urban design in this report is concerned with the environment at the local level, the arrangement of roads, spaces and buildings, the materials used and the way in which their design interacts to provide settings for urban life.

The degree of community influence on the evolution of these elements varies hugely according to the legislation on land rights and development rights. In some countries the individual land owner can build on their land relatively unhindered by state or municipal policy. In others stronger communal rules can shape the pattern of development to a major degree, subject to the willingness of private or public investors. The most significant determinant of future urban form is the transport infrastructure, normally constructed by national, provincial or local governments. This occurs even where the planning system is weak. It helps structure the decisions of commercial and institutional companies as they seek to maximize locational advantage.

The countries that have been most successful in avoiding the trend to obesogenic and unhealthy environments are those which have an integrated approach to all four of the spatial planning components, so that strategic land use and transport policy, local policy frameworks for green space and settlement form and detailed design are all mutually reinforcing.

Whilst elevating the importance of the role of spatial form in public health, it is also important to avoid the trap of 'physical determinism'. This concept was strongly represented in planning theory and application during in the latter half of the twentieth century; as if a set of rules or masterplan for an ideal community can be codified. On the contrary a physical plan for a healthy urban environment, with universal applicability, cannot be developed. What this review of the literature shows is that it is

the understanding of the interplay of physical form, cultural traditions and community bonds, economic activity and lifestyle which may result in successful interventions and spatial policies and plans that can support health.

5.1 The effect of land use pattern on the health risks

This section addresses the large-scale issue of land use pattern. In most settlements the land use pattern, which is dynamic and constantly changing, results from the decisions of a myriad of land owners, in a context of market forces, mediated or not and to varying degrees by a spatial planning system. Spatial planning policies especially separating uses into different areas (zoning) and large area spatial designs (masterplanning) can have a profound effect on the developing urban form as expressed by the land use pattern.

This land use pattern comprises the nature, disposition and density of land use. Issues of layout, networks, connectivity, accessibility, distribution and availability of facilities and functions are influenced. In terms of impacts on health of the land use pattern we can discern relevant impacts at a series of distinct but nested scales. These are the region, city, town, district and neighbourhood scales. Several commentators discuss the general evidence of the impact of land use patterns on health (Lavin et al. 2006; Rao et al. 2007). In terms of land use pattern, there is evidence for significant health impacts at the smaller spatial scales of the street, the block; these are dealt with in the section on urban design.

5.1.1 *The effects of land use pattern on physical activity*

Urban land use pattern is one of the main influences on levels of physical activity, particularly among lower income groups who get much of their physical activity through active travel rather than recreation. Land use influences physical activity as part of a complex system of interactions with pattern systems at larger and smaller scales.

Modern urban systems can serve to discourage activity (RCEP, 2007).

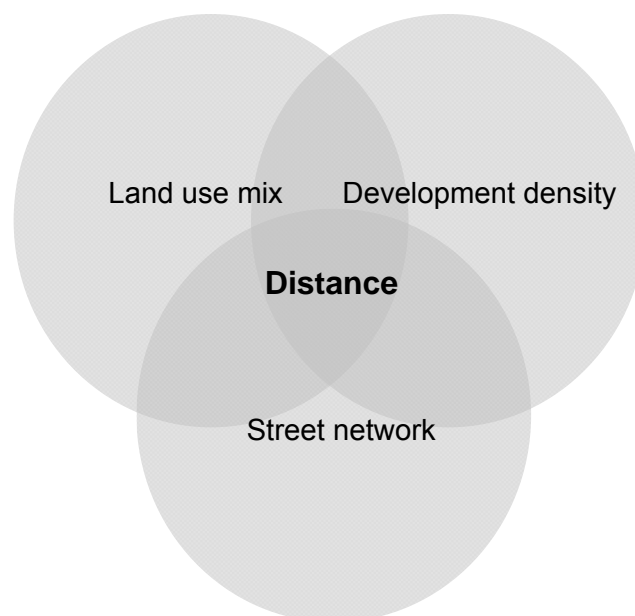


Fig. 4: Urban distance is dependent on density, land use mix and street network pattern.

Distance is key to the level of active travel. If facilities, jobs and social contacts are within certain distance thresholds of households, with routes that are perceived as relatively pleasant and safe, then walking and cycling will be common (Lee and Moudin 2008, Barton et al 2009). The main parameters of the strategic land use pattern that determine distance are land use mix (Lavin et al. 2006) and density of development (Fig. 4). These act in concert with the type of street network, to control a key factor in physical activity, namely the distance and availability of required facilities (Bauman and Ball, 2007). Evidence associated with each of these three parameters is presented below.

Land uses can be highly separated, often referred to as zoning or integrated, referred to as mixed-use. Mixed land use provides multiple destinations within close proximity. This has been found to be conducive to walking and cycling (TRB, 2005) with reasonable consistent associations for physical activity levels (Bauman and Bull, 2007). Conversely where urban development is unplanned or planned as segregated single use zones, often spreading out into areas adjoining the edge of a city, car dependency is likely to be increased (Lavin et al. 2006).

Major trip generators, that is retail, office, leisure, educational and health will facilitate access through active travel modes (on foot and by cycle) if located within the built-up area of the settlement they are serving (Schwanen, Dijst and Dieleman 2004; Cavil 2007). They will also lead to better viability of public transport access, whose health impact is reviewed later in the report. A review by the Public Health Institute of Ireland notes that land use practices that isolate employment locations, shopping and services and housing locations can encourage car use, particularly where public transport options are not available or attractive alternatives (Lavin et al. 2006).

There is evidence that building shopping malls at the fringes of cities may lead to a reduction in the number of shopping trips by foot made per month (to any location) and a tendency towards the use of motorised vehicles for the new pattern of trips (NICE, 2008).

Development density is the second critical parameter which determines distance. In terms of distance, higher residential densities can reduce distances to shops and increase shop availability, reasonable consistent associations have been found between physical activity levels and residential density (Bauman and Bull, 2007). Jones et al. (2007) concluded that several studies show a consistent positive association between density and walking. Higher residential densities increase the catchment population for services, shops and faculties, improving their viability and likely availability. A critical review of 65 studies, mainly in the USA but also including some European studies, stated that 'accessible neighbourhood resources are strongly associated with levels of physical activity' (Croucher et al., 2007, pvi).

The third parameter influencing distance, especially for non-motorized transport is the type and nature of the street network. The pattern of this network is the focus here, the quality of experience is covered in later sections on urban design. Active travel distances to the nearest shop are strongly influenced by local street network design. This can facilitate short routes and a choice of routes (e.g. a grid based or reticulate pattern) or lead to long detours from the most direct path (e.g. cul-de-sac

and dendritic patterns). A large review of cross-sectional research studies predominantly, but not exclusively, from the United States of America and Australia, concluded that there was a consistent correlation between active commuting and street connectivity (Wendel Vos et al, 2007). A separate review undertaken by Jones et al. (2007) also found consistent positive associations between street connectivity and walking. In the United Kingdom paying attention to the provision of safe routes to school was associated with short-term increases in level of walking and cycling (NICE, 2008), though the qualitative understanding of what comprises a safe route may need further research to widen applicability.

Urban sprawl is a combined term used to describe land use practices that both physically separate and isolate different functions and services in a settlement (land use pattern) and one that builds residential, and often retail and commercial, accommodation at low densities (development density).

A planning review in the USA estimated that for active transport, short trips and everyday tasks, walkable distances were those less than 800m and cyclable distances were those of less than 5km (Vojnovic, 2006). Current research (Barton et al., 2009) gives a more nuanced picture from the United Kingdom, with walking as the dominant mode at varying distances according to trip purpose; within 400m for trips to superstores, 1000m for trips to local shops and services, and over 2000m for trips to school and leisure activities.

A review of studies in the United States of America has shown that shops and services within a walkable distance result in significant increase in physical activity (Duncan, Spence and Mummery, 2005). This has also been confirmed by recent empirical work in the United Kingdom (Barton et al., 2009).

5.1.2 The social and psychological impacts of land use pattern

Where the land use pattern places work and home at a distance, with ease of commuting (this can be by car or public transport), long commuting times can have a negative impact at the individual and community level. They impact on mental health and family life and since they can also leave people with less time for civic engagement, they impact negatively on the supportive social networks which also underpin mental health (Dannenberg et al. 2003 in Lavin et al, 2007).

Land use mix will determine the presence or absence of physical community infrastructure such as churches, schools and other municipal support services. With a highly zoned and segregated land use policy these services and facilities will be in a different 'estate' to residential housing, average distances will be greater and resulting access poorer. Horowitz highlighted the importance of churches and youth programs to minimize exposure to violence and increase social support. Additionally access to local facilities such as doctors' surgeries and counselling services were shown to have a positive effect though reducing fear of community violence (Horowitz et al, 2005).

Other evidence also shows a complicated situation dependent on the community's perceptions of facilities and their reputation. For example, the presence of police or social services can be perceived with distrust; with the police seen as 'intrusive and provocative' (Horowitz et al, 2005) in some studies in the United States. However,

Wilcox et al (2003) found no such increase in fear from crime from the presence of schools in a large metropolitan city in the west of the United States, whether crime was controlled for or not.

Evidence from an inner urban area in North London found that residents experienced a 'time-space inequality' as a consequence of crime and other related factors (Whitley et al, 2005). This has been shown to result in poor mental health including feelings of social isolation, negative mood and low self-esteem. 'Time-space inequality' describes the variation in ability of community residents to access and use spaces both within their immediate and wider environment at different times during the day or night. This was less prevalent in mentally healthy men or middle-income women. Time-space inequalities seemed to be diminished by interventions that encouraged spatial and temporal movements and encourage connectivity to a wider geography, for example comprehensive local public transport systems and government-issued free travel passes for vulnerable populations. Mixed land use has also been shown to encourage connectivity, where networks for pedestrians and cyclists are provided within the closer and wider community (Lavin et al, 2006). If facilities are locally accessible then not only will active travel be the rule, but social networks and the sense of community may be enhanced (Calve Blanco 2009). Additionally, urban regeneration of inner city areas has been shown to reduce fear of crime if central spaces are more open. (Whitley et al, 2005).

Perceptions of increased community safety have been the main driver behind the development of 'Gated Communities' (Atkinson et al, 2004). However, it is not clear whether crime is actually reduced in such communities as many are built in low-crime areas (Atkinson et al, 2004). Some community police officers report that gated communities may either displace or focus criminal activity on surrounding communities (Atkinson et al, 2004). This can cause tension in the surrounding communities along with tensions resulting from the elitism of such gated residences.

5.1.3 The effects of land use pattern on air quality

Land use patterns determine levels of exposure to air pollution by determining where people live in relation to their daily activities and in relation to sources of air pollution. Transport is the leading source for many of the chemicals which contribute to air pollution (Kavanagh et al. 2005) although other sources such as industry and energy production are also important, the impact of transport on air quality is dealt with more fully below. Typical air quality analysis in urban areas addressed five pollutants: nitrogen dioxide (NO₂), fine particulates (PM₁₀), sulphur dioxide (SO₂), carbon monoxide (CO), and benzene. Ground level ozone can also adversely impact on health.

In terms of land use pattern, the health impacts of air pollution are greater in urban areas with high density and tall buildings; these have higher levels of traffic and congestion, lower air dispersal characteristics and more people (RCEP 2007). There is a complicated balance of conflicting parameters, more compact urban centres will reduce the amount of per capita vehicle travel but at the same time the greater density can still result in increased numbers of vehicle trips in a given area (Frank et al. 2006) which together with higher congestion levels results in higher levels of air pollution.

With regards to health inequality a study reporting on England (Walker, 2003) found that the most deprived wards were clearly those with highest pollutant concentrations. The social distribution of NO₂ was typical, showing that people in deprived wards are exposed to concentrations higher (by 41%) than those of wards of average deprivation. The report stated that:

The relationship between poor air quality and deprivation in England is particularly strong for peak pollutant values, including exceedances of standards. The number of people in wards above pollution thresholds increases progressively with increasing deprivation.

The reverse pattern was found in Wales, a country with a much more rural population. This was due to the least deprived households in Wales tending to be more urban than their English equivalents and mostly located in the more urbanized south, where most of the poorest air quality occurs.

The report also describes “clusters of wards [local election areas] that have poor aggregate air quality and high deprivation” or “hot-spots ... [of] ... pollution-poverty”, with large clusters in the parts of the main cities (Walker, 2003).

A more recent stream of evidence has confirmed these patterns and broadened the understanding. Based on the findings in the United Kingdom that, in terms of NO₂, PM₁₀ and SO₂, there is a tendency for the most deprived communities to experience the poorest air quality; these deprived areas often have a higher proportion of children living there, increasing the overall susceptibility of the population. (NETCEN 2006, Mitchell and Dorling 2003). These links between higher air pollution and deprived neighbourhoods have also often found in other countries such as Norway (Naess et al 2007). Other studies have highlighted that even in cities that might not follow this trend and where people with higher socioeconomic status are exposed to the highest pollution concentrations, mortality rates from air pollution related causes are still highest amongst those with lower socioeconomic status (Forastiere et al 2007) indicating a greater susceptibility to the effects of air pollution amongst the most deprived.

5.1.4 The effects of land use pattern on noise exposure

The pattern of land use is an important factor affecting noise exposure as a determinant of health. Patterns of land use can have a significant impact on transport types, volume and proximity to areas of human activity. The extent to which noisy activities impact on health is determined particularly by their siting in relation to housing, schools and open spaces which should be “peaceful havens” (Mayor of London, 2007). In non-industrial urban environments, opinion poll research conducted in 2003 (cited in RCEP, 2007) found that environmental noise problems are worse in areas of high density housing, rented accommodation (both social and private sectors), areas of deprivation and areas which are highly urbanised. Other sources of noise annoyance come from late night entertainment and other 24-hour activities where they affect residential areas and hence sleep (Mayor of London, 2007).

5.1.5 The effects of land use pattern on unintentional injuries

Evidence refers to two main ways in which urban land use patterns have an impact on unintentional injury; flooding and the heat island effect. Both of these are currently linked to climate change, which will intensify the severity and increase the frequency of occurrence, however, both also have a long history of study as urban problems.

Flooding is the most common natural disaster in Europe (WHO, 2002b). Land use of the floodplain is a strategic urban planning issue as spatial planning can be used to control development in the floodplain and ascribe uses compatible with different levels of flood risk (LiFE, 2009).

Urban flooding will present an increasing risk to health due to climate change (McMicheal et al., 2006). In addition to risk of inundation from the sea, as a result of sea level rise, development has occurred on fluvial floodplains in many cities. Climate change also brings more extreme weather events with higher risks of heavier and more prolonged periods of precipitation (Costello et al. 2009; RCEP, 2007). Direct health effects from flooding are mortality from drowning, heart attacks and injuries; and injuries that do not lead to loss of life. Indirect health effects are infectious diseases, poisoning and post-traumatic stress disorder. The latter should not be underestimated in impact. Data from the United States collected 36 months before a disaster and 48 months afterwards showed a statistically significant increase in suicide rates following floods, from 12.1 to 13.8 per 100 000 population (WHO, 2002b). Another significant health risk, often overlooked, is the secondary health risk of the loss of essential urban services which may be temporarily unavailable or severely disrupted by flooding. This includes utilities such as electricity, domestic water supplies, and services such as police and fire-fighters (LiFE, 2009).

In terms of health inequality, the effects of flooding can be particularly devastating to already vulnerable populations, such as children, older people and/or disabled people, ethnic minorities and those with low incomes (WHO, 2003b). A study in the United Kingdom (Walker et al., 2003) found that for England, the tidal floodplain analysis showed a clear relationship with deprivation. Of the population living within the tidal floodplain, there were eight times more people in the most deprived decile compared to the least deprived. In contrast, for the fluvial floodplain, there was an inverse relationship with deprivation, although of lesser strength, with a higher proportion of the floodplain population in the more affluent compared to the more deprived deciles. For Wales, the pattern of social distribution was less distinct but showed some similarities to England.

Heat islands are urban and suburban areas that capture and retain too much heat. This can make the ambient air temperature significantly warmer than areas in the surrounding countryside.

Exposure to heat is a cause of morbidity and mortality in the urban environment, and heat stress is a condition that can cause illness and death. Human exposure to excessively warm weather, especially in cities, is an increasingly important public health problem. Harlan (2006) examined heat-related health inequalities within one city in order to understand the relationships between the microclimates of eight diverse urban neighbourhoods, population characteristics, thermal environments that regulate microclimates and the resources people possess to cope with climatic

conditions. Statistically significant differences were found in temperatures between the neighbourhoods during the entire summer, which increased during a heat wave period. Lower socioeconomic and ethnic minority groups were more likely to live in warmer neighbourhoods with greater exposure to heat stress. High settlement density, sparse vegetation, and having no open space in the neighbourhood were significantly correlated with higher temperatures. People in warmer neighbourhoods were more vulnerable to heat exposure because they had fewer social and material resources to cope with extreme heat.

5.2 The effect of transport on the health risks

The transport infrastructure and the land use pattern are interdependent. The existence of transport networks affects the pattern of accessibility which helps determine where land use development occurs. The pattern of use determines movement patterns, which in turn triggers demand for extra transport provision.

The average person in the European Union cycles about 0.5 km, walks about 1.0 km and travels 28 km by car per day (Racioppi, 2004). Cycling and walking, as active modes, could be especially relevant in the urban environment where more than 50% of the total urban trips currently carried out by car in the European Union are shorter than 5 km (Racioppi, 2004).

5.2.1 The effect of transport on physical activity

The location of different land uses relative to one another for example, residential, retail and offices as well as the amount of development in a given location has an impact in how people travel. Together with the increase of labour saving devices at home and at work, the increase in personal motorised transport has reduced the level of physical activity involved in daily living (TRB, 2005).

Modal choice is the main factor that determines transports impact on physical activity. Reflecting the causal web of interactions in the urban environment (RCEP, 2007), the key to modal choice (active as opposed to passive travel) is distance and route quality. The use of public transport – normally accessed by foot and therefore making a contribution to physical activity – is also heavily influenced by distance to stops, as well as service cost and quality and the ease or difficulty of using the car. Distance (as explained above) is a resultant outcome of land use mix, density and street pattern. It is the relative distance that people have to travel, to conduct general activities of daily living for example shopping and recreation that affects whether they choose to use active transport such as walking, cycling and roller blades or motorised transport (Cavil, 2007). If residential numbers are low, then facilities are likely to be sparse, which necessitates the increased use of motorised transport for commuting. In addition to distance, if access routes are poorly conceived, difficult to access, poorly maintained or perceived as unsafe these can also act as barriers to encouraging the use of active transport.

Trips can involve several modes of transport. In terms of physical activity, recent policy debate is paying attention to the synergistic effects that public transport can have in promoting walking and cycling to access public transport stops. This has not been reflected yet in systematic review evidence but some empirical papers and reports have been included below where they contain data relevant to the debate.

Car infrastructure has been the focus for many reviews. The construction of bypasses in and around urban areas increases total car use, however evidence now suggests that the construction triggers a greater switch to car use than previously forecast (Matson et al., 2006). Furthermore, this can then lead to a case for further road building in these areas (Matson et al., 2006). In general, insufficient action has been taken to improve accessibility to urban areas by foot, bike or public transport. In six town centres where improvements in pedestrian access were made at the same time as a bypass was constructed, a study found that people walked further and felt more relaxed; however it also reported that they were not walking more as a mode of travel into the town centre (Silcock, 1999).

Perceived physical danger posed by motorized traffic has been cited as one of the main barriers to engaging in walking and cycling (Davis, 2002). This has had a disproportionate effect on activity levels in both children and older adults. However, these issues don't seem to have been the focus of any recent systematic review studies. A recent meta-analysis in the United States of America showed that if individuals did not perceive traffic as a problem they were 20% more likely to be physically active (Duncan, Spence and Mummery, 2005). Further studies have also shown that busy traffic can reduce activity levels (Bauman and Bull, 2007).

Individuals from low-income groups, older people and those with disabilities are less likely to have access to personal transport (Lavin et al., 2006). These groups may find that access to services such as shops and health care is reduced. Consequently, they may spend a higher proportion of their income on transport (Lavin et al., 2006).

With regard to public transport infrastructure; settlement size, urban form and mix of uses all have an influence on public transport use, but it is difficult to establish the precise nature of these relationships (Balacombe, 2004). The higher the density of a city, the higher the demand for public transport. Contributing to this rise in demand is the association between high density areas and lower income groups with less car ownership. The more each new development is linked into the existing public transport infrastructure the more viable that infrastructure becomes (Balacombe, 2004).

The perceived quality of public transport services is related to several factors such as the safety and cleanliness of its operation. It is also strongly influenced by the built environment which includes the proximity to a transport pick-up point, frequency of the service, attraction of destinations served, reliability, and total trip time compared with other modes of transport (Balacombe, 2004). Investment in high-quality public transport infrastructure can prove a positive stimulus to people walking (Cavil, 2007). People will walk up to 1km to access good quality public transport, with the distance they are prepared to walk diminishing in line with a reduction in the quality of service offered (Balacombe, 2004; O'Sullivan, 1996).

In terms of cycling infrastructure, closing roads or reducing the capacity for motorised transport can lead to long-term increases in the levels of walking and cycling within the vicinity (Jones et al. 2007). In a similar manner, long term increases in cycling can result from introducing road charging schemes for motorised traffic such as in London (NICE, 2008). Additionally, infrastructures to support cycling can have

positive, long-term effects on the prevalence of people using bicycles as a preferred mode of transport. (NICE, 2008). Infrastructures such as cycle lanes, preferably separated from other road users, and other measures to calm motorised traffic can be effective, in addition to off road cycle paths (Lavin et al., 2006).

Cycling can also be used to access good quality connected public transport, in particular the longer inter-urban journeys, with people prepared to not only travel a longer distance but also spend a longer time in accessing the public transport stop (Krygsman et al. 2004).

Moving the discussion now to walking infrastructure; in a review of European best practice for delivering integrated transport (CFIT, 2001) it was thought that levels of investment in pedestrian facilities contributed to the higher levels of walking found in wealthier countries.

Several reports have identified that the presence of pavements and other dedicated walking routes have a strong association with increased levels of walking (TRB, 2005; Lavin et al., 2009). These reviews go on to say that the poor maintenance and management of pavements can have a negative effect on walking. Littered streets, poorly maintained surfaces and 'crime-ridden streets' (p6) have been associated with low levels of physical activity.

A WHO report (Davis, 2002) reviewing walking found that populations who are most at risk from poorly maintained paved areas include older people, those with chronic diseases that restrict their ability to be mobile and independent, and parents with young children in prams and push chairs. It also stated that adaptations and thoughtful maintenance of the built environment are key to promote independence, active living and reduce falls where possible in this population. Reduction of uneven walking surfaces, ensuring walkways are clutter free, provision of public toilets (Greed, 2006) and seating can help contribute towards this (Davis, 2002; Bauman, 2007).

Walking to and from public transportation can help physically inactive populations, especially low-income and minority groups, attain the recommended level of daily physical activity (Besser and Danneberg, 2005). Therefore increased access to public transit may help promote and maintain active lifestyles.

5.2.2 The social and psychological impacts of transport

Access to transport that enables residents to move outside of their own community has been shown to positively correlate with a reduced fear of social isolation and positive mental health (Whitley et al, 2005). For those on higher incomes this is by car or taxi. However, for those on lower incomes access to public transport is important (Whitley et al, 2005). Fear of crime has been shown to be a barrier to the use of bicycles as transport for recreation (Stafford et al, 2007).

The density of motorised transport can negatively affect social cohesion within a community. Both through direct community severance due to road construction or through the impact of high levels of heavy motor traffic. The results of what has become a classic study in the United States of America were published by Appleyard (1981); his findings have since been replicated in the United Kingdom (Hart,

[unpublished] 2008). Appleyard found increased in motor traffic on roads where they live, forced people to make major adjustments in their lives to shield against the nearly constant noise, pollution, dust and danger outside their front doors. Many residents reported sleep disturbances, no longer spending social time outside on their street and curtailing the independence of their children.

Increased risk of road traffic collisions from high traffic density can contribute towards the development of long-term mental health problems in drivers, passengers and victims (Racioppi, 2004). According to Mayou et al (1993), after an accident approximately 10% will develop mood disorders, 20% phobic traffic anxiety and 11% may develop post traumatic stress disorder. Moreover, nearly 20% of those injured in a road traffic collision develop an acute stress reaction and 25% display mental health problems within the first year after the accident.

5.2.3 The effect of transport on air quality

Road transport is the major source of urban air pollution, emitting pollutants that damage human health and reduce life expectancy (RCEP, 2007). Douglas et al. (2007) suggest that long-term exposure to transport-related air pollution would reduce life expectancy by a few months, a similar effect to that estimated from passive smoking. The impact of transport on this determinant of health is best understood by looking separately at issues of emissions and then issues of exposure.

In terms of emissions, the main transport related pollutants in the urban environment are particulate matter, ozone, carbon monoxide, nitrogen oxides and sulphur dioxide (RCEP, 2007) mainly due to emissions from the combustion of fuel. Particulates are also created from dust propelled into the air by tyres; ozone is a result of the reaction of emissions with the atmosphere (Kavanagh et al, 2005).

Road transport is expected to continue to contribute significantly to urban air pollution over the next few decades in most European cities whilst in some less developed cities it is still a growing problem (RCEP 2007; WHO 2005b). Whilst greater regulation and technological improvements have reduced individual vehicle emissions over the last decades, transport growth, more diesel vehicles and congestion have largely countered any improvements in air quality (RCEP 2007; WHO 2005b).

Continuing increases in the number of cars (RCEP, 2007), urbanization and expansion of urban areas and longer commutes (WHO 2005b) all point to transport related air pollution remaining a significant health issue for an increasing proportion of the population. Another issue in urban centres is that many trips are too short (<6km) for catalytic converters to be effective so average emissions per km are high (WHO 2005b) and congestion, involving more stopping and starting and changes in acceleration, means more fuel is used and even higher emissions result (Kavanagh et al, 2005). Importantly, studies of the impact of congestion charging in London, implemented for traffic flow reasons and not air quality, have not detected air quality benefits (TfL 2008).

Trends in measured ambient outdoor air quality across central and inner London continue to primarily reflect factors external to the scheme, such as

the weather and vehicle technology changes, not all of which have been beneficial. No clear scheme impacts from either the original central or western extension zones can therefore be discerned. (p6)

Although in absolute terms improvements were outweighed by external factors the report goes on to add:

Although congestion charging and other changes originally led to reductions in emissions, this did not feed through to observable improvements to measured air quality. This was to be expected, for reasons explained in previous reports. However, all other things being equal, reduced emissions will feed through to relative improvements in outdoor air quality, against conditions in the hypothetical absence of the scheme. (p107)

Transport hot spots with increased air pollution include street canyons which trap transport-related pollutants and belts along major urban highways which also clearly show higher levels of certain pollutants. Others are spread more evenly over the wider city area (WHO 2005b). Other transport hot spots include railway stations, airports and harbours which generate heavy road traffic as well suffering the bursts of high pollutant levels from diesel locomotives, airplanes and ships (WHO 2005b). Near ports and airports, although ships and planes do cause some increase in pollution levels (10-20% from ships in coastal areas), the majority of the particulates come from the road transport serving the facility (WHO 2005b).

Emissions are only one side of the equation. Exposure is determined by daily activity patterns and the amount of time spent in highly polluted environments; living or working near busy roads and time spent in traffic are critical factors. Travelers can be exposed to levels three times the background levels and cyclists and walkers may experience higher levels as their physical activity means that they breathe in more air per minute, although generally motorists experience the highest levels of exposure (Douglas et al. 2007; Frank et al. 2006; WHO 2005b).

Research cited by the WHO (2005b) gave the example of Gare de l'Est in Paris which has 100 000 travelers on an average working day and is in a dense urban area. Within a 1000m radius of the station, the diesel locomotives (80 movements per day) emit about 16% of total nitrogen oxides and 9% of primary particulates in the area; the rest is due to heavy road traffic. During peak operating periods when three locomotives operate simultaneously, they contribute about 50% of nitrogen oxides and 33% of particulates with the pollution lingering for up to 9 minutes.

5.2.4 The effect of transport on noise exposure

Transport is the main source of environmental noise in urban areas. Road traffic is the main cause with additional impacts from trains and airplanes being experienced by those people living close to railway lines or airports. (Kavanagh et al, 2005). Data on noise exposure in major agglomerations and at major infrastructures was reported to the European Commission in 2007 and cited by the EEA (2009c). This consisted of information on 162 settlements (with more than 250 000 inhabitants), some 82 000 km of major roads, approximately 12 000 km of major railways and 74 major civil airports (data from DG ENV 2008 cited EEA 2009c). The figures show that almost 67

million people living in towns and cities (i.e. 55% of the population) are exposed to daily averaged road noise levels exceeding 55 dB L_{den} , (the lower benchmark for the combined noise indicator), which is associated with significant annoyance (EEA, 2009b). Overall 80 million people (cities and rural areas) are exposed to continuous road traffic noise above 65 dB (A) which is associated with cardiovascular effects (EEA, 2009b).

Daily exposure to railway noise and airport noise in these settlements is lower but still significant, with 5.6 and 3.2 million people respectively exposed to levels above 55 dB L_{den} . With almost 48 million people exposed to levels exceeding 50 dB L_{night} , (the lower benchmark for night-time noise) road noise is also by far the largest source of exposure to night-time transport noise. In urban transport hot spots, almost 21 million people live in areas where night-time road noise levels are greater than the 55db limit beyond which there will be detrimental effects on health. Night-time rail noise also impacts on around 2 million people in urban hot spots (EEA 2009c). In the United Kingdom around half the population may be exposed to daytime noise levels above 50-55db (RCEP 2007).

Road noise comes mainly from three sources: engine systems, tyre/road interaction and air turbulence, which in turn are influenced by factors such as vehicle speed, traffic flow rate, vehicle type, tire width, driving style, road surface and weather (Frank et al. 2006; Douglas et al. 2007; EEA 2009c). Vehicle horns and theft alarms are also sources of noise (Frank et al. 2006). Buses, trucks and motorcycles produce relatively high noise levels (Frank et al. 2006). Research has shown that “an holistic approach, combining measures on vehicles, tyres and road surfaces with speed moderation, would yield 5dB reduction in road noise at source in most situations with current technology” (Kropp et al 2007 cited EEA 2009c p24). Specific data on speed shows that “cars travelling at 30kph produce maximum sound pressure levels that are 7dB lower, and equivalent sound pressure levels that are 5dB lower, than cars driving at 50kph” (Kavanagh et al, 2005 p30). Surfacing impacts vary from the higher noise levels generated by concrete, stone and rough surfacing such as that with potholes caused by utility company works to porous asphalt which can be used to reduce noise (Douglas et al. 2007). Traffic calming measures such as road humps may also increase traffic noise (Frank et al. 2006).

Rail noise can be the subject of significant public concern, especially from proposed high speed lines (EC 2008). In 2003, freight noise was ranked as the biggest railway noise problem (EC 2008; EEA 2009c) followed by high speed railways and inner urban railways (EEA 2009b). Freight is important because of the associated volumes of evening and night-time traffic (EC 2008; EEA 2009c). High speed rail impacts are from the pass-by noise peaks occurring by day and more significantly at night. Railway stations also result in road traffic hotspots.

In relation to air travel, the number of people exposed to noise around major European airports has been increasing and this is likely to continue as airport capacity continues to expand (EEA 2009c). Impacts are both from greater numbers of aircraft and road traffic noise (Douglas et al 2007: EEA 2009c).

5.2.5 The effect of transport on the risk of unintentional injuries

The effect of transport on the incidence and prevalence of unintentional injuries includes the impact of both motorised and active transport across all ages. Globally, road traffic collisions are the single largest cause of unintentional injury, despite preventative strategies being in place (WHO, 2008b).

Road traffic collisions in the Member States of the European Union annually claim about 43,000 lives and leave more than 1.8 million people injured (ERSO, 2008). In 2006, 67% of all road traffic collisions occurred in an urban environment (European Commission, 2007). Europe data reveals that in 2006 the majority (51%) of fatalities are car or taxi passengers, with 24% two-wheeled vehicle and 18% pedestrian deaths (7% others, tractor, coaches, vans and lorries etc.). Of the two wheeled vehicles 18% of people were on motorcycles or mopeds and 6% were cyclists (ERSO, 2008). The main determining factor relates to traffic speed. Evidence exists to support lower speed limits being associated with lower numbers of injuries and fatalities from both motorised and active transport road traffic collisions (Racioppi et al, 2004; Wilson et al, 2009). A 1km/h increase in speed is associated with a 3% increased risk of a crash involving and injury (Racioppi et al, 2004). This gives an exponential relationship with the probability of a pedestrian dying from car impact rising with car speed from about 4% at 20km/h to 10% at 30km/h, 30% at 40km/h and 70% at 50 km/h.

Children aged 0-19year and older adults aged 60 plus are particularly vulnerable to injury through road traffic accidents, (DfT 2005a; DfT 2004).

A number of different factors negatively impact on the rate of collisions and injuries associated with transport, for example, street lighting (Beyer et al, 2009). It has been shown that where there is adequate street lighting this may prevent road traffic collisions, injuries and fatalities (Beyer et al, 2009). Additionally, alcohol-related road traffic collisions, where drivers have exceeded a blood level of 0.05g/dl of alcohol account for between 5-40% of road traffic deaths in the European Union (Racioppi, 2004).

Pilot schemes have been shown that the introduction of a congestion charge for entering inner-city areas can reduce both the amount of congestion via reduced car traffic by an average of 19% in London and Stockholm, and general congestion by up to 30% (KK, 2009a). There has also been a compensation increase in the use of public transport (KK, 2009a; TfL, 2009). In London where congestion charges were introduced in 2003, there has been a reduction in the rate of road traffic collisions by up to 5% (TfL, 2009).

5.3 The effect of green space on the health risks

In the urban realm, green space includes a huge variety of land from the strategic sale of country parks and river corridors running through cities, to the local, such as residential gardens and pocket parks. It includes land in public, commercial and individual ownerships. It includes a wide range of uses including public and private gardens and squares, amenity and sports open space (often associated with mown grass, play space (often associated with shrubberies and mown grass), green corridors, river and canal corridors and greenways, natural and semi-natural habitats

(including derelict and previously developed land) and other functional green space such as allotments, churchyards and cemeteries. In some settlements this broad category could also include remnant countryside now within urban boundary such as woodlands, cliff ridges and coast-lines. For this review, green space is also taken to include two important elements of urban nature, not necessarily connected with a specific territory, street trees and green roofs.

A number of reviews have established that there are multiple connections between urban green space and health (Brown and Grant 2005; Bird 2004, 2007; SDC 2008) with conclusion broadly in line with Newton (2007, p4) that 'the natural environment provides synergistic physical, mental and social well-being benefits'. The idea that engaging with nature has beneficial impacts on well-being is prevalent across many cultures and societies. A range of different cultures identify sacred places, set in natural landscapes, as having a role in the spiritual well-being of individuals (Burns 2006; Smyth, 2005). A biophilia hypothesis (Wilson 1984) has been used to describe an innate emotional affiliation of humans to nature that goes beyond nature's role in providing basic needs to include what could be seen as a role in salutatory health (Bird, 2007; Brown and Grant 2007).

Many studies indicate an association between living with green space and health and well-being (Green space Scotland et al. 2008), but components such as physical health, mental health and longevity are not always disaggregated. A large-scale epidemiological study in Tokyo found that living in areas with green space had a positive influence on longevity independent of several other socio-demographic characteristics usually associated with health status such as income and education (Takano 2002).

5.3.1 The effect of green space on physical activity

The natural environment plays a large part in facilitating physical activity. 'Evidence consistently shows that accessible and safe urban green spaces have a positive influence on levels of physical activity' (Croucher et al. 2007). Accessible nature, including trees, wooded areas and green open spaces can both encourage and facilitate communities to become more active. A number of studies have found that these effects are only valid where the green space is well-maintained and safe to use (Green space Scotland et al. 2008).

The link between green space and activity can be separated into two domains. The first is the effect of background and everyday nature such as street trees, green verges, pocket and local parks and front gardens and their associated flora and fauna. The second is green space used for active and passive recreation, local and regional parks and greenways. These two domains merge since the recreational green space will provide background nature within its immediate environs and visually at a distance in the urban fabric and equally background green space can provide the setting for some recreational activities such as jogging or dog walking.

A number of reviews have attempted to explore whether green space in the environment actually encourages people to exercise more, these are reported in below. A review undertaken for the Institute of Public Health in Ireland concluded that provision of attractive parks and open spaces can facilitate people taking the opportunity for exercise (Lavin et al. 2006). Evaluations of programmes for

encouraging exercise indicate that an attractive, green environment close to home and work provides the best opportunities to encourage daily exercise in the form of walking and cycling (HCN 2004, Bird 2004). In these studies it has also emerged that people keep exercising for longer in natural surroundings.

Evidence shows that children who have better access to safe green spaces, such as parks and playgrounds, are more likely to be physically active compared to those living in neighbourhoods with reduced access to such facilities (Croucher, et al. 2007). In the secondary analysis of an European cross sectional survey it was found that the likelihood of being physically active may be up to three times higher in residential environments that contain high levels of green space compared with areas with low levels of green space; the likelihood of being overweight or obese may be up to 40% less (Ellaway et al., 2005) Access to green space also has a positive effect on physical health, particularly on those from low income groups (Mitchell et al, 2008).

A recent study conducted in Sweden found that access to such recreational green space areas was associated with a positive assessment of neighbourhood satisfaction and time spent on physical activity, which they predicted could be expected to reduce obesity (Björk et al. 2008). A comprehensive literature review selecting 87 primary studies from 550 identified was undertaken by Green space Scotland (Croucher et al. 2008). Approximately one third of the studies were from the USA, a further third in the United Kingdom, and the remaining studies in Australia, Canada, the Netherlands, Japan, Sweden and Denmark. Physical activity was found to be influenced the following attributes of green space:

- distance of residence from a green space
- ease of access in terms of routes and entry points
- size of the green space in terms of levels of population use
- connectivity to residential and commercial areas
- attractiveness, including biodiverse habitats and absence of graffiti and litter
- range of amenity, the wider the range of informal and formal facilities the more likely the space is to be used by different kinds of people.

The study concluded that exercise was not 'however, the primary motivation for the majority of park users Moreover, many green space activities are sedentary or involve gentle exercise. Evidence from a number of reported in Croucher et al. (2008 p4) indicates that green space is most valued as an escape from the stress, dirt, and noise of urban environments' (Croucher et al. 2008, p4).

5.3.2 The social impacts of green space

According to several reviews access to green spaces and nature has been shown to positively affect mental health, possibly through reducing stress and through providing a distraction and distancing ourselves from the everyday activities (HCN, 2004; Pretty et al., 2005; Lavin et al, 2006). Additionally, green spaces have a positive effect on promoting social interaction and cohesion (Green space Scotland, 2008).

Conversely restricted access to green spaces has been associated with poorer mental health (Guite et al, 2006; Kuo 2001). Residents in urban social housing who

had views of trees and open spaces demonstrated a greater capacity to cope with stress compared to those who did not have such access (Kuo, 2001). Older people in particular benefit from such access (Orsega-Smith et al, 2004).

However, in the United Kingdom, those who live in disadvantaged areas are less likely to benefit from green spaces and parks (Lavin et al, 2006). According to a United Kingdom report on urban green spaces (Department of Transport, 2002), in the 100 most deprived authorities, 40% of parks were in decline and 88% of parks that were already assessed as being in poor condition were in further decline.

A negative impact on health regarding the social impact of green space, is a community's perceived risk of crime, in particular fear from assault or violence (Croucher et al, 2007). This fear manifests itself in a reduce ability to accrue the positive benefits to mental health from accessing green spaces (Croucher et al, 2007). Closed or over landscaped designs that restrict the view of the immediate environment can reduce feelings of perceived safety. Also there is a potential for crime and anti-social behaviours in green space where areas are relatively isolated, lack people and lack supervision (Green space Scotland, 2008).

However, in spite of this, an England based survey found that 57% of respondents felt that safety in parks was good (Sport England, 2003). However, it also noted that people rarely visit parks alone unless walking a dog and that woman in particular are unlikely to visit green spaces unless accompanied by others.

5.3.3 The effect of green space on air quality

Green space has a positive impact on health by improving air quality and removing pollutants. Both gases and particulate matter can be filtered by vegetation (Lavin et al 2006). Canopies of trees act as a physical filter for pollution by trapping particles on the leaf surfaces as well as absorbing harmful gases (LUC 2004). Green space also helps to cool urban areas and moderate the heat island effect which also helps to address air pollution by reducing the formation of photochemical ozone (RCEP 2007). Woodland areas especially are cooler although this varies with season and species. Research cited in Lavin et al. (2006) and LUC (2004) suggest that, for example, broad leaved woodland can reduce ambient air pollution by 17% and that streets with trees have around a quarter of the particles of those without. A possible adverse effect of dense planting may be that in some situations, the effects of pollution may be amplified by creating an enclosed space (Green space Scotland et al. 2008). Some species, such as pine, larch, and silver birch, have a more positive effect on air quality than others like oak, willow and poplar, since the latter emit higher levels of volatile organic compounds that contribute to the formation of other pollutants such as ozone and particulates (RCEP 2007 p70).

5.3.4 The effect of green space on noise exposure

Green space, particularly trees and large shrubs, can have a positive impact in reducing environmental noise by providing a barrier to screen out noise (Green space Scotland et al. 2008; RCEP, 2007). The ability of vegetation to attenuate noise is related to the size and density of planting (Green space Scotland et al. 2008; LUC 2004). Research suggests that dense planting reaching to the ground and with no gaps may achieve noise reductions of up to 15db. It is also suggested that sharp

tones especially may be softened (LUC 2004). Street trees are the most commonly found trees in urban areas, there are statements that these may absorb some limited traffic noise (Mayor of London 2007) but no empirical evidence was found for this.

People may also value green space for its restorative capacity in allowing an escape from the noise of the wider built environment (Green space Scotland et al. 2008). The perceived intrusion of noise from traffic can be reduced by vegetation obscuring the noise source and associated traffic movement although there is little research to establish the actual benefits of urban green space as a distance barrier or oasis (LUC 2004).

5.3.5 The effect of green space on the risk of unintentional injuries

This can include unintentional injuries from both water and land based open spaces. In 2005, there were 6,156 deaths from accidental drowning recorded from 26 European countries. This represents 3.4% of all deaths due to external causes. Many of these deaths occurred in naturally occurring water situated within green space. Other risks from open water include the possibility of contracting infections from protozoa, viruses, or bacteria, many of which are intestinal parasites. These are most likely to cause gastrointestinal disturbances.

Additionally, unsafe play areas in green space, account for a large proportion of injuries to children and young people. Poor equipment design, poor design and layout of play areas, unsuitable equipment, incorrect installation, lack of regular inspection and inadequate maintenance all contribute towards injuries. However, not all injuries are equipment related. An estimated 424,000 injuries occur as a result of falling where 66% of these involve falling from a height. Unsafe ground surfacing in children's play areas is a major source of injury from falls in children.

Other risks from green space areas include contracting blood-borne disease through contamination from discarded syringes (Croucher 2008). Additionally, there is a small potential for catching diseases from resident wildlife. However, further research is needed to properly explore these risks and associated risk-reduction strategies (Croucher et al, 2008)

5.4 The effect of local urban design on the health risks

The way we experience and use our immediate environments in towns and cities is determined at the smaller spatial scale of the street, the public square, the block and individual building (Rao et al, 2007). This is the realm of urban design. Impacts on health risks occur through these environments as modified by aesthetic perceptions, often unconscious, of containment and exposure, comfort and threat as much as by physical constraints (Croucher et al, 2007). Diversity and the presence or absence of nature and public realm activity are also important parameters.

Urban design can also have a health impact not mediated by our perceptions and use of space such as direct effects of impervious surfaces or green roofs on flood risk and aquifer recharge.

Urban design, at a slightly larger scale, can also determine the degree of social mixing or segregating through the locational control of social housing in new build and neighbourhood regeneration.

5.4.1 The effect of local urban design on physical activity

There have been several recent major reviews of evidence of the effect of urban design on physical activity (Jones et al., 2007; Bauman and Bull, 2007; Croucher et al., 2007). However, much of the original data is based on studies in the United States of America or Australia. The dominance of lower density development means that the findings may not necessarily be comparable with those from European cities. These reviews also attempt to synthesize evidence from a disparate range of study methodologies with little consistency in the way potential variables in the urban environment are identified. Nevertheless, some broad conclusions can be drawn which may be generalisable in Europe.

Street Networks: Evidence surrounding this element has been covered in earlier sections on land use patterns and transport. An example of the effect of street network form on physical activity is reported in Lavin et al. (2007, p17) in a study of Los Angeles residents where it was found that ‘those living in areas laid out in a ‘traditional grid system’ were up to 25% more likely to regularly walk to work compared with residents in socioeconomically similar areas that were laid out specifically for cars’.

Convivial spaces: Urban environments that lack public gathering places can encourage sedentary living habits (Lavin et al., 2006). In the same review the attribute of ‘enjoyable scenery’ also positively impacts on physical activity levels within a community. Urban environments that are aesthetically pleasing and landscaped have been shown to encourage people to explore and access their local community by foot or bicycle when compared to the same urban space prior to renovations (Cavill, 2007, Duncan, 2005). There is also some evidence that observing people being active is positively associated with activity (Duncan, 2005) though further research is needed to examine this effect in a variety of situations with differing levels of background activity.

Many studies have attempted to find correlations between people’s perceptions of the local environment such as convenience, safety, satisfaction and perceived distance with physical activity levels. Few consistent significant associations have been found. However, two categories of environmental perceptions have been found to have fairly consistent positive patterns of association with physical activity. The first is an association between levels of physical activity (not including general walking) and perceived local safety and perceived leisure time. The second is an association between general walking and perceived convenience (Jones et al., 2007). Parent’s perceptions of neighbourhood safety were found to impact on the levels of physical activity in children (Croucher et al. 2007).

A meta analysis by Duncan et al. (2005) found that the perceived presence of pavements, shops and services and perception of ‘traffic as not being a problem’ were each separately positively associated with physical activity after adjusted for age, income and education. A Danish study found that both perceived and actual safety, with regard to risk from motorised traffic, were important factors in the take-up

of cycling in areas where new cycling infrastructure is been developed (Jensen et al., 2007).

Lavin et al. (2006) found that deteriorating physical features of urban environments such as dilapidated environments, vandalism, graffiti and litter can impact on physical health through reduction in physical activity. The findings from this study indicated that people are more likely to exercise if pavements are appropriately maintained. This points to a situation where health inequalities are exacerbated since graffiti and vandalism were also disproportionately found in disadvantaged areas. The impacts are confirmed by Ellaway et al. (2005) in the secondary analysis of a European cross sectional survey of 12 cities. They found that, compared to respondents from areas with low levels of litter and graffiti, those from areas with higher levels, were 50% less likely to be physically active and 50% more likely to be overweight.

In a systematic review, Jones (2007) notes that several studies have failed to find relationships between specific measurable attributes of the local environmental characteristics that might impact on physical activity. Attributes such as the presence of benches, trees, cleanliness, street width, traffic volumes have been investigated. However, Jones notes that some studies, both Australian, have demonstrated associations between combined composite variables.

Examples of composite variables

Pikora et al. (2006) uses a 'walkability score' based on the presence of features in the local neighbourhood, including safety, aesthetics (cleanliness, green space etc.), function (pavement quality, street width, traffic volume etc.) and density of destinations such as local amenities and parks.

Giles-Corti et al. (2003) uses a 'physical environmental determinate score' which includes living on a street that is aesthetically pleasing, with minor traffic, trees, pavements and a local shop.

Jones et al., (2007) note that "... using a combined variable might reflect the synergistic combination of a supportive environment, as hypothesised by theoretical ecological models of the environmental determinants of physical activity" (p26). The importance of treating the urban environment as a system, especially in rising to challenges of supporting public health is covered in more detail in the conclusions.

5.4.2 The social and psychological impacts of local urban design

At the larger scales of neighbourhood and estate layout, the local urban environment, as controlled through urban design also concerns itself with the placing of housing for different social groups. This is influenced though the nature of tenure, size and form of the residential units. Consequently the location and dispersal patterns of residence from different social classes and subcultures are strongly influenced by urban design both during new build and regeneration programmes. The nature of dispersal especially the size of similar residential units is critical. People feel more secure in areas where there are others from a similar social culture. It has been shown that the level of social inclusion in a society is just as important for health as income (Marmot, 2004). Yet without a degree of mixing ghettos are created.

Urban designs that facilitate neighbourhood bonds and encourage supportive social networks have been shown to be effective in reducing fear of crime (Lavin et al, 2006). Examples are urban designs that are mixed-use (including work and shops in predominantly residential areas) and those which include pedestrian and cycling oriented facilities. Such designs enable residents who do not own car to perform activities of daily living.

Lack of availability and accessibility of municipal services such as libraries, health facilities doctors surgeries, schools and social support can have a negative social impact on communities and affect both physical and mental health (Horowitz et al, 2005; Lavin et al, 2006). Places which lack facilities often become ghettoised fostering a risk of further criminal activities

Lack of facilities such as public toilets (Greed, 2006), impacts on vulnerable groups for example young children, older people and those with illnesses or chronic diseases. Lack of suitable areas for resting, for example benches and seating may also limit the ability for certain groups to explore or walk longer distances. With respect to the elderly this impacts negatively on social isolation.

The design of an urban environment can affect a community's perception of safety (Wilcox et al, 2003). There is an inverse relationship between the fear of crime and lack of safety and subjective measures of good mental, physical and social health. Although many neighbourhood characteristics may not directly affect physical health, the perceived fear of crime can act as barrier to participating in social and health-promoting activities, leading to feelings of social isolation. This can impact directly on mental, physical and social health (Foster et al, 2008, Stafford et al, 2007). Women and older people are more concerned about safety in their neighbourhoods compared to men and younger women.

One of the main social impacts related to urban form, is residents perceived fear of violence or crime (Horowitz et al, 2005; Whitley et al, 2005). These aspects have been shown to negatively affect mental health. Groups who feel most vulnerable include women in particular mothers on a low-income and those with mental illness (Horowitz et al, 2005; Whitley et al, 2005). Perceptions of safety are influenced by fear of street crime but also injury from traffic (Croucher et al. 2007) and a reaction to the aesthetic impression, which includes the presence of graffiti, litter and state of disrepair of the surrounding community (Lavin et al, 2006). The latter is disproportionately high in low-income and disadvantaged areas (Lavin et al, 2006).

Poor building design for example those with small niches and blind spots, inadequate lighting and overgrown landscaping increase perceived feelings of fear from crime. Such areas provide opportunities for refuge of prospective criminals, in addition to restricting the opportunity of escape for potential victims (Wilcox et al, 2003). However, according to Whitley, these fears are diminished if vulnerable areas are monitored by CCTV (Whitley et al, 2005).

Children who live in neighbourhoods that they perceived as unsafe are at greater risk of developing behavioural problems such as hyperactivity, aggression and becoming withdrawn (Lavin et al, 2006). According to recent research, up to 71% of children in

a large metropolitan city in the west of the United States suffered from post traumatic stress disorder or partial post traumatic stress disorder (Horowitz et al, 2005).

5.4.3 The effect of local urban design on air quality

Air pollution in the outdoor environment has been dealt with extensively in preceding sections in terms of land use pattern, transport (giving rise to the bulk of urban emissions) and green space. But far from all aspects having already been dealt with, street design has a major impact on air pollution at the local level.

The Local Air Quality Management process in the United Kingdom has seen every Local Authority in the country undertake a rigorous assessment of air quality. Whilst it was initially thought that the worst air pollution problems would occur close to motorways and other very heavily trafficked roads (flows > 20,000 vehicle movements a day), a combination of open terrain leading to good dispersion of pollutants, and a lack of public exposure in close proximity to these roads mean that they are rarely a significant problem (Longhurst et al, 2006). Further work has identified that high levels of air pollution tend to be more dependent on the street geography and characteristics of the flow. The latest United Kingdom guidance for the Local Air Quality Management process now instructs local authorities to assess air quality on congested roads with flows as low as 5,000 vehicle movements a day where there are buildings on both sides of the road, and buildings on one side are within 2m of the kerbside (Defra, 2009a), as it is these narrow and congested streets which are causing most of the air quality problems in the United Kingdom.

It should be noted also that indoor air pollution originates from both outdoor and indoor pollutants. As outdoor pollution also enters buildings, indoor pollution problems are worse in urban areas where the general air quality is low. Indoor sources of air pollution include household chemicals and airborne biological agents such as bacteria, fungi, allergens from dust mites and animals and viruses. Of course these too can all contribute towards respiratory diseases, including childhood asthma.

5.4.4 The effect of local urban design on noise exposure

Noise exposure has been dealt with extensively in preceding sections in terms of land use pattern, transport (giving rise to the bulk of noise emission) and green space. In terms of urban design and the local environment the role of point sources related to urban planning come to the fore.

Traditional concerns are 'noisy neighbour' impacts, whereby many planning systems attempt to limit incompatible users, e.g. nightclubs and pubs, through a mixture of zoning and licensing. New issues are coming to the fore, namely increased noise exposure from neighbours in higher densities, in mixed-use areas and in the central areas now being promoted in many cities for 24 hour living. These have not yet been the subject of study for long enough to provide the material for a systematic review of health risk.

The urban building form of perimeter block development can lead to tranquil inner courtyard areas but no reviews of empirical work were found for this study.

5.4.5 The effect of local urban design on the risk of injuries

Road traffic collisions, which are the main cause of injury in the urban environment, have been discussed in an earlier section and are partially contributed to by poor urban design in the local environment. Falls are the next main cause of unintentional injuries related to the local environment. Causes of falls resulting are mainly due to extrinsic factors i.e. individual not medical conditions. Up to 20% of falls in all ages and 30-50% of falls among older people living in the community may be due to such factors (WHO, 2004b).

Unintentional injuries associated with urban design occur from several other sources. These can include poor street lighting (Beyer et al, 2009), choice of materials for footpaths and walkways or injury resulting from poor maintenance of the built environment, poorly designed urban environments and poor maintenance of public open spaces, play areas, paths, rights of way, and canal towpaths (NICE, 2008).

Another cause of injury from the local urban environment includes adverse reactions caused by exposure to heat. Determinants of this heat island effect are found at the strategic scale with regards to land use pattern and strategic green space and these have been outlined previously. Contribution to heat islands are also found at a local level with local contributors being the hot 'exhaust' from summer air conditioning plant, lack of greenery (which provides cooling both through shade and evapotranspiration) and the use of materials in paving, walls and roofs which captures a wide spectrum of the sun's energy and then re-emits it in the heat spectrum (Gartland, 2007). Sparse vegetation and having no open space in the neighbourhood were significantly correlated with higher temperatures (Harlan 2006). Local urban design detailing can lead to localised ambient air temperature differences with poorly designed areas being considerably warmer compared with other similar areas (Gartland, 2007).

Summary

This brief overview takes each of the chosen determinants of health in turn and reviews the significance of the urban environmental components. Undoubtedly the most fundamental issue is physical activity. The 'epidemic' of obesity, while it owes much to changing social and economic conditions, is also being exacerbated by the progressive evolution of the urban environment to suit car and lorry access. The dispersal of activities onto lower density, single use, car-oriented sites served by major highways has reduced the opportunity to walk and cycle to facilities and work. The research consensus – not so long ago rather equivocal about the significance for physical activity – is now quite clear. Distance and route quality are critical factors. Where urban areas can provide safe and convenient networks and land use patterns are appropriate, then active travel will be higher. This has particular importance for poorer households which get most of their physical activity from such travel. All aspects of spatial policy play a crucial role in this, from strategic transport investments down to the design of streets. The accessibility of green space is also important. People, especially children, are much more likely to make use of it for recreational activity if it is close.

The social and psychological impacts of spatial planning are not unconnected with physical activity. The evidence here is less overwhelming and sometimes contested, but all the pointers suggest that the existence of local facilities, convivial public spaces and accessible green space is important for the development and maintenance of social networks. Those networks in turn help to reinforce the sense of belonging and hence of mental well-being – particularly important for those who are less mobile, more dependent on the local neighbourhood for their social contact. Green space also has a clear positive impact, just by its existence (even in the form of street trees), on emotional well-being.

Air pollution, noise and accidents are in some ways the other side of the coin. The same trends that have led in most places to declining levels of physical activity and the loss of local social networks, are also responsible for much of the poor air quality, high noise levels and (despite the best efforts of engineers and designers) continuing unacceptable levels of road traffic injury. The life, health and well-being impacts of traffic are well attested. There are other causes, besides traffic. Air pollution has been long associated with noxious industry; disturbing noise can result from industry embedded in housing and from high density mixed use development, where the social activities of some disrupt the sleep of others. Green space can mitigate the effect of both air pollution and noise if well distributed.

Section 6

Climate change

This review does not attempt a comprehensive review of climate change and its associated health risks, it lies beyond the scope of the current work and the issue is being dealt with in depth in other quarters in the run-up to the Copenhagen 2009 meetings which are seeking to reach a post-2012 climate change agreement (Costello et al., 2009; McMichael et al. 2008). Neither can this review fail to mention climate change, as this would be an obvious omission. The purpose of this section is to provide an outline of urban spatial planning in terms of climate change and in particular the basis on which climate change interacts with the urban components and risk factors dealt with in the preceding section.

At the World Health Assembly in May 2008, 193 Member States adopted a resolution acknowledging the profound and adverse ways in which climate change will affect fundamental determinants of health (WHA, 2008). In doing so recognition was also given to the strong global scientific consensus that warming of the climatic system is unequivocal (IPCC, 2007). Climate change has been stated as being the biggest global health threat for the 21st century (Costello et al., 2009; p1693)

The main threats are from regional weather changes and sea level rise. Regional weather changes affecting the urban environment will, in addition to rising average temperature, involve more frequent and more extreme weather events, such as heat waves, droughts, storms and sudden and heavy precipitation (RCEP, 2007).

6.1 Direct Health risks

Climate change is predicted to have effects throughout the global politico-socioeconomic system. The impact of sea level rise, weather events and heat could lead to health risk through adversely affecting inequities between rich and poor, territorial habitability and migration pressures (Costello et al, 2009). In terms of direct health risk in the European urban environment the following are cited in the literature (Costello et al, 2009; DH/HPA, 2008; RCEP, 2007; Haines et al., 2006; NEF, 2009) which all contain details of predicted increases in morbidity and mortality:

- Heat stress; excess mortality and morbidity in the summer months
- Flooding; mental health and stress effect flood and potential flood situations, potential for water-borne disease outbreaks
- Vector-borne disease; changes in patterns of disease
- Drinking-water; adverse effects on quality and availability
- Food poisoning; likely increases in incidents
- Air quality: higher ground level ozone concentrations in the lower atmosphere
- Ultraviolet exposure: Cases of skin cancer and cataracts are likely to increase.

In terms of population effects at a settlement level, older people, children and infants are more susceptible to prolonged exposure to heat (RCEP, 2007). There may also be an uneven distribution in heat in relation to income, with more wealthy residents tending to live in area with more micro-climate moderation through being less low-lying and having a greater proportion of green space.

It should be noted that due to warmer winters, a reduction in excess winter deaths in the elderly through hypothermia has been predicted in the United Kingdom (RCEP, 2007). Contributing to excess winter deaths, in some European countries, is the combination of older building stock (poorly insulated and with inefficient heating systems) and relatively short periods of winter minimum temperatures, leading to a lack of incentive to upgrade insulation or heating systems.

6.2 An outline of climate change and urban settings

The breakdown of European greenhouse gas emissions (mainly carbon dioxide, methane and nitrous oxide) in 2006 was 59% from energy use (EC, 2008), with the urban population in accounting for 69% of all European energy use (EEA, 2009b). Transport accounts for 21% of the emissions; the amount of emission is determined by both mode of travel used and spatial land use distribution. Industry processes account for 8%, 9% is due to agriculture and 3% is from waste disposal (EC 2008).

The literature contains two basic responses to climate change, mitigation and adaptation.

Mitigation is technological change and substitution that reduce resource inputs and emissions per unit of output. Mitigation means implementing social, economic and technological policies to reduce greenhouse gas emissions and enhance sinks (Verbruggen. 2007).

Adaptation means the initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects. Various types of adaptation exist for example anticipatory and reactive, private and public, and autonomous and planned (Verbruggen. 2007). This can include relocation of activities and changing design and construction standards.

6.2.1 Mitigation

The quantity of carbon dioxide emission due to transport is determined by both mode of travel used and spatial land use distribution. These two components interact as described in earlier sections. For example, a combination of segregated land use and low densities can greatly reduce the relative attractiveness (and viability) of low carbon transport, both public transport and active travel. Mitigation requires tackling density and land use separation together.

Electric vehicles in towns may have a role in mitigation but only if the electricity is generated from low CO₂ emitting technologies.

In terms of green space, increasing the number of street trees and the quantity of urban green space is an adaptive response, reducing heat island effects and also a mitigating response in areas where air conditioning is used. Climate change

mitigation also occurs through urban tree planting in colder climates due to the increases in wind friction which can have the potential to reduce heat loss from residential areas in winter by up to 5%.

Urban heat island reduction policies should specifically target vulnerable residential areas and take into account equitable distribution and preservation of environmental resources (RCEP 2007).

One of the most prevalent greenhouse gasses is CO₂, the role of urban energy consumption and production has in reducing CO₂ emissions has become a focus. In urban areas decentralized energy distribution systems, involving more use of combined heat and power, district/community heating networks and local green energy sourcing would provide a contribution to climate change mitigation (NEF, 2008). Some of these measures (combined heat and power and district/community heating networks) become more viable in the mixed use areas which would also become more prevalent as a consequence of implementing some of the transport and land use mitigation measures.

Reducing the energy consumed through space heating and cooling has become a research focus in building design and construction. Low carbon emission forms of providing energy in the urban realm, such as solar space heating, solar electricity generation and solar water heating, and ever increasing levels of insulation are increasingly cited in literature as important mitigation measures to take in the built environment.

6.2.2 Adaptation

Urban areas will have to adapt to some level of climate change, whether mitigation is effective or not. Spatial planning has a major role to play in enabling cities to cope with extreme weather events. This includes the proper planning of the water cycle, including rain water capture, grey water reuse, flood risk management and sustainable urban drainage (see section 4.1.5 on flood risk). Along coastlines, where sea-level rise and bigger storm surges could threaten coastal settlements, it may mean extra sea defences or managed retreat where defence is impracticable.

Urban heat islands (discussed in 4.1.5) are caused not only by the energy consumed within a limited area (including air conditioning in summer) but also by the nature of the urban materials. Buildings, tarmac and paving absorb and store heat, increasing air temperature, particularly noticeable at night. If temperature is to be moderated then the essential parameters are surface roughness, colour, porosity (all affecting albedo characteristics) and presence or absence of trees and vegetation which cool areas through shading and evapo-transpiration (Gartland, 2008). The progressive greening of cities in gardens, through green roofs, through extending parklands is critical.

In the discussion of global ecology, and of the measures needed to mitigate or adapt to climate change, it is salutary to note the intimate connection between microcosm and macrocosm. The measures which research convincingly suggests will increase the likelihood of healthy lifestyles, and healthy towns, are the very same measures which will promote a healthy planet.

Section 7

Challenges for a healthy urban planning

This evidence review has concentrated on specific determinants of health and how they are affected by spatial planning and urban design. It has not attempted to review well known health risks such as lack of access to good quality housing, lack of availability of employment and the basic environmental health concerns of good sanitation, food and water. The intention is to contribute to a better understanding of the impact of spatial policies, spatial patterns and layout on health.

Having reviewed the evidence in a necessarily topic by topic basis, this section highlights the need to relate to the field of health and urban form as a single system. Many reviewers come to a similar conclusion. The systemic nature of the problem of health in the urban environment calls for interdisciplinary research approaches, such as that found in the Foresight Obesity report and its mapping of the obesogenic environment (DH, 2007). These new approaches often highlight tensions between biomedical models and the holistic approaches which combine biological, cultural, economic, political, psychological and social factors (Lawrence, 2004).

7.1 A new public health for the urban environment

The twin pressures of rising levels of obesity and the increasing threats of climate change, against a background of ever larger, more populous and more sprawling urban settlements, loom large in the urban health agenda. Fuelled partly by this there has been a very high level of interest and research into how our health is affected by the human settlements in which we increasingly live and work.

Primary data is unearthed and written up and published in positivistic research papers, which are then collated into reviews and meta-studies, which in turn are synthesized into reviews of reviews. Through this process new understandings emerge, based sometimes on hundreds, if not thousands of primary papers. In terms of the risks and challenges to health in the urban environment, the emerging evidence points firmly in the direction:

- of legitimizing the validity of holistic approaches,
- of recognizing the strength of the shift of focus from illness towards salutogenesis (Antonovsky, 1987; Antonovsky, 1996),
- of moving from an individual based approach to a population based approach, and
- of “shifting away from a mechanistic and reductionist focus on single health problems, risk factors and linear causality—towards a more holistic view, concerned to develop supportive contexts within the places that people live their lives”. (Kickbusch, 2003).

Knowledge needs to flow from holistic approaches to the evidence base into policy and practice. Reviews of research need to “bridge the gap” to be accessible to policy-

makers (WHO, 2008a) but to ensure effectiveness right through to implementation (as demonstrated in the examples given above) both policy development and decision-making need to be undertaken in a systemic manner (see Box 1).

Box 1: Health and the planning of urban areas

Urban plans are key determinants of the shape of human settlements, the health and well-being of the inhabitants, and urban socio-economic conditions generally. It follows that planning decisions can systematically take account of the influence of the urban environment on human health. Urban planning practice can therefore be regarded as a central determinant of environmental health. Because cities are human creations as well as human habitats, human health is a central (if often un-stated) value in urban planning and governance. Urban planning priorities will therefore include both the enhancement of the quality of urban quality but also the provision of facilities and resources, which can protect and enhance human health.

Regrettably, this is often not the case because urban planning practice tends to be fragmented and planning for a great variety of urban purposes commonly lacks an integrated approach. Development planning often tends to be separated from daily governance as a direct consequence of sectoral approaches to these activities, and of functional and disciplinary specialization. In effect, there is a built-in resistance to intersectoral collaboration because of established specialist values and the interests of sectoral agencies and professional institutions.

This section presents some case studies that demonstrate the power of making an 'up-stream' intervention as an essential step in systemic health interventions for healthier urban environments.

7.1.1 The nature of the evidence

Several studies point out gaps in the evidence base. These usually relate to:

- Studies being unable to provide evidence of causal relationships. For example Bauman and Ball (2007) point out the need to distinguish between 'determinants' (antecedent causal variables) and correlates, which are parameters that are constantly associated together in the data. When stepping across disciplinary boundaries close attention needs paying to definitions.
- Evidence not being sufficient to identify which specific changes would have most impact on physical activity and health outcomes (TRB, 2005). Most systematic reviews, especially those undertaken within a medical paradigm, note the lack of an ability to ascribe causality in the published studies of interventions.

Studies arising from the urban design and transport fields have not been designed to attribute causality. Many studies arise from data collected when evaluating natural experiments, under these open system conditions, research methodologies required to examine causality are complicated and don't yet have a long track record of research (MRC, 2008).

However, even though causal connections have not been demonstrated, the available evidence builds a strong case to suggest that attention to health risks in built environment policy, programmes and projects can facilitate better health outcomes across a range of public health objectives.

7.2 Public health challenges

Effective planning for public health involves much more than planning for and responding to specific health conditions. It is about healthy human habitat, locally and globally, and supportive social structures (Barton and Grant, 2003). The public health challenge is related to our ability and commitment to creating a healthier built urban environment. The idea is expressed in Lavin et al. (2007 p23) as

Neighbourhoods are the localities in which people live and evidence shows they are vitally important for health and well-being. Combating heart disease, respiratory problems and mental illness means ensuring opportunities for healthy exercise, air quality and local social networks, all of which are influenced by the physical nature of localities.

To this should be added the public health challenges arising from inequalities in health. Evidence shows that a disproportionate burden of ill health associated with the built environment is borne by certain groups within the population. The least well-off people in society suffer poorer health (Marmot, 2004). Several of the reviews cited indicate that poor people are more likely to live in poor quality built environments (including the determinants of noise and air quality) and this contributes to poor health. Lavin et al. (2007) also identify children and the elderly as being particularly vulnerable not only because of a biological vulnerability but also because of the significant numbers of children and elderly who are poor.

7.3 Policy and planning responses

A key question underlying the literature is the extent to which it is reasonable to expect people to change their lifestyles in an environment that does not support such changes. Responses in urban planning are needed and stakeholders from urban planning and health need to collaborate to increase healthfulness of urban settings (see Box 2).

However, the agenda is not just about new build communities, which will always only represent a small fraction of the built environment, nor is it about only including major regeneration schemes. It must also include the continuing modification to the built environment which provides opportunities, over time, to make significant changes to health risk (TRB, 2005). Such action is needed to make the changes that will affect “the multiple pathways within the obesity system in a sustainable way” (Foresight, 2007 p11). Reinforcing this message, with relation to physical activity, the Transportation Board Report (TRB, 2005 p15) recommends that:

Those responsible for modifications or additions to the built environment should facilitate access to, enhance the attractiveness of, and ensure the safety and security of places where people can be physically active.

Box 2: Merging urban planning and health: bringing actors together

When the professions engaged in urban planning and urban health are compared, the picture becomes even more complex. Modern urban planning practice is largely concerned with design and maintenance of the built environment, with practitioners often working in a politicised decision-making context. Health professionals have an entirely different agenda, influenced by the Hippocratic imperative of helping the sick, the infirm, the disadvantaged.

Whilst both professions serve the public interest, their respective sources of praxis and theory differ greatly. It is therefore not surprising that in the structure of the modern city bureaucracy, each sector tends to stand alone and to go its own way – even though each aspires to improving the overall well-being of the citizenry at both the individual and community levels.

It is this common goal, which links the two professions. It is a goal whose achievement in the typical city administration would appear to be more a matter of accident than design. The research suggests that in the typical European city there is considerable scope for building new bridges between the two professions. In particular it would seem that if municipal agendas and staffing arrangements could be reshaped to take into account the common ground, the potential public benefits could be significant.

The Transportation Board Report goes on to add (p15) that:

Even though causal connections between the built environment and physical activity levels have not been demonstrated in the literature to date, the available evidence suggests that the built environment can play a facilitating role by providing places and inducements for people to be physically active. Local zoning officials, as well as those responsible for the design and construction of residences, developments, and supporting transportation infrastructure, should be encouraged to provide more activity-friendly environments.

Similarly the recommendations from the National Institute for Health and Clinical Excellence (NICE, 2008 p6) cover all urban development activity in recommending that action needs to be taken by:

Those responsible for all strategies, policies and plans involving changes to the physical environment. This includes the development, modification and maintenance of towns, urban extensions, major regeneration projects and the transport infrastructure.

7.3.1 Policy objectives

Policy objectives were set out in the *Healthy Urban Planning* book (Barton and Tsourou, 2000): twelve health objectives for planning and other professionals and decision-makers who determine the shape and design of the urban environment. The chart below elaborates that list and relates it explicitly to the settlement health map. The only significant innovation is to use the inner 'people' sphere 1 to relate to the principle of 'health for all', and therefore to the concerns about health inequalities. The two sphere 1 objectives are fundamental, and cut across all the other objectives.

Spheres of the Health Map	Objectives for Healthy Urban Planning
1. People	<ul style="list-style-type: none"> • providing for the needs of all groups in the population • reducing health inequalities
2. Life-style	<ul style="list-style-type: none"> • promoting active travel • promoting physically active recreation • facilitating healthy food choices
3. Community	<ul style="list-style-type: none"> • facilitating social networks and social cohesion • supporting a sense of local pride and cultural identity • promoting a safe environment
4. Economy	<ul style="list-style-type: none"> • promoting accessible job opportunities for all sections of the population • encouraging a resilient and buoyant local economy
5. Activities	<ul style="list-style-type: none"> • ensuring retail, educational, leisure, cultural and health facilities are accessible to all • providing good quality facilities, responsive to local needs
6. Built environment	<ul style="list-style-type: none"> • ensuring good quality and supply of housing • promoting a green urban environment supporting mental well-being • planning an aesthetically stimulating environment, with acceptable noise levels
7. Natural environment	<ul style="list-style-type: none"> • promoting good air quality • ensuring security and quality of water supply and sanitation • ensuring soil conservation and quality • reducing risk of environmental disaster
8. Global ecosystems	<ul style="list-style-type: none"> • reducing transport-related greenhouse gas emissions • reducing building-related greenhouse gas emissions • promoting substitution of renewable energy for fossil fuel use • adapting of the environment to climate change

Table 2: Healthy Urban Planning objectives

7.3.2 Effective urban policy

So what would effective urban policy look like? The Urban Environment report published by the Royal Commission on Environmental Pollution (2007 p8) warns that the “principle reason for the lack of satisfactory progress in many areas of urban environmental policy appears to have been the mismatch between complex problems and simplistic policy prescriptions”. The report suggests that focus should be given to more complex structure such as urban governance arrangements. Similarly Lavin et al. (2007 p23) talk of a need to guide “... physical development by outlining housing, transport and infrastructure demands and provide ... the strategic direction for future needs.” There is indeed a perhaps surprising degree of consensus about what policies need to be pursued. The problem is more one of public perceptions, political will and economic dynamics than it is of finding good technical answers. Comparative studies of progress towards sustainable development in various European cities are

illuminating (Falk and Hall 2009). The cities which are most conspicuously successful in promoting healthy environments and responding to the challenge of climate change are those with strong local government, able to plan all the different facets of the urban environment in a holistic, integrated way. They have a community approach to land rights, an effective planning regime, and a political system that supports long-term strategies.

Inherent in a systemic approach is the truth that, as part of an open system, the correct solutions for a healthy environment will be necessary, but not sufficient. One major research project on British cities concluded that in order to tackle the intractable problems that face us, effective land use and transport and design solutions will have to be combined with much improved technology, radically different fiscal signals, changed decision structures, and changes to the dominant societal values (Echenique et al 2009).

Making decisions

Each of the urban components lie across several decision areas which ultimately affect the health risks. These decision areas may sometimes be the responsibility of a particular agency or department, though more often a number of agencies are involved. Without coordination this can lead to contradictory decisions, undermining the ability of any one agency to deliver positive health and sustainability outcomes.

For example taking the component 'local urban environments': the broad decision theoretically lies with the planning department, but many of the key decisions are likely to be taken by the economic development unit and the transport authority; similarly with transport, the strategic decisions may be taken by the national department of transport, or the national rail authority, rather than the municipal authority. The situation can be very confused – hence the need to establish collaborative working methods that draw together the relevant agencies and ensure a coherent approach (see Box 3).

Box 3: Merging urban planning and health: bringing actors together

The development of integrated urban development policies based on sustainable city models stands as a special priority target. In the immediate future this will be the main challenge and responsibility of local authorities throughout Europe.

The *Sustainable City* model is based on the connecting the three pillars *Environmental, Economic and Social*, and on the introduction and integration of multi-level and multi-sectoral governance structures. For health planning and the wider field of planning for healthy cities, this means devising new ways of responding to old problem whilst coping with the what might be described as an 'avalanche' of new problems, new laws, new policies and regulatory regimes.

Ideally, this new integrated approach to sustainable urban development will be based on finding harmonies and synergies within and between all public policies that affect the city, from the European to the municipal level. This will require new ways of organising territorial governance and partnerships between different levels of administration and other relevant stakeholders. In the environmental health field in particular it will require a loosening of the old 'silo' mentality within agencies and between professionals working across the entire urban health and planning spectrum.

Environmental health indicators

Decisions, and monitoring of subsequent implementation, need to be based on relevant and useful data. In the face of the ‘complexity and specificity of human settlements’ Lawrence (2008 p323) calls for the “radical reorientation of current uses of indicators” as a “worthy goal for identifying and counteracting the unintended consequences of persistent urban pathologies and problems. The spatial planning system itself may be a good place to look for indicators.

One process indicator which may herald future success is the focus that health risk is starting to command within urban planning policy. In the United Kingdom, for example, transport policy has always been about roads, yet in recent years it is becoming accepted to consider walking and cycling within a wider context of integrated transport planning (Cullingworth and Nadin, 2006).

7.4 The need for systemic research, policy and intervention

In approaching the urban health environment as a system, systemic approaches are required. Effective approaches should seek to identify key entry points within the system where interventions will affect multiple parts of the system. It is as if many of the issues and their solutions are tangled up at these nodes, hence we are calling them – nodes for systemic change (KNOTs).

One decision area usually relates to a whole series of objectives. Taking ‘the design of public spaces’ as an example; this is an important decision area which has the direct intention of creating an aesthetically stimulating environment, it has potential impacts across a range of health risks including active travel, supportive social networks, cultural identities, safety, economic buoyancy, accessibility, green space, air quality and greenhouse gas emissions. Equivalently each health risk will be influenced by action in many different decision areas. This too points to the need for all agencies to take off their traditional blinkers and, working with others, adopt a holistic view (see Box 4).

7.4.1 Examples of interventions for systemic change

Sweden’s vision of road safety: In 1997, Sweden, launched a road safety strategy known as ‘Vision Zero’, this progressive policy had the aim of reducing road accident fatalities to zero by 2020. The strategy has made a big difference. In 1995 there were a total of 572 road deaths in Sweden, or a fatality rate of 6.5 per 100,000. A decade later, in 2005, Sweden recorded some 440 road deaths or 4.9 per 100,000. (By way of comparison, in 1995 there were 2,995 road deaths in England or 6.1 per 100,000 and ten years later there were 2,735 deaths, equivalent to 5.4 per 100,000).

Underpinning the governance, and critical to Vision Zero is the emphasis on shared responsibility, widening the responsibility for road safety from being that of the road user alone to includes that of the road system designer. Other parts of a chain of responsibility include making bicycle traffic safer; quality assurance in transport work; making better use of technology, public responses to traffic violations and examining supplementary ways of financing new roads and emphasizing the role of voluntary organizations in road safety work.

Box 4: Planning for health: a new paradigm

The urban environment is a highly complex interactive socio-physical system, with competing expectations and priorities. To date, considerations of health and wellbeing have had insufficient influence on urban design and planning. Creating healthier cities requires new approaches to planning, giving greater prominence to health as well as recognition of a range of health-based objectives including:

- opportunities for healthy lifestyles
- social cohesion and supportive social networks
- access to employment opportunities, high-quality facilities, and open space
- road safety, enhancement of personal security
- an attractive environment with acceptable noise levels and good air quality
- good water quality and sanitation,
- and reduction in emissions that threaten climate stability.

The achievement of physical, mental, and social well-being should ideally become a central goal of plans governing land use, transport, open space, housing and economic development in cities. This implies a fundamental shift in the philosophical underpinnings of the professions involved in pursuing such a goal.

Such a shift can be summarised as recognition that the essential principle of *healthy urban planning* is interdisciplinary, interagency and intersectoral collaboration, with shared recognition of the problems and shared will to address them. There is a need for collaboration between public and environmental health professionals and planners, as well as between construction, civil engineering, and other relevant sectors. Those outside the health arena need to be aware of the impact of their actions on health, and those working within health need to understand the planning process and policy environment to provide relevant and timely input. The challenge, both for planning and public health, is to learn from each other and combine best practices.

Also important is its emphasis on best-possible scenarios. Using a holistic approach it therefore emphasizes the optimal state of Sweden's roads, rather than just tackling existing problems (SPG, 2008).

Health outside a 'health setting': Working with and making use of the natural environment has been shown to improve both physical and mental health, through reducing stress and strengthening communities (Department of Health, 2009). Examples where this has been shown to be effective have been demonstrated by the Green Gyms set up by the British Trust for Conservation Volunteers. An evaluation by Oxford Brooks University demonstrated increased levels of fitness, better mental health and a strong retention rate of 70% in its participants after six-months.

Examining this concept, Jones et al. (2007 p18) use the term the "Supportive neighbourhood". This concept aligns well with the term 'supportive environments' promoted by the WHO as a core concept, as found in the Sundsvall statement on supportive environments for health (WHO, 1991). There is notable tension between their positivistic finding that "... there is no strong evidence of consistent positive associations between summary variables for a supportive neighbourhood and leisure-time physical activity" and their statement that:

A supportive neighbourhood environment for physical activity or walking is an obvious development from examining the relationships of different categories of environmental variables. Combinations of different components of the environment

could make it more attractive to physical activity (because of the effect of the sum of its parts, rather than the parts alone). This view would be supported by ecological and social cognitive psychological theories of the environment interacting with and reinforcing physical activity behaviour.

In the United Kingdom there has been some development of the concept of a healthy living centre whereby 'health' can spill out from a local hub that has co-located medical, social support, amenity, community and educational faculties. Although more developed in concept than actuality, this facility would face outwards and could be a stimulus for cycle routes, allotment gardening and other health promoting activities in the surrounding neighbourhoods.

The approach is heavily influenced by the Peckham Experiment (PHF, 2007) a study into the nature of health.

The researchers decided to study the family unit in a community setting to study what contributes to human health. In a purpose built centre/laboratory, known as the Pioneer Health Centre they conducted that research by annual medical checks and observations of families interacting in social activities. Recognizing the importance of sound nutrition, they rented a farm to provide fresh organic food. The Peckham Research Findings have influenced authorities across the world including the WHO.

Some of the features were: a study of health rather than disease; using a holistic approach; incorporating a social club and family membership; health checks and family consultations together with open discussions and non-directional help.

Supporting cycling in Copenhagen: In Copenhagen there are 350 kilometres of cycle tracks and 40 kilometres of green cycle (off-road) routes. One person out of three commutes by bicycle to work or school every day (KK, 2009b). Cycling and increases in cycling in Copenhagen are supported through strategic policy 'Cycle Policy 2002-2012', with a biennial monitoring and progress report 'Cycling Accounts'. The policy brings together the economic, health, environmental and quality of life divers together with decision areas including street design, street cleansing and maintenance, car parking provisions, public transport planning, parks and open space and neighbourhood renewal.

Great care and attention is given to the design of the street, using both vertical and horizontal cues and devices, to support active travel. Interventions are chosen from a palette of evaluated and constantly developing designs.

Cycle tracks, the preferred element in Copenhagen's cycle infrastructure (KK, 2002), have developed a preferred design. They are found used alongside many main roads, and are tarmac paths segregated vertically by low kerbs from both the cars on the roadway and the pedestrians on the pavement. Vertical cues are successfully used at side road junctions, maintaining a continuity of level (and priority) for the cyclist with car traffic entering or leaving the side road having to drive over a raised platform. This junction design often also involves reducing road space for parked cars and increasing pedestrian quality with seating and trees or shrubs.

At more major intersections a well chosen and evaluated palette of other devices are used including forward stop lines for cyclists, marked routes (in blue) across the intersection and advanced green traffic signals for cyclists.

The value of this was demonstrated in a recent study concluding that construction of slightly raised cycle tracks alongside road resulted in an increase in cycle traffic of 18-20% and a decline in car traffic of 9-10%, whereas the construction on cycle lanes (at grade) on roads only led to an increase of cycling by 5-7% and no decrease in car traffic (Jensen et al., 2007). The report also found that cyclists felt safer on the raised tracks and that construction of cycle lanes led to a greater increase in accidents than separate cycle tracks, however the increase in accidents with either intervention was not found to be significant.

Spatial mapping for health risk: In a brief example of synergistic working the role of spatial mapping of health need and health risk needs to be noted. This is a developing field. In terms of need there is a trend to map population data, disaggregated at various spatial levels to better understand the links between territory and need. In the United Kingdom one outcome is the current Joint Strategic Needs Analysis reports being compiled though joint working between local authorities and health authorities.

On the risk side, city and district maps covering subjects such as food accessibility, noise emissions and tranquil areas, air quality maps and walking accessibility are becoming increasingly common.

This spatial mapping can reveal hitherto hidden facts. For example noise maps can not only provide an overview of the ambient noise climate in urban areas but also provide details on the number of people affected by different levels of ambient noise, and the source of that noise, for example a road or industrial premises and the deprivation status of those people or other vulnerability factors (e.g. age).

Joint planning and health policy: The joining up of health and planning policy is the purest expression of what is often termed an 'up-stream' response. Such a response is common to all the case studies. It is more difficult to document the outcomes on the ground for up-stream interventions, partly since the results of joining-up at the level will be expressed differently in every local context. However there are many examples of this taking place. For example, each of the 90 cities in the phase IV of the WHO Health City Programme had a different but viable response to such an agenda, with many examples of health outcomes supported through healthy urban planning (Green and Tsourous, 2008).

Another recent example, from the United Kingdom, is the public health guidance covering urban planning published by the National Institute for Health and Clinical Excellence in the United Kingdom (NICE 2008). The recommendations are that:

- Strategies, policies and plans should ensure that applications for new developments always prioritize the need for people, including those with physical impairments to be physically active as a routine part of everyday living.

- Local facilities must be easily accessible by foot, bicycle and other modes of transport involving physical activity and they must ensure children can participate in physical activity.
- Planner and transport agencies should provide compressive networks of routes for walking, cycling and other modes of active transport. Reallocate road space to support physical activity, respect vehicle access, use traffic calming measures to restrict speed and create safe routes to schools.
- Public open spaces need to be reached by foot, bicycle or other forms of active transport and public transport; and that these are safe and well maintained.
- Hospitals and university campuses must ensure that the different parts of their sites are linked by appropriate walking and cycling routes. New workplaces should be linked to walking and cycling networks where possible and be accessible by public transport.
- School playgrounds are designed to encourage varied, physical active play.

These recommendations highlight the importance of urban design and spatial planning in facilitating a physically active population active within the urban setting. The important point here is the close joint working required between the medical and planning professions to create such guidance and to support it in implementation.

Section 8

Conclusions

Urban planning has a substantial potential to positively affect physical, mental and social well-being, and to enhance social inclusion, thus contributing to decreasing health inequalities. To achieve such a supportive urban environment, intersectoral collaboration needs to be actively promoted, in line with the conclusions of the EU Thematic Strategy on Urban Environment. This should involve urban planners, public and environmental health professionals, other relevant sectors, and administration at different levels. Citizens should also be engaged in this process.

Given the complex nature of urban and human health interactions, and the often competing interests (social, economic and environmental), an integrated approach is an absolute requirement. Further work is needed to develop and improve methods and tools available for 'healthy urban planning', and for assessment and monitoring of projects and programs. Efforts at designing and testing indicators and indices on various aspects of urban health should continue to be encouraged, building – to the extent possible – on existing activity.

With particular reference to urban built environments, the following dimensions establish a suitable framework for action:

- The *regional* dimension, recognizing and appreciating regional differences between cities in historical, climatic and cultural terms;
- The *design* dimension, recognizing the importance of diversity in the quality of built and green spaces in order to strengthen identity and loyalty to locale;
- The *technical* dimension, by optimising access to, and use of natural resources through efficient ventilation, solar access, and health-oriented design;
- The *social* dimension, by 'ownership' training for all stakeholders in order to overcome environmental neglect and develop responsibility for sharing health resources;
- The *political* dimension, by encouraging if not requiring elected decision-makers to take a holistic position when it comes to dealing with matters whose dimensions involve an overlap between urban planning and urban health.

References

- AEAT. (2005). *Cost–benefit Analysis of Air Quality Related Issues, in particular in the Clean Air for Europe (CAFE) Programme* AEA Technology Environment AEAT/ED51014/ Baseline Issue 5. (available online at http://www.cafe-cba.org/assets/baseline_analysis_2000-2020_05-05.pdf, accessed 20 September 2009).
- Antonovsky, A. (1987). *Unravelling the Mystery of Health*. San Francisco, Jossey-Boss.
- Antonovsky, A. (1996). The salutogenic model as a theory to guide health promotion. *Health Promotion International*, 11:11–18.
- Appleyard, D. (1981) *Livable Streets*, Berkeley, CA: University of California Press
- Atkinson, R., Flint, J., Blandy, A., Lister, D. (2004) *Gated Communities in England*. New Horizons Project.
- Balacombe, R. (Ed.) (2004). *The demand for public transport: a practical guide*, TRL 593, Wokingham: Transport Research Laboratory.
- Barton H., Grant, M. (2006). A health map for the local human habitat. *Journal of the Royal Society for the Promotion of Health*, 126(6):252-3.
- Barton, H., Grant, M., Guise, R. (2003). *Shaping Neighbourhoods, A guide for health, sustainability and vitality*, London: Spon Press
- Barton, H. (2005). A health map for human settlements. *Built Environment*, 31(4):339-55.
- Barton, H. and Grant, M. (2006). A health map for the human habitat. *Journal of the Royal Society for the Promotion of Health*, 126(6):252-261
- Barton, H. *et al.* (2009). *Local Accessibility Results from the SOLUTIONS Project*, unpublished. (Hugh.Barton@uwe.ac.uk).
- Bauman, A.E., Bull, F.C. (2007). *Environmental Correlates of Physical Activity and Walking in Adults and Children: A Review of Reviews*. London, National Institute of Health and Clinical Excellence.
- Besser, L., Dannenberg, A. (2005) Walking to Public Transit: Steps to Help Meet Physical Activity Recommendations *American Journal of Preventive Medicine*, 29, 4, 273-280
- Bird, W. (2004). *Natural Fit: Can Green Space and Biodiversity Increase Levels of Physical Activity?* Sandy, Royal Society for the Protection of Birds.
- Bird, W. (2007) *Natural Thinking: Investigating the Links Between the Natural Environment, Biodiversity and Mental Health*. Sandy, Royal Society for the Protection of Birds.
- Björk, J., Albin, M., Jacobsson, H., Ardö, J., Wadro, J., Östergren, P.O., Skärbäck, E. (2008) Recreational values of the natural environment in relation to neighbourhood satisfaction, physical activity and well-being. *Journal of Epidemiology and Community Health*, 62(4):e2.
- Bowman, S., Gortmaker, S., Ebbeling, C., Pereira, M., Ludwig, D. (2004) Effects of fast-food consumption on energy intake and diet quality among children in a national household survey. *Journal of the American Academy of Pediatrics*, 113:112-8.
- Brahman, S.S. (2006) The global burden of asthma. *Chest*, 130:4s-12s.
- Briggs, D.J.(2008) A framework for integrated environmental health impact assessment of systemic risks, *Environmental Health*, 7, 61, (available online at <http://www.ehjournal.net/content/7/1/61> accessed 1 September 2009).
- British Heart Foundation Statistics Web site. (2005). *Physical Activity Levels in Europe* (<http://www.heartstats.org/datapage.asp?id=4695>, accessed 24 March 2009).
- Brown C, Grant M (2005). Biodiversity and human health: what role for nature in healthy urban planning. *Built Environment*, 31(4):326-38.

- Brown C, Grant, M (2007). Natural medicine for planners. *Town and Country Planning – Special Issue: Planning for Healthy Communities*, 76(2):67-9.
- Burns, G (2006). Naturally happy, naturally healthy: the role of the natural environment in well-being. In: *The Science of Well-being*. Oxford, Oxford University Press, Huppert, F A, Baylis N, Kenvern B, pp 405-431.
- Calve-Blanco, T. (2009). The impact of local facility provision on social networks and mental well-being. Draft PhD thesis, (personal communication) University of the West of England, Bristol
- Cavill N (ed) (2007) *Building Health: Creating and Enhancing Places for Healthy, Active Lives; What Needs to be Done*. London, National Heart Forum.
- CDC (2008). Centre for Disease Control and Prevention [On line source for credible health information]. (<http://www.cdc.gov/physicalactivity/everyone/glossary/index.html>, accessed 5 May 2009).
- CFIT 2001, European best practice for delivering integrated transport. London, Commission for Integrated Transport. (<http://www.cfit.gov.uk/docs/2001/index.htm>, accessed 5 June 2009).
- Costello, A. *et al.* (2009) Managing the health effects of climate change. *Lancet*, 373:1693-733.
- Croucher K, Myers L, Bretherton J (2008). *Green space Scotland Research Report: The Links Between Green space and Health: A Critical Literature Review*. Stirling, Green space.
- Croucher K, Myers L, Jones R, Ellaway A, Beck S (2007). *Health and the Physical Characteristics of Urban Neighbourhoods: A Critical Literature Review, Final Report*. Glasgow, Glasgow Centre for Population Health.
- CSDH (2008). *Closing the Gap in a Generation: Health Equity Through Action on the Social Determinants of Health. Final Report of the Commission on Social Determinants of Health*. Geneva, World Health Organization.
- Cullingworth B, Nadin V (2006). *Town and Country Planning in the United Kingdom*, 14th ed., London, Routledge.
- Dannenburg, A.L., Jackson, R.J., Frumlin, H., Schieber, R.A., Pratt, M., Kochtizky, C., *et al.* (2003). The impact of community design and land-use choices on public health. *American Journal of Public Health*, 93:9.
- David Lock Associates Ltd. (2007). *Active Design: Promoting Opportunities for Sport and Physical Activity Through Good Design*. London, Sport England.
- Davis A (Ed.) (2002). *A Physically Active Life Through Everyday Transport*. Copenhagen, WHO Regional Office for Europe.
- De Silva MJ, McKenzie K, Harpham T, Huttly SRA (2004). Social capital and mental illness: a systematic review, *Journal of Epidemiology and Community Health*, 59:619-627.
- Defra (2007). *Air Quality Strategy for England, Scotland, Wales and Northern Ireland*, Department for Environment, Farming and Rural Affairs, London, 17 July 2007 (available online at <http://www.defra.gov.uk/environment/quality/air/airquality/strategy/index.htm>, accessed 20 September 2009)
- Defra (2009a). *Local Air Quality Management – Technical Guidance LAQM.TG(09)*, London: Department for Environment, Farming and Rural Affairs.
- Defra (2009b). *Noise: Noise Mapping*. Department for the Environment, Food and Rural Affairs. (<http://www.defra.gov.uk/ENVIRONMENT/noise/mapping/>, accessed 25 March 2009).
- DfT (2004). *Managing speed on our roads* (<http://www.dft.gov.uk/pgr/roads/managingspeedonourroads>. Accessed 25.09.09).

DfT (2005). *Road casualties Great Britain: 2004*. Annual report. London: Department for Transport

DH (2004). *At Least Five a Week. Evidence on the Impact of Physical Activity and its Relationship to Health. A Report from the Chief Medical Officer*. London, Department of Health, Crown Publications.

DH (2006). *Cardiovascular Disease and Air Pollution. A Report By The Committee on the Medical Effects of Air Pollutants*. London, Department of Health, Crown Publications.

DH (2007). Tackling Obesity, Future Choices. Department of Health. (<http://www.foresight.gov.uk/Obesity/17.pdf>, accessed 14 May 2009).

DH/HPA (2008). *Health Effects of Climate Change in the United Kingdom 2008: An Update of the Department of Health Report 2001/2002*. London, Department of Health/Health Protection Agency.

Douglas, M., Thomson, H., Jepson, R., Higgins, M., Muirie, J., Gorman, D. (eds) (2007). *Health Impact Assessment of Transport Initiatives: A Guide*. Edinburgh, NHS Health Scotland.

Duncan, M., Mummery, W.K. (2005). Psychosocial and environmental factors associated with physical activity among city dwellers in regional Queensland. *Preventive Medicine*, 40:363-72.

Duncan, M.J., Spence, J.C., Mummery, W.K. (2005). Perceived environment and physical activity: a meta-analysis of selected environmental characteristics. *International Journal of Behavioral Nutrition and Physical Activity*, 2:11.

EC (2008). Communication from The Commission to the European Parliament and The Council, Rail Noise Abatement Measures Addressing the Existing Fleet COM(2008) 432 final.

EC (2008). *Progress towards achieving the Kyoto objectives*, Communication from the Commission, Brussels, 19.11.2008, Com (2008) 651 Final/2, Commission of the European Communities

Echenique, M., Barton, H. et al (2009) The sustainability of land use and transport in outer city neighbourhoods (SOLUTIONS) – final conclusions (personal knowledge) EPSRC project, Cambridge University, University of the West of England, Leeds University, UCL.

EEA (2009a). About the urban environment, European Environment Agency web site (available on –line at <http://www.eea.europa.eu/themes/urban/about-the-urban-environment>, accessed 7 June 2009)

EEA (2009b). *Ensuring quality of life in Europe's cities and towns*, EEA Report No 5/2009 Luxembourg: Office for Official Publications of the European Communities

EEA (2009c). *Transport at a Crossroads. TERM 2008: Indicators Tracking Transport and Environment in the European Union*. EEA Report No 3/2009. European Environment Agency.

Ellaway A, Macintyre S, Bonnefoy X (2005). Graffiti, greenery, and obesity in adults: secondary analysis of European cross-sectional survey. *British Medical Journal*, 331:611-2.

ERSO (2008). *Annual Statistical Report 2008*, SafetyNet: Building the European Road Safety Observatory Workpackage 1 – Task 3 Deliverable No: D 1.20, (available online at http://ec.europa.eu/transport/wcm/road_safety/erso/data/Content/statistical_report-2.htm, accessed 8 June 2009)

Europa (2008). Air Quality Standards (<http://ec.europa.eu/environment/air/quality/standards.htm>, accessed 1 June 2009).

European Commission (2007). (http://ec.europa.eu/transport/roadsafety/road_safety_day/index_en.htm).

- European Secure Vehicle Alliance. (<http://www.motorprojects.org.uk/esva.htm>, accessed 29 May 2009).
- Eurostat. Eurosts Survey. Health Statistics: Key Data on Health 2002. (http://epp.eurostat.ec.europa.eu/portal/page?_pageid=1073,46587259&_dad=portal&_schema=PORTAL&p_product_code=KS-08-02-002, accessed 25 March 2009).
- Falk, N. and Hall, P. (2009). Why not here. *Town and Country Planning* 78.1.
- Forastiere, F., Stafoggia, M., Tasco, C., Picciotto, S., Agabiti, N., Cesaroni, G., Perucci, C-A. (2007). Socioeconomic status, particulate air pollution, and daily mortality: Differential exposure or differential susceptibility. *American Journal of Industrial Medicine*, 50, 208-216
- Foster, S., Giles-Corti, B. (2008). The built environment, neighbourhood, crime and constrained physical activity: An exploration of inconsistent findings. *Preventative Medicine*, 47:241-51.
- Frank, L., Kavage, S., Litman, T. (2006). *Promoting Public Health through Smart Growth – Building Healthier Communities Through Transportation and Land Use Policies and Practices*. Vancouver, Smart Growth BC.
- Gartland, L. (2008) *Heat Islands: Understanding and Mitigating Heat in Urban Areas*. London, Earthscan.
- Giles-Corti, B. Donovan, R.J. (2003) The Relative Influence of Individual, Social and Physical Environment Correlates of Walking. *American Journal of Public Health*, 93:1583–1589.
- Greed, C. (2006). CA Swaffield paper: The role of the public toilet: pathogen transmitter or health facilitator? *Building Services Engineering Research and Technology*. 27, 2, 1-13
- Green, G., Tsourous, A. (Eds.) (2008) *City leadership for health. Summary evaluation of Phase IV of the WHO European Healthy Cities Network*, Copenhagen: WHO Regional Office for Europe (available online at http://www.euro.who.int/InformationSources/Publications/Catalogue/20081105_1)
- Green space Scotland (2008). *Health Impact Assessment of Green space: A guide*. Health Scotland, Green space Scotland, Scottish Natural Heritage and Institute of Occupational Medicine.
- Guite, H.F., Clark, C., Ackrill, G. (2006). The impact of the physical and urban environment on mental well-being. *Public Health*, 120:1117-26.
- Haines A, Kovats RS, Campbell-Lendrum D, Corvalan C (2006). Climate change and human health; impacts, vulnerability, and mitigation. *Lancet*, 367:2101-9.
- Halpern D (1995). *Mental health and the built environment*, London; Taylor and Francis
- Hancock T (1993). Health, human development and the community ecosystem: three ecological models. *Health Promotion International*, 8(1):41-7.
- Harlan SL, Brazela AJ, Prashada L, Stefanov W, Larsenc L (2006). Neighborhood microclimates and vulnerability to heat stress. *Social Science & Medicine*, 63(11):2847-63.
- Hart J (2007). MSc in Bristol; University of the West of England
- Haskell WL, Min-Lee I, Pate RR, Powell KE, Blair SN, Franklin BA, Macera CA, Heath GW, Thompson PD. (2007) Physical activity and public health: Updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Circulation*, 116:1081-93.
- HCN (2004). *Nature and Health: The influence of nature on social, psychological and physical well-being*. Publication No. 2004/09E; RMNO publication nr A02ae, The Hague: Health Council of the Netherlands.
- Health and Safety Executive. (<http://www.hse.gov.uk/slips/causes.htm>, accessed 19 May 2009).
- Health Council of the Netherlands (2004). *Nature and Health*. Netherlands.

- Horowitz K, McKay M (2005) Community violence and urban families: Experienced, effect and directions for intervention. *American Journal of Orthopsychiatry*, 75:356-68.
<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0432:FIN:EN:PDF>
http://www.who.int/water_sanitation_health/en/factsfigures04.pdf
- IEGMP (2000). Mobile Phones and Health, Independent Expert Group On Mobile Phones chaired by Sir William Stewart, Didcot, Oxon: National Radiological Protection Board (available online at <http://www.iegmp.org.uk/report/text.htm>)
- Institut De Veille Sanitaire (2008). Drowning-related deaths in an enlarged European Union. (www.invs.sante.fr/publications/2008/anamort/drowning_related_plaq_anamort_m7_eng.pdf)
- IPCC (2007). *Intergovernmental Panel on Climate Change, Fourth Assessment Report. Climate Change 2007: Synthesis Report. Summary for Policy-makers*. Geneva, Intergovernmental Panel on Climate Change.
- ISOCARP (2008): Urban planning and human health in the European city. Report to the World Health Organization. Background document for the WHO expert meeting on Policy advice on urban planning, environment and health (Bonn, Germany, 24-25 November 2008). Unpublished.
- Jensen SU, Rosenkilde C, Jensen N (2007). *Road safety and perceived risk of cycle facilities in Copenhagen*, Lyngby: Trafitec.
- Jones A, Bentham G, Foster C, Hillsdon M, Panter J (2007). *Tackling Obesities: Future Choices – Obesogenic Environments – Evidence Review*. London, Department of Innovation Universities and Skills, Crown Copyright URN07/735.
- Kavanagh P, Doyle C, Metcalfe O (2005) *Health Impacts of Transport: A Review*. The Institute of Public Health in Ireland.
- Kickbusch I. (2003) The contribution of the World Health Organization to a new public health and health promotion. *American Journal of Public Health*, 93:383-8.
- KK (2002). *Cycle Policy 2002 – 2012, City of Copenhagen*, Copenhagen: Kobenhavn Kommune
- KK (2007). *Bicycle account 2006*, Copenhagen: Kobenhavn Komune.
- KK (2009a). Kobenhavns Kommune web site (<http://www.kk.dk/traengsel.aspx>, accessed 28 May 2009).
- KK (2009b) Kobenhavns Kommune web site (<http://www.kk.dk/sitecore/content/Subsites/CityOfCopenhagen/SubsiteFrontpage/DesignedForLife/GreenUrbanMobility/CityOfCyclists/Copenhagen-CityOfCyclists.aspx>, accessed 9 June 2009).
- Krygsman S, Dijst M, Arentze, T (2004). Multimodal public transport: an analysis of travel time elements and the interconnectivity ratio, *Transport Policy*, 11, 3, 265-275.
- Kuo FE. (2001) Coping with poverty: Impacts of environment and attention in the inner city. *Environment and Behaviour*, 33:5-34.
- Lavin T, Higgins C, Metcalfe O, Jordan A (2006). *Health Effects of the Built Environment: A Review*. Dublin, Belfast, The Institute of Public Health in Ireland.
- Lawrence RJ (2004). Housing and health: From interdisciplinary principles to transdisciplinary, *Futures*, 36, 4, 487-502.
- Lawrence RJ (2008). Urban environmental health indicators: Appraisal and policy Directives, *Reviews on environmental health*, 23, 4, 299-323
- Lee C and Moudon A (2008). Neighbourhood design and physical activity *Building Research and Information* 36 (5), pp395-411.
- Longhurst, JWS, Beattie CI, Chatterton T, Hayes ET, Leksmono NS, Woodfield, NK (2006). Local air quality management as a risk management process: assessing, managing and

remediating the risk of exceeding an air quality objective in Great Britain. *Environment International* 32(8) 934-947.

LUC (2004) *Making the Links: Green space and Quality of Life*. London, Land Use Consultants.

Marmot M (2004). *The Status Syndrome: How Social Standing Affects Our Health and Longevity*. London, Bloomsbury Publishing.

Matson L, Taylor I, Sloman L, Elliott J. (2006) *Beyond Transport Infrastructure – Lessons for the Future from Recent Road Projects*. London, Campaign to Protect Rural England.

Mayor of London (2007) *Health Issues in Planning: Best Practice Guidance*. London, Greater London Authority.

Mayou R, Bryant B, Duthie R. (1993) Psychiatric consequences of road traffic accidents. *British Medical Journal*, 307:647-51.

McMichael AJ, Friel S, Nyong A, Corvalan C (2008). Global environmental change and health: impacts, inequalities, and the health sector. *British Medical Journal*, 336: 91-4.

McMichael, A. J, Woodruff, R. E, Hales, S. (2006) Climate change and human health: present and future risks, *Lancet* 367, 9513, 859-69.

Mitchell G, Dorling D (2003). An Environmental Justice Analysis of British Air Quality. *Environment and Planning A* 35,909-929.

Mitchel R, Popham F (2008). Effect of exposure to natural environment on health inequalities: an observational population study. *Lancet*, 372:1655-60.

Moorhouse A (2009). Environmental Noise and Health in the United Kingdom. A report published by the Health Protection Agency on behalf of an ad hoc Expert Group on the Effects of Environmental Noise on Health – DRAFT, July 2009. (available online at http://www.hpa.org.uk/web/HPAwebFile/HPAweb_C/1246433634856 accessed 30 September 2009)

MRC (2008). Developing and Evaluating Complex Interventions: New Guidance. Medical Research Council. (Available online at www.mrc.ac.uk).

NEF (2007). Taking the Temperature: Towards an NHS Response to Global Warming. The New Economics Foundation. London, The NHS Confederation. (<http://www.neweconomics.org/gen/uploads/raqgyx45jjgxnf5gs3tu15522062007190400.pdf>, accessed 5 June 2009).

Naess O, Piro FN, Nafstad P, Smith GD, Leyland AH (2007). Air pollution, social deprivation, and mortality: a multilevel cohort study. *Epidemiology*. Nov 18, 6, 686-94.

NETCEN (2006). Air Quality and Social Deprivation in the United Kingdom: an environmental inequalities analysis. United Kingdom: AEAT (available online at http://www.airquality.co.uk/reports/cat09/0701110944_AQinequalitiesFNL_AEAT_0506.pdf accessed 20 September 2009).

Newton J (2007). Well-being and the natural environment: A brief overview of the evidence. Online: Sustainable Development Commission. (http://www.defra.gov.uk/sustainable/government/documents/Well-being_and_the_Natural_Environment_Report.doc, accessed 26 May 2009).

NICE (2008) *Promoting and Creating Built or Natural Environments that Encourage and Support Physical Activity*. NICE Public Health Guidance 8. London, National Institute of Clinical Excellence.

O'Sullivan, S, Morrall, J (1996). Walking Distances to and from Light-Rail Transit Stations *Journal of the Transportation Research Board*, 1538, 19-26

Orsega-Smith E, Mowen A, Payne L, Godbey G. (2006) The interaction of stress and park use on psycho-physiological health in older adults. *Journal of Leisure Research*, 36:232-56.

- Peden M, Oyegbite K, Ozanne-Smith J, Hyder AA, Branche C, Rahman AKMF, Rivara F, Bartolomeos K. (2008) *World Report on Child Injury Prevention*. World Health Organization, UNICEF.
- PHF (2007) *The Peckham Experiment*, Pioneer Health Foundation web site (available at <http://www.thephf.org/index.html>, accessed on 8 June 2009)
- Pikora, TJ, Giles-Corti, B, Knuiman, M.W et al. (2006). Neighborhood, Environmental Factors Correlated with Walking near Home: Using SPACES. *Medicine and Science in Sports and Exercise*, 38:708–714.
- Pretty J, Griffin M, Peacock J, Hine R, Sellens M, South N (2005). *Countryside for Health and Well-being: the Physical and Mental Health Benefits of Green Exercise*. England, Countryside Recreation Network.
- Racioppi F, Eriksson L, Tingvall C, Villaveces A (2004). *Preventing Road Traffic Injury. A Public Health Perspective for Europe*. World Health Organization Regional Office for Europe.
- Rao M, Prasad S, Adshead F, Tissera H (2007). The Built Environment and Health. *The Lancet*, 13.09. (<http://www.thelancet.com/journals/lancet/article/PIIS0140673607612604/fulltext>).
- RCEP (2002). *Environmental Planning, Royal Commission on Environmental Pollution*. London, The Stationery Office.
- RCEP (2007). *The Urban Environment, Royal Commission on Environmental Pollution*. London, The Stationery Office.
- Robinson V (2004). Fast food and obesity- is there a connection? *Health and Health care in Schools*, 4:12.
- Saffron L, Giusti L, Pheby D (2003). *The Human Health Impact of Waste Management Practices. A Review of the Literature and an Evaluation of the Evidence*. Management of Environmental Quality.
- Schwanen T, Dijst M, Dieleman FM (2004). Policies for urban form and their impact on travel: the Netherlands experience. *Urban Studies*, 41(3):579-603.
- Scottish Natural Heritage Commissioned Report No. 060 (ROAME No. F03AB01)
- SDC (2008). *Health, Place and Nature. How Outdoor Environments Influence Health and Well-being: A Knowledge Base*. Online: Sustainable Development Commission.
- Sethi D, Towner E, Vincenten J, Segui-Gomex, Racioppi F (2008). *European Report on Child Injury Prevention*. Copenhagen, World Health Organization Regional Office for Europe.
- SEU (2004). *Mental Health and Social Exclusion*, London: Office of the Deputy Prime Minister
- Shephard RL, (2008). Is active commuting the answer to population health? *Sport Medicine*, 38:751-158.
- Silcock R (1999). Bypass Demonstration Project. Further Research and Analysis in Relation to Attitudes to Walking. Social Research Associates, London: Department of Transport and the Regions.
- Smyth F (2005). Medical geography: therapeutic places, spaces and networks. *Progress in Human Geography*, 29:488-95.
- South West Public Health Observatory (2002). *Waste Management and Public Health: the State of the Evidence. A Review of the Epidemiological Research into the Impact of Waste Management Activities in Health*. England, South West Public Health Observatory.
- SPG (2008). *Sweden's vision of safety*, Web article: SPG Media (available at <http://www.roadtraffic-technology.com/features/feature1952/> accessed on 23 May 2009)
- Spinks A, Turner C, Nixon J, McClure RJ. (2005). *The 'WHO Safe Communities' Model for the Prevention of Injury in Whole Populations (review)*. The Cochrane Collaboration Database of Systematic Reviews, 2.

Sport England (2003). *The Use of Public Parks in England*. England, Sport England and the Countryside Agency.

SRSA (2008). *Fifth annual report from the Swedish Radiation Protection Authority's (SSI) Independent Expert Group (IEG) on Electromagnetic Fields*, Stockholm: Swedish Radiation Safety Authority (available online at http://www.ssi.se/ssi_rapporter/pdf/ssi_rapp_2008_12.pdf accessed on 23 May 2009)

Stafford M, Chandola T, Marmot M (2007). Association between fear of crime and mental health and physical functioning. *American Journal of Public Health*, 97:2076-81.

Takano T, Nakamura K, Watanabe M (2002). Urban residential environments and senior citizens' longevity in megacities areas: The importance of walkable green spaces. *Journal of Epidemiology and Community Health*, 56(12):913-8.

TfL (2008). *Congestion Charge – Sixth Annual Monitoring Report – July 2008*. (available online at <http://www.tfl.gov.uk/assets/downloads/sixth-annual-impacts-monitoring-report-2008-07.pdf> accessed on 22 September 2009)

TfL (2009). Transport for London web site, www.tfl.gov.uk accessed 1 June 2009

The Green Gym: An Evaluation of a Pilot Project in Sonning Common, Oxfordshire Veronica Reynolds. 1 902606 05 1. 1999. (http://www2.btcv.org.uk/gg_summary.pdf, accessed 20 March 2009).

TRB (2005). *Transportation Research Board Institute of Medicine of the National Academies. Does the Built Environment Influence Physical Activity? Examining the Evidence – Special Report 282*. Washington DC, Transport Research Boards.

Verbruggen A. (Ed.) 2007. Glossary, *In IPCC Fourth Assessment Report*, Bert Metz B, Davidson O. Bosch P, Dave R, Meyer L (Eds.), Cambridge. Cambridge University Press

Vojnovic I (2006). Building communities to promote activity: A multiscale geographic analysis. *Geografiska Analer Series B. Human Geography*, 88B (1):67-90.

Walker G, Fairburn J, Smith G, Gordon, M (2003). *Environmental Quality and Social Deprivation*, R&D Technical Report E2-067/1/TR, Bristol: Environment Agency.

Wendel-Vos W, Droomers M, Kremers S, Brug J, van Lenthe F. (2007) Potential environmental determinants of physical activity in adults: a systematic review. *Obesity Reviews*, 8(5):425-40.

WHA (2008). World Health Assembly Resolution on Climate Change and Health WHA61.19, WHO International. (http://apps.who.int/gb/ebwha/pdf_files/A61/A61_R19-en.pdf, accessed 5 June 2009).

Whitehead M, Dahlgren G (1991). What can be done about inequalities in health. *The Lancet*, 338:1059-63.

Whitley R, Prince M (2005) Fear of crime and mental health in inner-city London, United Kingdom. *Social Science Med*, 61:1678-88.

WHO (1991), *Sundsvall statement on supportive environments for health*, 9-15 June 1991, Sundsvall, Sweden, Geneva. World Health Organization

WHO (2002a). *The World Health Report 2002 – Reducing Risks, Promoting Healthy Life*. Geneva, World Health Organization.

WHO (2002b)., *Flooding: Health effects and preventive measures*, Fact sheet 05/02, Copenhagen and Rome, 13 September 2002, (available on line from <http://www.euro.who.int/document/mediacentre/fs0502e.pdf> accessed 7 June 2009)

WHO (2003a). *Shaping the Future*. Geneva, World Health Organization.

WHO (2003b). *Extreme weather events: health effects and public health measures*, Fact Sheet WHO Regional Office for Europe/04/03, Copenhagen, Rome 29 September 2003, (available on line from <http://www.euro.who.int/document/mediacentre/fs0403e.pdf> accessed 7 June 2009)

- WHO (2004a). *Global Strategy on Diet, Physical Activity and Health*. (<http://www.who.int/dietphysicalactivity/pa/en/index.html>, accessed 17 March 2009).
- WHO (2004b). *What are the Main Risk Factors for Falls Amongst Older People and What are the Most Effective Interventions to Prevent These Falls* (available at www.hse.gov.uk/slips/causes.htm, accessed 7 June 2009).
- WHO (2005). Krzyzanowski M, Kuna-Dibbert B, Schneider J. (eds) *Health Effects of Transport-Related Air Pollution*. Copenhagen, WHO European Office.
- WHO (2006). *Electromagnetic fields and public health*, WHO Media Centre (Fact sheet N°304 available at <http://www.who.int/mediacentre/factsheets/fs304/en/index.html>, accessed 9 June 2009)
- WHO (2007). Fact Sheet 317. Cardiovascular diseases. (<http://www.who.int/mediacentre/factsheets/fs317/en/index.html>).
- WHO (2007). *Quantifying Burden of Disease from Environmental Noise: Second Technical Meeting Report*. Bern, Switzerland.
- WHO (2008a). International Public Health Symposium on Environment and Health Research, Science for Policy, Policy for Science: Bridging the Gap, Madrid, Spain, 20-22 October 2008. WHO Regional Office for Europe.
- WHO (2008b). *Our Cities, Our Health, Our Future. Acting on Social Determinants for Health Equity in Urban Areas*. (http://www.who.or.jp/knusp/KNUS_final_report.pdf, accessed 17 March 2009).
- WHO (2008c). *Global Burden of Disease: 2004 Update*. (http://www.who.int/healthinfo/global_burden_disease/en/index.html).
- WHO (2009). *Zagreb Declaration for Healthy Cities: Health and Health Equity in All Local Policies*. Copenhagen, WHO Regional Office for Europe. (<http://www.euro.who.int/Document/E92343.pdf>, accessed 29 May 2009).
- Wilcox P, Quisberry N, Jones S. (2003) The built environment and community crime risk interpretation. *Journal of Research in Crime and Delinquency*, 40:322-45.
- Williams and Fisher (2007) *Draft guidance on health in strategic environmental assessment: Consultation document*, London: Department of Health
- Wilson E. (1984) *Biophilia: The Human Bond with Other Species*. Cambridge, Harvard University Press.

Appendix 1: The EU regulatory context on urban planning

Urban planning and environmental health in the context of European Union (EU) policies

1. Leipzig Charter 2007

The ambitious intent of the Charter is to “*overcome demographic and environmental problems, social inequality, social exclusion and the lack of low priced housing space in European cities by encouraging their strengths like the unique cultural and architectural qualities, strong forces of social inclusion and exceptional possibilities for economic development...*”²

EU cities should adopt the partnership model in their work with government at all levels and with civic and NGO bodies – especially in the preparation of integrated urban development programs, in SWOT analysis, and in defining concrete development objectives. Competition between cities should be reduced and replaced by a European city network within a set of strategic objectives covering

- The creation of high-quality urban public spaces and the protection of heritage (the *Baukultur* concept);
- The modernization of infrastructure and the more efficient use of energy through better traffic management including linkages between all modes; improved design of buildings and facilities based on low energy consumption and low emissions; the development of new low-carbon industries and businesses; stronger controls over land supply and speculative development through spatial and urban planning to inhibit sprawl and encourage the creation of compact energy-efficient settlements; and utilizing the newest communication and information technologies to improve education, employment, social service, health, safety and security and urban governance (all of which in turn go to improving quality of life and the attractiveness of the city as a location for business; and
- Enabling and assisting the development of proactive innovation and educational policies in order to capitalise on the great knowledge potential that the cities contain.

The Leipzig Charter has a second strand concerned with the support needs of deprived urban neighbourhoods and the problems of high unemployment rates and social exclusion. Policies for social integration and social housing should be used to create healthy, suitable and affordable housing. Participation of residents, and dialogue between political representatives, residents and the economic sector, are all seen as important ingredients in the process.

Under this second strand, the Leipzig Charter subsumes another set of strategies to overcome the obstacles blocking the achievement of sustainable urban development. These include the need to up-grade the physical environment (of urban areas) –

² European Commission, The Leipzig Charter, 2007

requiring quality urban structures and modern and efficient infrastructure necessary to initiate economic activity and investment.

In short, the Charter emphasizes that the utilization of European structural funds for substantial integrated urban development programmes should focus on specific difficulties and potentials in the Member States, thereby reinforcing (through training, research and knowledge sharing) the urban dimension of European policies such as the Lisbon Strategy 2000, where the origins of contemporary EU policies can be found.

Lisbon's strategic aim was to develop the EU *“to become the most competitive and dynamic knowledge-based economy in the world capable of sustainable economic growth with more and better jobs and greater social cohesion”*³. Europe was to be prepared for the challenges of globalization by investing in research, information technology, education and human resources to create a highly flexible economy decoupled from the use of natural resources. The program was initially structured around two ‘pillars’ – economic and social – with a third (environmental) being added in Gothenburg in 2001.

In Gothenburg the ‘environmental pillar’ of the Lisbon Strategy was explored amidst concerns about sustainable development and the environmental dimensions of employment, economic reform and social cohesion⁴. The Council proposed that future agricultural policy should include among its objectives the achievement of sustainable development by way of greater encouragement for healthy, high-quality products, and environmentally sustainable production methods.

In parallel, a sustainable transport policy would rising traffic and congestion levels, noise and pollution whilst encouraging the use of environment-friendly modes of transport and the full internalization of social and environmental costs. Greater use of rail, water and public passenger transport was to be pursued. Land use management policy would emphasize the need to promote more balanced regional development as recommended by the European Spatial Development Perspective.

Implementation of the Leipzig Charter

During the 2008 French Presidency, urban development ministers discussed the topic of the “sustainable and cohesive city” in Marseille (November 2008) and decided that implementation of the Leipzig Charter favoured integrated sustainable urban development⁵. This would be achieved by the adoption of a multisectoral approach; by linking governance, environment, economy and social inclusion; and by combining global and local approaches, blending the very short term with the long term.

Accordingly, the ministers confirmed their commitments to the adoption of the Leipzig Charter, with particular emphasis on supporting deprived city neighbourhoods where the very future of such cities is at stake. They recommended a regular follow-up of

³ European Commission, The Lisbon Strategy, 2000

⁴ European Commission, The Gothenburg Strategy, 2001

⁵ European Commission, Final Statement by the ministers in charge of urban environment, French Presidency, 2008

the implementation of the Charter through meetings of ministers holding urban planning and development portfolios. Furthermore, they proposed to push for an improvement of knowledge about the city, to consider the key roles of architecture and urban design in the achievement of integrated and sustainable urban development, and to implement integrated urban development policies.

Ministers favoured greater consistency between urban functions and the concurrent implementation of policies of local economic development, education of young people, urban planning development, and access to high quality transport (including public transport) for the benefit of residents of deprived neighbourhoods. They also decided to build a reference framework for the sustainable city, based on a Final Appendix to the final statement.

2. EU Sustainable development strategy: progress report

The European Council (June 2006) adopted an ambitious and comprehensive renewed SDS for an enlarged EU. It builds on the Gothenburg strategy of 2001 and is the result of an extensive review process that started in 2004.

The renewed EU SDS offers a single, coherent strategy on how the EU will more effectively live up to its long-standing commitment to meet the challenges of sustainable development. It recognizes the need to gradually change current unsustainable consumption and production patterns and move towards an effectively integrated approach to policy-making. It reaffirms the need for global solidarity and recognizes the importance of stronger work with partners outside the EU, including those rapidly developing countries, which will have a significant impact on global sustainable development.

Outline

The overall aim of the EU Sustainable Development Strategy is to identify and develop actions to enable the EU to achieve a continuous long-term improvement of quality of life through the creation of sustainable communities able to manage and use resources efficiently, able to tap the ecological and social innovation potential of the economy and in the end able to ensure prosperity, environmental protection and social cohesion⁶.

The strategy sets overall objectives and concrete actions for the following seven key priority challenges for the coming period until 2010, many of which are predominantly environmental.

- Climate change and clean energy
- Sustainable transport
- Sustainable consumption & production
- Conservation and management of natural resources
- Public Health
- Social inclusion, demography and migration
- Global poverty and sustainable development challenges.

⁶ Council of the European Union, EU Sustainable Development Strategy, 2006

To improve synergies and reduce trade-offs, a more integrated approach to policy-making is proposed, based on better regulation (impact assessments) and on the guiding principles for sustainable development (adopted by the European Council of June 2005). The external dimension of sustainable development (e.g. global resource use, international development concerns) is factored into EU internal policy-making and through integration of SD considerations in EU's external policies.

The EU SDS seeks to be a strategy for the whole EU. It therefore proposes mechanisms for improving coordination with other levels of governments and calls upon business, NGOs and citizens to become more involved in working for sustainable development. An example of this is the launch of a process for voluntary peer reviews of national sustainable development strategies, aimed at improving the sharing of good practices.

Education, research and public finance are stressed as important instruments in facilitating the transition to a more sustainable production and consumption patterns. And because monitoring and follow-up are crucial for effective implementation, the renewed strategy contains a strong governance cycle. Every two years (started in 2007) the Commission is to produce a progress report on the implementation of the strategy. This report is to form the basis for discussion at the European Council, which will give guidance to the next steps in implementation.

3. EU Strategy Papers

The Sixth Environment Action Programme of the European Community entitled "*Environment 2010: Our Future, Our Choice*" covers the period from 22 July 2002 to 21 July 2012, in which the European Union defines the priorities and objectives of European environment policy up to 2010 and beyond, and describes the measures to be taken to help implement its sustainable development strategy.

The action programme developed seven thematic strategies covering **air pollution**, the **marine environment**, **sustainable use of resources**, **prevention and recycling of waste**, **sustainable use of pesticides**, **soil protection** and **urban environment**. In 2006 the European Union adopted the Sustainable Development Strategy, with a progress report in 2007. Some components of urban planning and environmental health are described in the thematic strategies on air pollution and urban environment, but are not discussed explicitly.

3.1 Thematic Strategy on the Urban Environment

The Thematic Strategy on the Urban Environment, adopted in January 2006, is an important future policy element of the European Commission. It describes the problems facing many urban areas within the European Union and recognizes their widely divergent circumstances. It does not propose uniform binding measures – instead pointing to other ways in which cities' problems can be tackled. A Guidance related to the Thematic Strategy on the Urban Environment (EU, 2007⁷) aimed to assist municipal authorities in establishing systems for integrated environmental management and to improve environmental performance generally.

⁷ European Commission, Thematic Strategy on the Urban Environment, 2007

The Thematic Strategy recognizes that most cities face environmental problems such as poor air quality, high traffic and congestion levels, high levels of ambient noise, a poor-quality built environment, derelict land, greenhouse gas emissions, urban sprawl, excessive waste, and a lack of strong land-use planning instruments. Problems and their causes are interconnected; and only integrated inter-governmental policies and long-term strategic action plans will bring success. The Strategy proposes the following measures:

- An ***integrated approach to the management of the urban environment***, to achieve a long-term vision for the city development: “clear defined objectives, targets, accepted responsibilities, procedures for monitoring progress, public consultation, review, audit and reporting”;
- ***Sustainable urban transport plans***: “Transport planning should take account of safety and security, access to goods and services, air pollution, noise, greenhouse gas emissions and energy consumption, land use, passenger and freight transportation, and all modes of transport”;
- ***Exchange of experience and best practices***, through networking and demonstration;
- ***Internet Portal for Local Authorities***;
- ***“Face-to-face” training for authorities***, “in the adoption of an integrated approach to management involving cross-sector cooperation and training on specific environmental legislation, effective public participation and encouraging changes in citizens’ behaviour”;
- ***Drawing on other community support and urban research programmes***.

The Thematic Strategy also proposed synergies with other policies on climate change, nature and biodiversity, and sustainable use of natural resources. The policy on environment and quality of life is significant in the context of this report because of its emphasis on reducing air pollution and noise through sustainable urban transport and improvements to health and reducing obesity. The Strategy involves an Urban Audit (published in 2007 and accessible online: <http://www.urbanaudit.org>.)

3.2 Green Paper – Towards a new culture for urban mobility

In this Paper, urban mobility is recognized as an important facilitator of growth and employment with a strong impact on sustainable development in the EU⁸. The Commission’s Green Paper on urban mobility explores if and how the EC can add value to actions already taken at local level. Several EU policies have already addressed urban transport issues in past years; and some legislative initiatives (if somewhat fragmented) have been developed.

Topics covered include ‘free-flowing’ towns and cities; greener towns and cities; smarter urban transport, accessible urban transport, and safe and secure urban transport. The Paper discusses the creation of a new urban mobility culture, where knowledge and data collection will play an important role. The conclusion covers financial resources.

⁸ European Commission, Green Paper - Towards a new culture of urban mobility, 2007

3.3 Thematic strategy on air pollution

Air quality

In order to attain “levels of air quality that do not give rise to significant negative impacts on, and risks to human health and environment”, this Thematic Strategy supplements the current legislation. It establishes objectives for air pollution and proposes measures for achieving them by 2020. Existing legislation is improved, placing emphasis on the most harmful pollutants, and involving to a greater extent the sectors and policies which relate to air pollution⁹.

Health and environmental objectives and emission reduction targets are set for the main pollutants. These objectives will be delivered in stages, the aim being to protect EU citizens from exposure to particulate matter and ozone in air, and protect European ecosystems more effectively from acid rain, excess nutrient nitrogen, and ozone. A significant reduction in particulate matter and tropospheric ozone will bring public health benefits and will also generate benefits for ecosystems.

Compared to the 2000 picture, the Strategy sets specific long-term objectives (for 2020):

- 47% reduction in loss of life expectancy resulting from exposure to particulate matter;
- 10% reduction in acute mortalities from exposure to ozone;
- Reduction in excess acid deposition of 74% and 39% in forest areas and surface freshwater areas respectively;
- 43% reduction in areas or ecosystems exposed to eutrophication.

To achieve these objectives, emissions of SO₂, NO_x, volatile organic compounds, ammonia and primary PM_{2.5} (particles emitted directly into the air) will be significantly reduced. Implementing the Strategy will incur additional costs but these will be greatly exceeded by savings in health care and prevention, and in a substantial reduction in premature deaths. Environmentally, there should be favourable impacts as a result of reducing acid rain and nutrient nitrogen inputs resulting (among other things) in improved biodiversity protection.

The Strategy provides for revision of legislation on national emission ceilings. Subject to strict conditions, certain deadlines for the implementation of legislation, modernizing data communication, and improving coherence with other environmental policies are extended.

More efficient energy use can help to reduce harmful emissions; hence new targets for the production of energy and electricity from renewable energy sources (including biofuels) are major factors in this connection. The Strategy covers the energy performance of small combustion plants and small heating installations, and also provides for examining how to reduce VOC emissions at filling stations.

⁹ European Commission, Thematic Strategy on Air Pollution, 2005

Transport emissions

The Strategy proposes further reduction of emissions from new passenger cars, vans, and heavy-duty vehicles. Improved vehicle approval procedures, differentiated charging, and special provisions for older vehicles are envisaged.

The Commission plans to examine the impact of aviation on climate change in a forthcoming communication. Where shipping is concerned, the Strategy provides for the continuation of negotiations with the International Maritime Organization, the promotion of shore-side electricity for ships in port, and the consideration of pollution issues in relation to funding through programmes such as Marco Polo.

In agriculture, the strategy promotes reductions in the use of nitrogen in animal feeds and fertilisers together with possible provisions for reducing ammonia emissions from agricultural sources and from farm modernization in particular.

[Note: The Strategy was based on research carried out under the Clean Air For Europe (CAFE) programme and the following research programmes, and was adopted following a lengthy consultation process involving the European Parliament, Nongovernmental Organizations and industry and private individuals].

4. EU Directives relevant to urban environmental management and health

4.1 EU Directive Noise:

Further to the Commission proposal for a Directive relating to the assessment and management of environmental noise (COM.2000.468) the European Parliament and Council have adopted Directive 2002/49/EC of 25 June 2002 whose main aim is to provide a common basis for tackling the noise problem across the EU. The underlying principles of this text are similar to those for other overarching environmental policy Directives:

- * Monitoring the problems by requiring competent authorities in Member States to draw up *strategic noise maps* for major roads, railways, airports and agglomerations, using harmonised noise indicators – Lden – (day-evening-night equivalent level) and Lnight (night equivalent level). These maps will be used to assess the number of people annoyed and sleep-disturbed respectively throughout Europe.
- * Informing and consulting the public about noise exposure, its effects, and the measures considered to address noise in line with the principles of the Aarhus Convention.
- * Addressing local noise issues by requiring competent authorities to draw up action plans to reduce noise where necessary and maintain environmental noise quality where it is good. The Directive does not set any limit value, nor does it prescribe the measures to be used in the action plans. These remain at the discretion of the competent authorities.

- * Developing a strategy to reduce the number of people affected by noise in the longer term, and provide a framework for developing an European Community policy on noise reduction at source. In this context the Commission has made a declaration in relation to the preparation of legislation relating to sources of noise.

4.2 EU Directive - Ambient Air Quality and Cleaner Air:

The new Directive 2008/50/EC of the European Parliament and Council of 21

May 2008 (2008/50/EC) of the European Parliament and Council of 21 May 2008 on ambient air quality and cleaner air for Europe came into force on 11 June 2008. This new Directive includes the following key elements:

- The merging of most existing legislation into a single Directive (except for the 4th daughter Directive) with no change to existing air quality objectives;
- New air quality objectives for PM_{2.5} (fine particles) including limit value and exposure related objectives – exposure concentration obligation, and exposure reduction target;
- The possibility of discounting natural sources of pollution when assessing compliance against limit values;
- Allowing possible time extensions of 3 years (PM₁₀) or up to 5 years (NO₂, benzene) for complying with limit values, based on conditions and assessment by the EC.

The Commission adopted a proposal for a Directive on ambient air quality at the same time as it adopted the thematic strategy on air pollution.

The Member States have 2 years to transpose the new Directive, during which time the existing legislation will continue to apply. Some provisions of the new Directive such as PM_{2.5} monitoring requirements have to be implemented sooner. It is expected that the provisions enabling notifications of postponements or exemptions in respect of limit values for PM₁₀, NO₂ or benzene will be applied before the end of the 2-year transposition deadline.

4.3 Other Directives of relevance

Other relevant EU Directives or strategic documents of relevance to this study include

- EC Directive 91-271 EEC on urban waste water;
- EC Directive 2006-12-EC on waste water;
- Annex to sustainable urban transport plans;
- Sustainable urban transport plans;
- Thematic Strategy on Urban Environment;
- Guidance on Integrated Environmental Management;
- EC Directive 2002-49-EC on environmental noise;
- EC Directive 2008-50-EC on ambient air;
- EC Directive 2004-107-EC relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air;
- Commission Recommendation 2004-345-EC on enforcement in the field of road safety;
- EC Directive 2000-76-EC on the incineration of waste.

Appendix 2: Suggested action steps towards healthier urban environments

These suggestions are based on a working paper prepared by ISOCARP, the International Society of City and Regional Planners, in the context of the WHO expert meeting on urban planning and health (ISOCARP, 2008).

Action plan for cleaner urban environments

- * There is a need to plan comprehensively for healthier cities (which could simultaneously become more sustainable cities to counteract climate change). The procedures of Strategic Environmental Assessment (SEA) will assist in developing such plans. Improved planning for open space, biodiversity and sustainable urban transport will all bring opportunities for carbon minimization, physical exercise and healthier living.
- * At the individual project level, the environmental impact of proposed developments needs to be fully assessed and any approvals conditioned so that environmental standards and human health are fully safeguarded.
- * On air quality, there is a need for greater monitoring of conditions within Europe's urban areas with a view to preparing local action strategies including the designation of low emission zones in those locations where human health is particularly at risk.
- * There should be strong prohibitions against development being carried out in areas that are subject to flooding, or which are likely to become so under climate change.
- * At the project level, there should be an adoption of Sustainable Drainage Systems to minimise overall flooding.
- * Disused urban land should be assessed for possible contamination with a view to remedial action where necessary, and the systematic conversion of such land into productive use.
- * Existing landfill sites should be monitored to ensure that human health is properly safeguarded. New landfill sites (if needed) should be designed and managed to the highest standards possible.
- * Noise emissions and conflicts should be assessed as a regular element in citywide planning, and appropriate strategies devised to tackle noise at its source. Where necessary, individual projects should be the subject of noise impact assessments.

Action plan for healthier cities

- * Personal identity, ownership of space, and well-being are conditions which have a close relationship to variety in accommodation and the construction of dwellings. Regional variations in building style and form help to promote ownership and neighbourhood loyalty with a flow-on to improved health. New models of ownership might help to save our complex environment and our health.
- * As key criteria for healthy urban living conditions are progressively investigated and established, the built environment can be improved accordingly by ensuring that those criteria are fed into the urban planning process.
- * At the level of individual building projects, health in the European city can be improved and enhanced by choosing climate-friendly construction materials; reducing external and internal noise impacts; adopting safe and benign construction materials and techniques; encouraging natural light and natural ventilation in buildings; and advocating better communication between builders, users, planners, tenants, politicians and owners.
- * Education designed to improve public understanding of the relationship between climate, construction and community well-being will help people accept responsibility for ownership of their environment and their health.
- * Existing plans for dealing with climate change need to be reviewed as knowledge of this phenomenon improves. There is also a high probability that there are areas, which have been developed in recent decades, which have never been vulnerable to flooding or other natural disasters but which might now be regarded as endangered.

Annex 3: Case study summary report – Rennes, France



PAVEL PROJECT

Policy advice on urban planning, environment and health

Case study A: The City of Rennes

Service Communal Hygiène et Santé

Alain Jourden

1 – Introduction

Rennes, the capital of the Brittany Region in the west of France, is part of the Rennes Metropolis District created on 31st December 1999 after the transformation of a previous district founded in the 1970s.

There is a total of 403,943 inhabitants in the District divided between 37 towns. The city of Rennes has 209,922 inhabitants including 58,000 students.

Rennes is renowned for the quality of its environment and its economic dynamism. This situation is a central feature of the development of the urban area.

The interests of Rennes are in receiving new-comers whilst preserving this quality of life and in being responsive to new needs and ways of life.

Rennes and its District share several competencies that concern urban planning and protection of the environment and health.

The environment and health departments of the city of Rennes take part in some decisions of town planning when their opinion and expertise are requested by urban departments (building permits, polluted sites, environmental prescripts and in particular energetic in the files of creation of area earmarked ...)

Rennes has been part of the European and French networks of the WHO Cities Health for twenty years and developed a strong focus on town planning and health (see attached documents “Urban project and Health Policy in Rennes” and “Health Impact Assessment”)

2 – Urban planning challenges in relation to environment and health conditions

2.1 Noise

Due to the increased use of public transportation methods traffic has decreased inside the town of Rennes along with traffic speed. This has enabled the stabilization of transportation’s noise. A mapping of population exposure to rail and road networks noise pollution is already under way and will allow the drawing up of the state of situation in Rennes.

With regard to noise in the neighbourhood the town centre of Rennes, being very enlivened at night, is a place of noise nuisances linked to the gathering of young people and to the high concentration of bars.

2.2 Air quality

The quality of air in Rennes is perceived as good in spite of some peaks in nitrogen oxides, ozone and particles. The main source of pollution is motorized transportation

whilst industrial emissions are weak. However, the region also emits pollutants of agricultural origin (pesticides, ammoniac, methane).

The air quality monitoring network is composed of 6 monitoring stations. A map of emissions of air pollutants has been realized. Moreover, specific studies have been undertaken on Rennes urban area:

- ✓ Impact of a car factory's activity through the monitoring of Volatile Organic Compounds in air,
- ✓ Pesticides concentration measures in air, on Rennes lost-urban zone (since 2005, 86 molecules are being searched, 10 compounds are discerned every year:)
- ✓ Studies on air interior quality in some Rennes schools
- ✓ In accordance with Directive European n°2000/76/CE requiring the installation of measurement systems to monitor the parameters and relevant emission limits, transposed into French law in September, 2002, monitoring is enacted every year around the incineration plant.

2.3 Green areas and public spaces

In Rennes, which aspires to be a green city, the population is guaranteed access to near-green areas or 'green corners' by:

- ✓ 811 hectares of green areas among which 48% of parks, leisure centres, sports grounds, that is 15% of the city area.
- ✓ About twenty parks from 1 to 16 hectares.
- ✓ 8 sites of communal family gardens with 772 individual plots for families

In forty years, the scale of Rennes' green areas has increased ten-fold. The city of Rennes and its District also work on the sustainable maintenance of these areas.

For this, local departments compiled a guide book for the management of green areas. This management must be consistent with the conception and use of each area; therefore different types of area are maintained to a different degree, but with concern of a high quality everywhere. The use of pesticides is strongly restricted.

Also, the notebook of the general prescripts of the public space endeavours to conceive of and accomplish a homogeneous public space in all quarters of the city.

2.4 Traffic

Various actions were undertaken to reduce the use of the car in Rennes:

- ✓ Setting up of a subway line and increasing the frequency of public transport services
- ✓ intermediary car park

- ✓ financial support to a car-sharing organization
- ✓ reduction of the space allocated for cars
- ✓ pay parking in town centre
- ✓ limitation of parking numbers in trades and offices areas

Since employing these measures, we have observed the gradual stabilization of traffic along with an increase in usage of public transport and mobility. Rising oil prices is one of the reasons that may explain this quick increase of public transport-going.

2.5 Water

The issue of drinking-water supply requires continuous attention.

In an environment endowed with a modest hydrographic network and submitted to intensive agricultural pollutions; the city must face the population growth of Rennes and its suburbs and ensure water supply in sufficient quantity (to minimise the risk of drought) and quality (resources protection and quality restoration).

2.6 Water waste and pluvial water

Problems linked to the collection and treatment of urban waste water are kept under control due to a collection network covering the vast majority of houses in Rennes and also due to an efficiently running treatment plant.

On the contrary, there are emerging problems that are linked to toxic pollutants, the residues of medicaments and radiotherapy. The city also has to prevent floods risk that could be made worse with the increasing ratio of sealed ground and surface water flows.

2.7 Waste management

Waste quantities that need to be incinerated are decreasing as a result of improved outcomes of selective collects and waste reduction measures that have been implemented.

Work on incineration plants has complied with the European Directive 2000/76/CE concerning atmospheric emissions and environmental monitoring. The conditions and targets set out for combustion were accomplished in time before the target date of December 28th, 2005.

Collections of toxic medical household waste are made by the city's council.

3 – How urban planning and urban management can have an effect on environment and health conditions in the city?

For ten years the population growth of urban areas in Rennes has been one of the strongest in France. It is projected that by 2020, the town and its suburbs will have near 450,000 inhabitants and will consequently face several new challenges:

3.1 Accommodations

- Regarding accommodation, Rennes Metropolis pursues, across its local housing programme, a policy to welcome new inhabitants and promote solidarity. The city aims to allow access to accommodation for all households and favours social mixing. We aim to increase the availability of accommodation with a view to receiving new inhabitants and fulfilling the new comfort criteria (larger and flexible dwellings), while taking into account the reduction of the household size.
- We seek to restore and renovate existing accommodation in the historical centre of Rennes, some of which is of an inadequate standard; and in some cases detrimental to the health of its inhabitants.
- We seek to improve the social and the private accommodations of the years 1960-70.

3.2 Restriction of noise nuisances and local pollution which contributes to the displacement of inhabitants

Rapid population growth and resulting changes in living and environmental conditions have increased the need for mobility. This applies to mobility to reach the workplace, but is also relevant for recreational mobility (for hobbies and leisure time activities) and the specific mobility needs of elderly and handicapped people.

The interests of the municipality facing a rapid rise in displacements are as follows:

To make united and equitable development, by controlling public and private expenses of displacements, by providing the persons with reduced mobility the conditions for better mobility

- Promote environmentally sustainable mobility as a symbol of modern economic dynamism: easy access to jobs and to shop, access of goods...
- Preserve a quality environment. Transportation modes are generators of acoustical nuisances and atmospheric pollutants. As a result of the population growth, these types of pollution may increase. We need to stabilize the exposure of the inhabitants to noise and to atmospheric pollutants due to transport.

3.3 Urban staggering and preservation of the ecological corridors

We need to preserve the balance between the city and the country, natural areas and agricultural activities within its territory. So, the city of Rennes and the district are vigilant at the consumption of necessary agro-natural areas to develop and extend the city, in all urban planning documents by using the concept of an “ archipelago city “. Actions are carried out to bring the public services and amenities back into the city, to work on urban forms, address problems of the specialized zones of activity that are not well organized and use a lot of municipal ground.

4 – Political mechanisms and regulations used to face up these challenges

4.1 The Urban Planning

Rennes District uses three main tools in urban area development:

The district’s territorial coherence scheme (SCOT), worked out on the scale of the Rennes country (64 towns), defines the key orientations of town and country planning. It outlines Rennes’ plans to preserve agricultural and natural areas; to follow urban development economizing space, and to favour and establish a new organizational strategy for displacement.

The Local Urban Plan (PLU), implemented on the communal scale, must allow the town to construct more while preserving urban areas. The towns can thus invent new forms of housing, which fit to the evolving way of life, combining economy of space, prices control, and sustainable development.

Finally Rennes Métropole defines the overall strategy of displacement on its territory through its **Plan of Urban Displacements (PDU)** and, in this frame, notably organizes the public transport policy for its 37 towns.

The application of the Directive on Strategic Environmental Assessment (SEA), which imposes the environmental valuation of plans in order to predict potential environmental effects of urban planning, (Directive 2001/42/CE) has been used for the district’s plan of urban displacement and for the district’s territorial coherence scheme.

4.2 Policies and sectoral regulations used to work on town planning and environmental health

Topic	Local policies/regulations	National policies/regulations	EU policies/regulations
Noise		<ul style="list-style-type: none"> ▪ The organization of public transport in France is principally governed by law n ° 82-1153 of December 30th, 1982 on domestic transport orientation, called "LOTI" ▪ Decree n ° 2006-361 of March 24th, 2006 relating to the establishment of noise map and the plans of noise prevention in environment and changing the town planning code ▪ Law n ° 92-1444 of December 31st, 1992 relating to the struggle against noise ▪ Order of May 30th, 1996 relating to classification of road networks and the acoustical isolation of the buildings in areas affected by noise ▪ Order of May 3rd, 2002 taken to be the application of the decree n ° 2002-867 of May 3rd, 2002 relating to subventions granted by the State concerning the operations of acoustical insulation of the black points of national road and rail networks noise. 	<ul style="list-style-type: none"> ▪ <u>Directive 2002/49/EC</u> of the European Parliament and of the Council of 25 June 2002 relating to the assessment and management of environmental noise.
Air quality	<ul style="list-style-type: none"> ▪ Bylaw issued by the prefecture of 24 July 2008 relating urgent measure on the Rennes urban area in case of not accidental origin pollution episode. ▪ Atmosphere Protection Plan of Rennes urban area, June 9th, 2005 adopted. ▪ Regional Plan of 	<ul style="list-style-type: none"> ▪ Law concerning the air pollution of 30 December 1996 	<ul style="list-style-type: none"> ▪ <u>Council Directive 96/62/EC of 27 September 1996</u> on ambient air quality assessment and management ▪ <u>Council Directive 99/30/EC of 22 April 1999</u> relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air.

	<p>the Air Quality, nowadays subjected in the public opinion, aims at raising an appraisal of the Air Quality and listing measurements allowing to reduce pollution</p>		<ul style="list-style-type: none"> ▪ <u>Directive 2000/69/EC</u> of the European Parliament and of the Council of 16 November 2000 relating to limit values for benzene and carbon monoxide in ambient air. ▪ <u>Directive 02/3/EC</u> of the European Parliament and of the Council dated 12 February 2002 relating to ozone in ambient air.
Green areas and public spaces	<ul style="list-style-type: none"> ▪ A guide book to manage green areas in consistency with their conception and in a differentiated way ▪ Development schemes and waters management of Vilaine (cf topic Water) imposes on municipality to accomplish a plan of weeding. It has been approved by city council in September 2006. 	<ul style="list-style-type: none"> ▪ Decree n°94-1136 of implementation December 18th, 1996 requirement of security for the playgrounds. 	
Traffic	<ul style="list-style-type: none"> ▪ Rennes District defines the overall strategy of displacements on its territory through its Plan of Urban Displacements (PDU) and, in this frame, organizes in particular the policy of public transport on its 37 towns 	<ul style="list-style-type: none"> ▪ The organization of public transport in France is principally governed by law n° 82-1153 of December 30th, 1982 on domestic transport orientation, called "LOTI" 	<ul style="list-style-type: none"> ▪ France had created the plans of urban displacement before European regulation imposes it
Water et water waste	<ul style="list-style-type: none"> ▪ Development schemes and waters management of Vilaine, Rance and Couesnon rivers, that definite uses and objectives for surfaces waters quality of Rennes and its suburbs. ▪ The State and Region Plan Contract that sets an action program and reconquest means of waters quality in Brittany. 	<ul style="list-style-type: none"> ▪ The law n°2006-1772 date 30 December 2006 about water and aquatic environment. ▪ The public health Code more particularly its articles R1321-1 to R1321-63 	<ul style="list-style-type: none"> ▪ The water framework Directive passed on 15th September 2000. ▪ The Directive n° 91/676/CEE from 12th December 1991 called "nitrates Directive" concerning the waters protection against the pollution by nitrates from agricultural sources.

Waste management	<ul style="list-style-type: none"> ▪ Local town planning and local agenda 21 ▪ The aim of the departmental plan of waste household management is to orientate and to coordinate all the actions to be led, both by the authorities and by private organisms. It's nowadays being reviewed by the Department 	<ul style="list-style-type: none"> ▪ Law dated 13 July 1992, transposition in national law of the European Directive 1191/156/CCE, being reviewed. 	<ul style="list-style-type: none"> ▪ The incineration factory has been made complied with the Directive 2000/76/CE. ▪ The Directive 2006/12/CE is being transposed in French law.
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A law, which is the outcome of “le Grenelle de l’Environnement” being prepared, could change the national regulations documented above.

5 – Improvements necessary for implementation

Before envisaging new regulations, improvements to the effectiveness of existing policies and regulations could be proposed.

Simplification and streamlining could address the number of competent administrative authorities responsible for each topic and could bring them together in joint projects.

Simplification could also concern the structure of financing of projects.

Also, the inadequacy of existing regulation controls by the State Departments is detrimental to their effectiveness.

Finally, concerning water and mobility issues, existing regulations set targets to local authorities to achieve, while demands and action requests for the responsible polluters (industry emissions, agricultural policies, car fleet programmes etc.) are often only advisory and therefore not legally binding, or come too late (ie, despite the need to improve water quality, European and national agriculture policies still promote intensive and polluting models. For particles in air, rules about filters for diesel vehicles are insufficient).

Integration of national and European strategy, supported by common indicators, is necessary to help local authorities make the best decisions in developing initiatives to sustain the environment and foster good health for the population. The development of valuation tools with regard to the positive and negative impacts of strategies on health is an important recommendation.

A place for and the encouragement of experimental planning approaches must be left to local authorities with a pooling and dissemination of results at national level

6 – CONCLUSIONS

For the city of Rennes and its District, the “top three challenges” for the near future linked to health and environment topics are:

- Preserving both agricultural and natural areas and answering to the need of new dwelling by searching for innovative and high-quality urban forms and increasing density in urban areas
- Eliminating or minimising the environmental footprint of new developments
- Addressing the mobility issue by monitoring and regulating the impacts on environment and health and promoting the use of alternative sustainable modes of transport.

Moreover, we believe it is important for the PAVEL project that we adopt a social dimension in approaching health and development and advance towards a multisectoral approach that addresses issues of social mixing, equity intergeneration, well-being and environmental and social risks.

Finally, it would be valuable to propose others topics such as:

- Polluted sites
- Healthy habitat
- Climate change and prevention of extreme events.

7 – List of municipal staff and experts who have contributed to the municipal workshop and summary report

Annette Sabouraud	WHO Collaborating Centre of Rennes (Health and Sustainable Development)
Didier Louis	Environmental Health engineer, French National Health Services
Didier Le Bougeant	Deputy Mayor, delegated to Health
Doctor Le Bris Sophie	Hygiene and Health Department- City of Rennes
Alain Jourden	Hygiene and Environment Department – City of Rennes
Soazig Lecalvez-Corgas	Hygiene and Environment Department – City of Rennes
Anne Dollé	Hygiene and Environment Department – City of Rennes
Martine Ralaivao	Hygiene and Environment Department – City of Rennes
Roland Gicquel	Environment and Sustainable Development Department – Rennes Metropolis
Julien Hervé	Displacements Department, Urban Research Department – Rennes Metropolis
Erwan Ranson	Displacements Department, Urban Research Department – Rennes Metropolis
Magali Corron	Air Breizh, Air Quality monitoring Agency
Cyrille Lomet	Public Garden and Green Areas Department – City of Rennes
David Clause	Services with industrial and commercial characteristics Direction – City of Rennes
Daniel Helle	Services with industrial and commercial characteristics Direction – City of Rennes
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Boris Gueguen	Water waste Department – City of Rennes
Christelle Leproust	Environment Mission – City of Rennes
Olivier Schontjes	Architecture and Town Planning Direction – City of Rennes
Pierre Benaben	Urban Research Department – Rennes Metropolis
Frederic Auffray	Urban Research Department – Rennes Metropolis

Annex 4: Case study summary report – Torino, Italy



CITTA' DI TORINO

VICE GENERAL DIRECTION
THE MAYOR'S CABINET AND CULTURAL SERVICES
INTERNATIONAL AFFAIRS DEPARTMENT

PAVEL PROJECT

Policy advice on urban planning, environment and health

Case study B: The City of Torino

2008
Anno della Sicurezza
nei luoghi di lavoro

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1) Introduction

In 2000, Torino was the first Italian city to adopt a **Strategic Plan**, a decision that was followed by many other cities in the following years. The first Strategic plan for the promotion of the city was developed when Torino was already feeling the acute crisis affecting the manufacturing industry and the Fordist society, a crisis brought by the socioeconomic changes underway in Western countries.

By developing the strategic plan, the city committed itself to elaborating a project to maintain its ability to produce richness and innovation through the diversification of its productive system having a look at the international image of the city which was undergoing a deep process of renewal.

In 2006 that first document was updated in order to respond to a socioeconomic context that had changed even further over the years so it was necessary to create new opportunities and different growth objectives. Consequently the **2nd Strategic Plan for Knowledge Society** was issued hinged upon the idea of a Knowledge Society, a development model which is taking hold in the more advanced countries and which leads to an evolution from the traditional economic system to production based on a strong level of planning, study and research. The model of development defined by a Knowledge Society puts great importance on the city which regains its original function as a crossroad of exchange in which modern services mix and cohabit in favour of business, consumers and the public administration. The metropolitan area plays a very important role and for this reason, the 2nd Strategic Plan for Knowledge Society involves the entire metropolitan area of Torino a territory with 1.600.000 inhabitants, comprised of over 30 municipalities encircling the regional capital.

The document is divided into four thematic areas (metropolitan territory, quality of society, cultural potential and economic development) and a fifth one, more transversal, concerns the vision of the plan. These four areas are divided into twelve project directions involving important topics; among them we can quote urban and territorial transformation, transportation and mobility, health and care, homes and urban regeneration.

With regard to **urban and territorial transformation**, all decisions related to urban planning start from the Town Planning Scheme passed by the City Council aiming at giving a precise definition of urban transformations. The forecasts of the Town Planning Scheme are accompanied by studies and analyses regarding the fundamental resources of the environment: water, air and soil. There are also specific standards that involve editing at the urban planning level, including specific

departmental plans, for example the Acoustic Plan which integrates the general rules of the Town Planning Scheme. Indeed, the quality of a project regarding urban transformation depends to a great degree on whether it is considered part of a system which studies not only the single project, but its relationship to all the other projects in a unitary vision of the city; in which the functional and competitive reorganization of the territory is combined with attention to the quality of the environment and the urban context.

A national standard acknowledged by the Region maintains that urban planning variations and urban transformation interventions should be accompanied by a study concerning: traffic analysis, analysis of atmospheric emissions, analysis of containing energy consumption, landscape analysis, environmental pollution and the impact of mobility. Indeed, it is necessary to enhance public transportation infrastructures (rail lines, subway lines etc) in order to reduce private vehicle traffic and, furthermore, there should be diffused containment practices for energy consumption. Finally, the city is working on the rationalization and integration of services (transportation, waste, energy etc) throughout the whole metropolitan area. This is very important if the city wants to offer its citizens better health conditions and a more rational approach to urban management.

2) Key challenges

2.1 Mobility

For mobility, the intelligent management of this topic is a very important issue, since traffic congestion has reached levels that make it difficult for the city to function and also have a heavy impact on the environment. Indeed, transportation infrastructures greatly influence how a territory develops and functions and they can change the face of the countryside. The intimate relationship between infrastructure and territory complicates the topic of accessibility, since it involves numerous factors and projects of different types and dimensions. In Torino there are a few critical points of high traffic congestion and street size reduction that require infrastructure intervention. In order to solve these kinds of problems, the City is facing up to new challenges thanks to financial plans from the Environmental Ministry and the Infrastructure and Transportation Ministry, which can allow the construction of new public transportation infrastructure; the implementation of traffic telecommunication system (for instance: traffic light centralization, traffic information centre); the modernization of public transportation fleets, transportation sustainability (car sharing, bike sharing, van sharing, bike paths) etc.

In 2008 a 2% increase in public transportation in Torino has been estimated based on the number of passes and tickets sold. This is due to the renewal of transportation means, specifically the new line 1 of the subway. In addition, it is expected that a transportation shift due to the rise in fuel prices for private vehicles and the unfavourable economic situation will further contribute to the increase of public transportation. At the moment 62% of households own a car but it is necessary to reduce the use of cars in order to solve the problems caused by high traffic congestion.

The effectiveness of the reduction policies has not yet reached its maximum results since some of the construction projects are still in course. Nevertheless, in some citizen areas (like the historical downtown) a significant improvement in public transportation and a decrease in the use of private means have been observed.

2.2. Waste management

Waste management is a crucial topic related to modern society. In Torino 100% of households are served by regular waste removal services even if sometimes it can occur that waste is abandoned and discharged in an abusive manner in the territory. Over the recent years, waste production has been stable partly due to the economic crisis and the consequent containment of consumption; fortunately differentiated collection of waste is increasing as a result of several campaigns aiming at

developing citizens' awareness that waste should be treated in different ways in order to improve recycling and re-use of plastic, paper and glass.

The Environment and Green Division of the City of Torino takes care of managing the service contract between the municipality and the public agency that is in charge of waste collection, disposal and cleaning the city (AMIAT, S.P.A, a Joint Stock Company whose capital is completely public and whose major actor is the City of Torino).

At the national level, there is a main law in force which is called "*Norms regarding environment*" and waste management in the Piedmont Region is carried out in accordance with the provisional regional law passed in 2002. This law provides for the subdivision of the territory into Consortium Basins (responsible for the management of waste collection and transport to the plants) and Field Associations (which realize and manage the technological plants that recover and dispose waste). Finally the City of Torino is working on the construction of a waste incinerator.

2.3 Traffic noise

In Torino during night time 50% of the population is exposed to traffic noise above 65 dB and 76% of population is exposed to traffic noise above 55dB. This is a typical problem of large urban agglomerates like Torino. Constant road traffic, critical situations tied to large works in progress (concerning subway, underground train link, road maintenance) contribute towards noise problems.

The most critical situations are decreasing due to the local regulatory initiatives and monitoring of the Municipal Police Corp and ARPA (Regional Agency for Environmental Protection). The lack of financial resources prevent from achieving greater effectiveness of the policies adopted for the reduction of noise in the city (such as acoustic mapping and action plans against noise). This is the reason why the city is asking for more sufficient resources to enable them to actively implement the decisions taken at political level even if the difficult economic situation doesn't help in this process.

2.4 Water supply

Torino is a city which doesn't face any particular water supply problems. In fact, 100% of households are connected to clean water supply and 99% is connected to a sewage system.

In the last five years the city has not recorded any problems concerning potable water supply or disposal of waste water. The current potable water supply services are composed as follows: 75% wells, 16% rivers, 9% springs. All waste water is treated in a single plant. A Joint Stock Company whose capital is completely public

(called SMAT S.P.A.) and whose major actor is the City of Torino manages the integrated water cycle whilst the policies regarding water management are both at provincial and regional levels. The Piedmont Region, in collaboration with another relevant organization, created the Water Protection Plan the Local Water Authority in 2007. In collaboration with SMAT S.P.A. it created the Area Plan, periodically updated, which permits the planning of necessary adjustments for water networks and plants.

At national level the law number 36 issued in 1994 governs all management of water resources; at European level Directives have been acknowledged at the national level and this consents to improve water quality levels in Italy.

2.5 Air pollution

Air pollution is another very important and serious topic for a modern and big city like Torino but it is fortunately decreasing in recent years. The available data reveal that the main cause of air pollution is vehicle traffic (53%) and that the concentration of dusts is, of course, higher in areas of the city where there are streets with particular amounts of traffic. In 2004 the City of Torino instituted a Limited Traffic Zone (ZTL) in its centre which covers an area of approximately 1 Km² with a ban of vehicles circulation in the morning on weekdays (except for Saturday). Three years later, in January 2007, a Limited Environmental Traffic Zone (ZTLA) has been constituted aiming to forbid the circulation of old vehicles certified before the instalment of Euro 3 Directive (and successive amendments), motorcycles and scooters certified before Euro 1 Directive, commercial distribution vehicles certified before Euro 3 Directive.

Furthermore, Torino adopted another measure in November 2007 that forbids the circulation of the most pollutant vehicles throughout the entire citizen territory. From January 2009 the city will deliberate a ban on the circulation of diesel vehicles with a Euro 2 certification older than 10 years. All the above measures contribute to the decrease of air pollution and in 2007 the average value of dusts decreased by 18% in comparison to 2006. The concentrations of sulphur dioxide, lead, benzene and carbon monoxide are lower than the limits imposed by established standards on this subject. We are now planning to also develop a flexible road pricing system for accessing the centre of the city, based on different categories of vehicles (less or more polluting) and of users (commuters, city users etc). Each person will have a certain number of free accesses and afterwards will pay with different rates measured by combining the category of the vehicle and of the user. There are about 300.000 persons who everyday enter the city of Torino for reasons of work, study, leisure...

The most important elements which favour the decrease of air pollution are traffic limitation measures enacted by the city, a complex renewal of the fleet of cars and an increase in utilizing low environmental impact energy production techniques which consequently reduce the employment of combustible fuels. Torino aims to achieve 55% coverage of the urban territory with thermal district heating by 2011.

Since Torino, like the other cities of the Padan Plain, has a morphologic configuration which inhibits the dispersion of pollution; it is necessary to find funds to further increase local public transport and to reduce the currently elevating number of cars per capita (which is one of the highest in Italy). Other measures adopted beyond limiting circulation of pollutant vehicles in the urban area are the promotion of alternative forms of individual transportation such as car and van sharing; the organization of events aimed at sensitizing and informing citizens about environmental themes (for instance: ecological Sundays, environment film festival); the promotion of photovoltaic roofs and the increase of district heating network by 2011.

2.6 Green/recreational areas

Torino is very proud to be a green city. As such, there are 18.400.000 square meters of public green spaces maintained by the municipality (this means 14,2% of the total surface area). There is no specific rule that requests a minimum size for green spaces in relation to a given number of residents but the Town Planning Scheme of Torino provides for 33.081.900 square meters dedicated to green use and this means that there are 36,76 square meters of green per inhabitant. Furthermore, the Town Planning Scheme of Torino envisages a reorganization, distribution and better accessibility to playgrounds even if there are no regulations addressing the number of them in relation to a given number of residents.

Over the last years, Torino has experimented by a big urban transformation process and the breaking down of architectural barriers has caused a progressive increase of green spaces in the municipal territory. The key problems related to the management of green spaces are cuts in the budget and a lack of human resources working on them.

3) List of Departments of the City of Torino contributing to the collection of data and information for PAVEL project:

- Green Spaces and Policies Department
- Environmental Protection Department (for waste management, air pollution, noise)
- Urban Planning and Private Housing Department
- SMAT (Società Metropolitana Acque Torino), a joint-stock company whose capital is completely public and whose major actor is the City of Torino
- Infrastructure and Transportation Department (mobility)
- Association Torino Internazionale, working on the development of the Strategic Plan of Torino for the promotion of the City and its metropolitan area