Building Health

Planning and designing for health and happiness

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Masterclass Briefing

Evidence Review
Spatial Determinants of Health in Urban Settings

Part 2a

Land use pattern

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Text based extracts from:
Evidence Review on
the Spatial Determinants of Health in Urban Settings
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The basis of the material

Evidence was reviewed in terms of reports from 2005 onwards. The search for evidence was based in the main on meta-studies, systematic reviews and reviews of reviews. Other evidence, either from before this date or findings from single studies, has been included where significant. The four components of the urban situation looked at are:

- Land use pattern (Part 2a)
- Transport (Part 2b)
- Green space (Part 2c)
- Urban design (Part 2d)

This section of the evidence review (Part 2) takes one urban component and reviews its significance in terms of five health factors. The health factors are:

- physical activity
- social and psychological impacts
- air quality
- noise exposure
- unintentional injury

This section should be read in conjunction with the overview paper (Part 1).

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The evidence
Land use pattern and its impact on the determinants of health

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 myriad 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.

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).

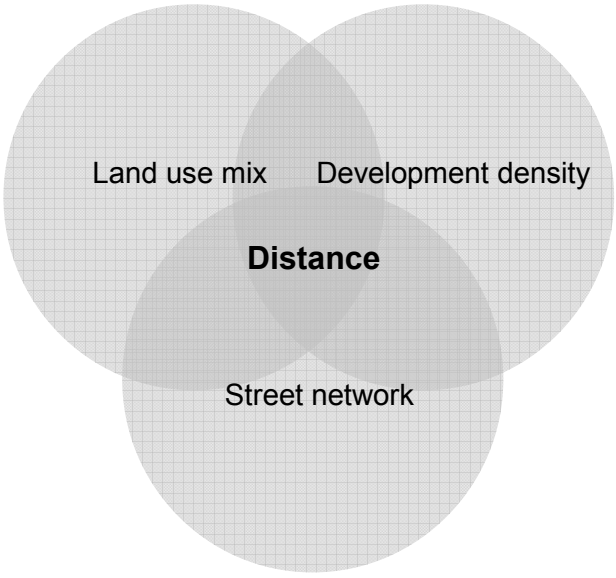

Figure 1: Urban distance is dependent on density, land use mix and street network pattern.

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 (Figure 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 though 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 facilities, 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-motorised 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 UK, paying attention to the provision of safe routes to school was associated with short-term increases in the 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).

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 programmes to minimise 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 and Prince, 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.

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 (NO_2), fine particulates (PM_{10}), sulphur dioxide (SO_2), 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 NO_2 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 exceedences 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 urbanised 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 UK that, in terms of NO_2, PM_{10} and SO_2, 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 been 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 socio-economic status are exposed to the highest pollution concentrations, mortality rates from air pollution related causes are still highest amongst those with lower socio-economic status (Forastiere et al 2007), indicating a greater susceptibility to the effects of air pollution amongst the most deprived.

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).

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 the 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.

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