accidents don't have to happen

Public Health England

Delivering Accident Prevention at local level in the new public health system

Part 2: Accident prevention in practice

Research Road safety policy and links to wider objectives

Safety issue

Raise awareness

Education

Preventative measures

Partnership working

Reduced Risk of Injury

Delivering accident prevention at local level in the new public health system

Part 2 RS1

Accident prevention in practice

RESEARCH: Road safety policy and links to wider objectives

Traffic injury is a major cause of death and ill health in Great Britain (GB). The annual number of traffic injury deaths peaked in 1966 when there were 7,985 fatalities in a single year. Since then there has been a reduction in the annual number of deaths. In 2011 there were 1,901 deaths, the first rise in almost a decade, this still represents a major cause of mortality that is both predictable and preventable.

Road safety should also be seen in the context of the large changes to the way we travel. Firstly, more households now have regular access to cars. In 1955 just under 20% of households had regular access to one car; in 2005, about 50% of households had regular access to one car and a further 20% had access to two or more. The increasing regular use of cars has been accompanied by declines in other modes of transport.

The increasing ownership of cars has given many people access to jobs and a wider choice of destinations. The mobility they offer allows users to travel from place to place and, by and large, arrive within short distances from their destination or easily visit several destinations on the same trip. There is no need to change transport mode on long journeys, as the same road network connects car travel both between and within cities. This increased movement of people and goods by road has been accompanied by a period of growth in GDP.

However, the growth in car ownership has also led to car dependency. Many new developments have decentralised functions away from city centres and are not always easy to access by other forms of transport. Conversely, improvements in the road infrastructure have led to increases in the amount of traffic through induced demand as more developments occur along these routes. This has cemented the car as the default choice for many journeys, and cars are now used by a large proportion of people for short trips. Many people are now trapped in a cycle of car use simply because there is no provision for them to choose to make their journeys by other modes. The limited accessibility of many destinations by modes of transport other than the car has a negative impact on families without regular access to cars, and this reinforces social inequalities.

This is the necessary context for road safety policy as transport is an important determinant of health besides traffic injury. The growth in traffic and reliance on cars has had a wide range of negative impacts on health. Decreases in the amount of active travel such as cycling and walking has meant that more people are less active and use less energy during their daily routines, which has contributed towards a higher prevalence of overweight or obese adults and children. Emissions from cars contribute towards man-made climate change. The use of oil for local transport is a future threat to food security, as this is the same resource required for the growth and distribution of affordable food. Transport and health policy increasingly looks towards mitigating many of these impacts and this is the context in which future road safety policy must be formulated. Road safety is one aspect of the transport system and should not be considered in isolation from other areas of health and transport. The opposite is also true, as wider changes in transport impact upon road safety. This chapter discusses the common characteristics between a safe and a healthy transport system that can form the basis of action to improve both. There are three strands of road safety policy that link with these wider objectives.

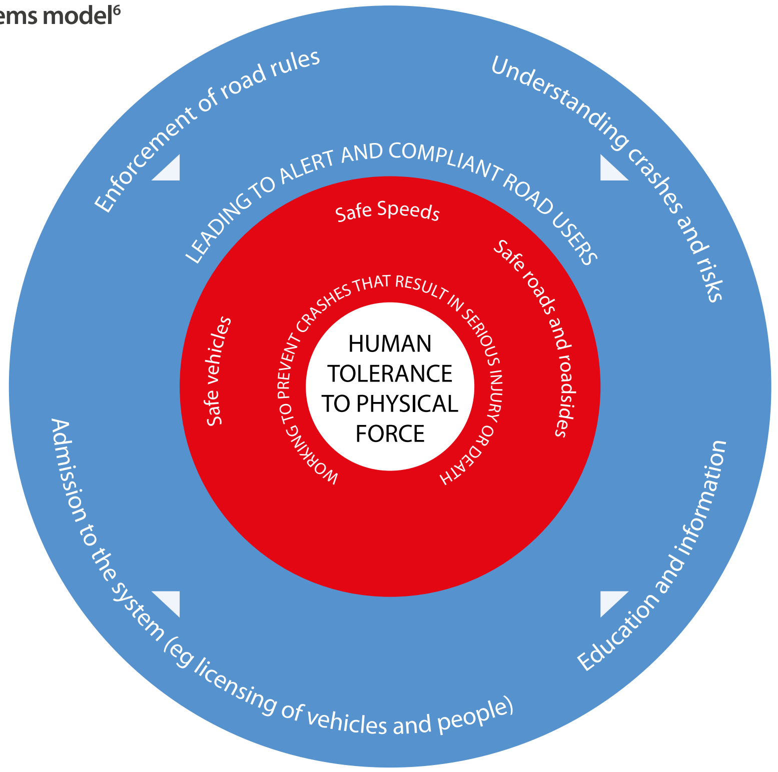
- Adopting the safe systems model to create safe and liveable communities
- Reducing traffic volume by addressing excessive dependency on cars
- Understanding and addressing the social equity aspects of road safety

The safe systems model

A major conceptual leap in understanding injuries occurred in 1961, when two papers developed the science of injury prevention. Firstly, a paper on the psychology of injury categorised environmental hazards by the type of energy released.[i] The second paper cemented the thinking behind this categorisation and identified the release of energy [1] as the most important and largest necessary cause of injury – when delivered to the body in quantities high enough to cause tissue damage. [2] Preventing this release or interrupting the transmission, therefore, became a specific goal of many injury prevention activities. The application of this conceptual leap has led to an understanding of the magnitudes of energy that are beyond human tolerance and cause injury, and then to redesign products or environments to prevent or mitigate its transmission. This was advanced through an engineering approach to injury prevention. [3] The introduction and optimisation of in-vehicle restraint systems such as seatbelts [4], and motorcycle helmets [5] are examples of the successful application of this approach.

This understanding of injury has been adopted as a central design requirement for the road network in some countries and, in turn, the World Health Organisation's (WHO) safe system model for road safety. This model is shown in Figure 1.

Figure 1: The WHO safe systems model[6]



The WHO safe systems model encompasses a wide number of approaches to prevent injury, but at the centre is the human tolerance to injury. The design of roads, vehicles, and vehicle speed should be part of an integrated system that prevents fatal injury from energy damage occurring.

Vision Zero and the Effectiveness of the Safe Systems Model

One of the earliest and best examples of how the WHO's safe systems approach works in practice is the Swedish Vision Zero. This is an ethical, political and scientific approach to road safety.[7] The ethical statement at the heart of Vision Zero is that it is not acceptable that people are killed or seriously injured whilst using the roads and that health should not be traded for mobility. Therefore, the aim should be to eliminate deaths from injury entirely rather than just reduce them.

This is supported by a scientific statement: the only way to achieve this is to prevent exchanges of energy that would be likely to cause death. Finally, the political statement is that road users cannot achieve this goal on their own and that responsibility for doing so is shared between the road designers, who design a safe system, and the road users themselves. Rather than stating that road users should not make errors, this admits that often they do occur, but also that roads and cars should be designed so that these errors do not result in death.

[i] Injury is caused by acute exposure to mechanical energy, heat, electricity, chemicals and ionizing radiation in quantities that exceed human tolerance to it. The formal definition of injury also includes instances such as drowning or frostbite where there is the sudden lack of essential agents.

This fundamentally changes the problem at the heart of road safety from "accident" to "fatal injury". As the magnitude of energy exchanges that routinely lead to fatal injury are understood, these are placed at the heart of how the road network is designed. Assuming that road users follow the speed limit and use a seatbelt, it is theoretically possible to prevent a large proportion of traffic fatalities. This shift in perspective is also important when analysing why fatal injuries occur. Previously studies have looked at the contribution of road design, vehicle failure and human error to crashes and found that human error is a factor in about 95% of crashes. [8] This does not imply that addressing human error is the most effective way at preventing injuries. Redesigning the environment is generally more effective at preventing injury than requiring behaviour change from a large proportion of the population. [9]

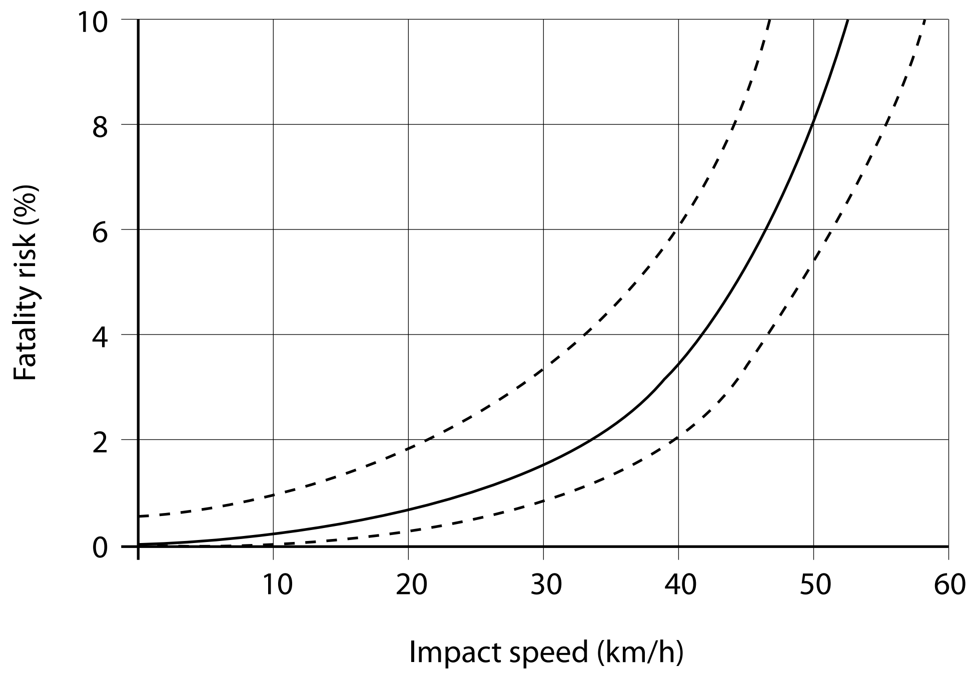
Therefore, a different approach to analysing why fatal injuries occur is to define the criteria of a safe system in terms of the vehicle, the road design and the speed where a fatal injury is theoretically very low risk. The data from fatal crashes can then be compared against these criteria to identify whether they were met.

This approach was applied to the 248 fatal injuries to car occupants that occurred on public roads in Sweden in 2004. [10] It was possible to classify 93% of the crashes that occurred and compare them against the criteria for a safe system set by the Swedish Road Administration. In approximately 63% of all deaths the vehicle or road environment did not meet the criteria. This implies that 63% of deaths could have been prevented if the criteria for a safe system had been met, without having to change road user behaviour.

The safe system and road design

There is a strong relationship between speed of travel and speed of impact. A wide range of studies have looked at the relationship between pedestrian injury and vehicle impact speed using different sampling methods and in different countries. A recent review identified the most reliable modern estimates. [11] Figure 2 shows the likelihood of a fatality at speeds of between 0 and 60km/h and is taken from one of these reliable studies. [12]

Figure 2: Showing the relationship between the risk of fatal injury to adult pedestrians and vehicle impact speed. [ii]



This graph shows that a car hitting a pedestrian would result in a fatal injury in slightly less than one out of every ten collisions at 30mph, which is the speed limit in most urban areas of the UK. Where a safe system approach has been adopted, 20mph should be the speed limit in the majority of urban areas where pedestrians, cyclists and vehicles cannot be divided through the provision of separate infrastructure. [13]

In the UK, early 20mph zones were accompanied by traffic calming (e.g., humps and chicanes in the road to physically encourage slower speeds). This created large areas of traffic calmed streets – particularly in London and Hull – and has been very effective at preventing fatal injuries, particularly amongst vulnerable road users such as pedestrians, cyclists and children. [14] [15] [16]

[ii] The solid line is the most likely estimate and the dotted lines show the 95% confidence limits. Higher speeds have a fatality risk over 10%. The difference between 30km/h and 50km/h is the closest rounded approxmation to 20mph and 30mph. 30km/h = 18.6 mph, 40km/h = 24.9mph, 50km/h = 31.1mph

More recently cities such as Bristol and Portsmouth have introduced 20mph limits without traffic calming. These can cover much larger areas because of the reduced expense in engineering the roads themselves. They have been effective at reducing traffic speeds, although less so than zones with traffic calming. [17] [18] 20mph limits can be more effective when coupled with other transport planning and road safety interventions.

The wider adoption of 20mph zones or limits could reduce fatal traffic injuries further. The North West Public Health Observatory estimated that 20mph zones in the region's residential areas between 2004 and 2008 would have prevented 140 fatal or serious injuries to children. This would have been a reduction of 26% on the actual figures. In addition, there would have been a 26% reduction in all pedestrian casualties and 14% reduction in all cyclist casualties. [19]

As well as vulnerable road users, the safe system can prevent fatal collisions to car occupants. There are several design standards in Vision Zero that are based on the idea of separating traffic, or integrating it at speeds that have a low risk of fatal injury:

- Car occupants should not be exposed to other motorised vehicles at speeds exceeding 50km/h in 90° crossings – If this criteria cannot be satisfied then the traffic should be separated or the angle reduced
- Car occupants should not be exposed to oncoming traffic at speeds exceeding 70km/h or 50km/h if oncoming vehicles are of considerably different weights – If this criteria cannot be satisfied then separate the traffic or homogenise weights
- Car occupants should not be exposed to road sides at speeds exceeding 70km/h or 50km/h if the road side contains trees – If this criteria cannot be satisfied then traffic should be separated from the roadside [20]

Separation in Vision Zero is achieved by physical means, such as by using barriers or redesigning roads so that traffic is spatially separate (e.g., dual carriageways). Methods to separate traffic in time, such as traffic lights or pedestrian crossings, are not seen as measures that satisfy the criteria for higher speeds.

Cable barriers are often used to separate the traffic on single carriageway national trunk roads in Sweden. These roads are 13m in width and a 2+1 lane layout is used, meaning that one direction of traffic has a single lane and the other direction has two, with the extra lane alternating between the directions. The barrier is continuous. An evaluation of these roads found there was a 76% reduction in fatalities when compared with the normal outcome for the previous road layout. [21]

Reducing traffic volume as a road safety intervention

Traffic injury is a problem that is caused by travel. Travel is rarely an aim in itself but is caused by a demand for activities such as employment, shopping, or socialising. Due to this, the amount of travel that a population does by different modes is influenced by urban planning, as this determines how accessible various activities are.

For instance, the longstanding policy of urban containment has prevented urban sprawl and meant that public transport networks are still possible within cities; it has also caused an increasing separation between homes and workplaces which led to more long-distance commuting. [22]

This increase in traffic has meant that the urban environment has been changed to accommodate it, [23] predominantly through building new roads. This created a cycle which leads to more car use and further changes to the urban environment. The result of this is an excessive reliance on cars as a form of transport.

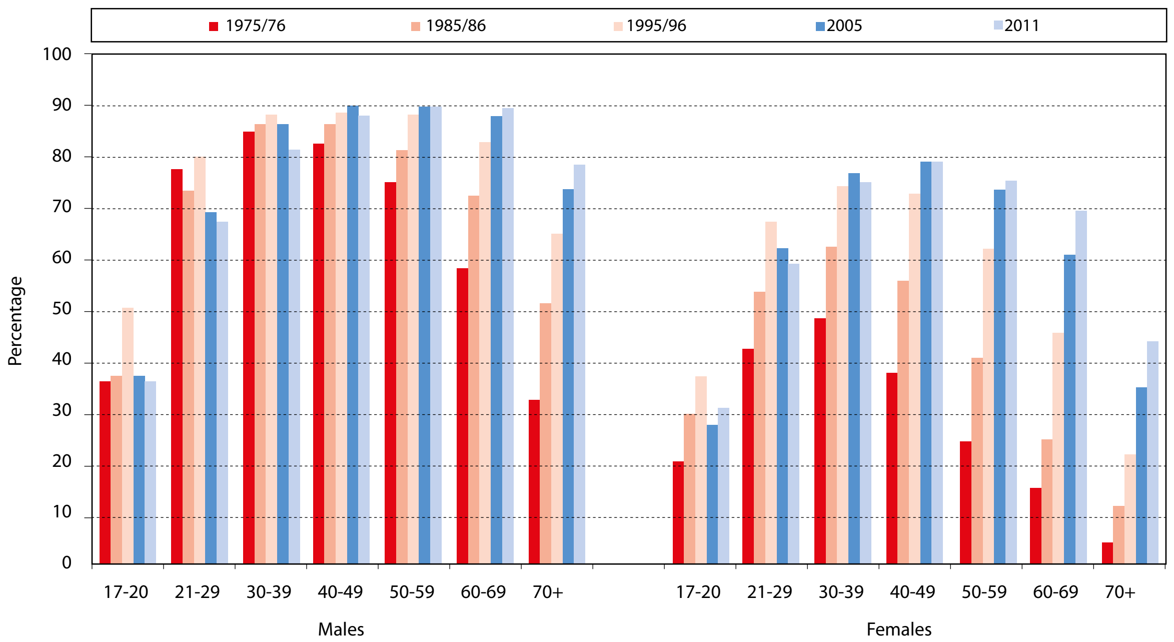
In the 1990s it became apparent that this cycle could not continue, as it was impossible to meet the forecasted traffic volumes, especially in urban areas. [24] Transport planning started to shift from a "predict and provide" model to a "predict and prevent" one.

During the economic downturn that began in 2008, there was a reduction in the total amount of car use and a significant drop in the number of driver injuries in many western countries. Analysis of this drop identified there was a declining number of younger drivers. [25] [26] However, the overall growth in car use leading up to the economic downturn has potentially disguised the longer term downward trends in the number of younger drivers.

Since the millennium there have been reductions in the amount of car travel by young drivers, particularly young males, in many of the major western economies. [27] This has been reflected in the decreasing percentage of young people who hold a driving licence, as shown in Figure 3. [28]

The mechanisms behind this decline in the number of licence holders are relatively unexplored, however, increasing youth unemployment, the use of other forms of travel, or the use of technology as a substitute for travel, seem to be likely explanations.

Figure 3: Percentage of full car driving licence holders by age and gender in Great Britain at four time periods.



It has been argued that there are three directions that the trend in car travel can take in future.[29]

Continued growth
The first argument is that the current decline in the amount of car use is temporary and directly due to the economy. At the point where the economy recovers, the amount of travel by car will also increase. This has happened following other times of poor economic performance since the 1950s.

Saturation of demand
The second argument is that car use has arrived at a level where it will now plateau. [30] Since around 1970, travel times – measured by hours per person per year – and the number of trips per person per year have remained fairly static. Despite increasing car ownership, the amount of time that individuals spend travelling is relatively stable, however there has been an increase in the distance travelled during that time. This is because greater car use has allowed a greater choice of destinations within the same travel time.

However, this also means that there is a point at which the increased distance that could be travelled does not lead to greater choice, since someone's needs are already well met within the distance that they can already travel. This would result in the saturation in demand for car travel.

Peak car
The third argument is that car use will peak and then decline, similar to train use in the 1920s and bus and tram use in the 1950s. The current reductions in the amount of car travel are the start of that decline following the peak. Conversely, the historic long term decrease in the amount of walking and cycling has also stopped. Whilst the recent recession has exaggerated the trend, the turning point occurred around 1992. Peak car seems to have already occurred amongst some demographics – such as younger people under the age of 25 – and in some areas, such as London.

Understanding which of these trends is occurring is essential to the interpretation of road casualty statistics. Traffic volume is an under developed area for road safety policy.

Traffic volume and injury

Historically, many western countries, including the UK, saw increases in the annual number of fatalities on the road, which peaked and then declined. The decline has been due in part to the introduction of effective safety measures, such as safer vehicles and roads, and the introduction and enforcement of traffic laws. The declining use of some modes of transport has been another factor that has led to lower numbers of fatalities amongst some road user groups.

This decline in the number of casualties appears to have occurred despite the increase in traffic volume, disguising the idea that traffic volume is an underpinning cause of injury. The relationship between traffic volume and injury has been investigated through several different methods. The consistency of the results show a relationship, and their replication in different countries increases the confidence in this strong relationship.

As the amount of traffic is linked to the number of casualties on the road, efforts to decrease it will have a positive effect on road safety. Some studies have found that when traffic volume decreases, the proportion of severe injuries can increase, despite reductions in the overall number of severe injuries. This highlights the importance of combining this approach with the safe system model to prevent this increase.

Ecological studies
One approach to study the relationship between traffic volume and injury has been to measure both at a population level, and then to compare the yearly trend or the difference between regions. This is referred to as an ecological study. Regression analysis is usually used to model this relationship, and often includes other factors that may explain the variations seen. From this, a calculation can show the extent that traffic volume explains the number of traffic fatalities.

Variables such as traffic volume have often been used in regression models that investigate the effects of other interventions. A study on the introduction of seatbelt laws in February 1983 used the car traffic index – a measure of the number of kilometres travelled by cars in a month – as an explanatory variable for the number of injuries. [31] This model found that a 1% increase in traffic volume leads to a 0.62% increase in pedestrian casualties and a 0.93% increase in pedestrian fatalities. A similar trend was found for cyclists where a 1% increase in traffic leads to a 0.77% increase in cyclist casualties and a 1.12% increase in cyclist fatalities – although the power of the model to explain variances in the latter was poor, given the relatively low numbers of monthly cyclist fatalities. Changes in traffic volume had a larger influence on the number of cyclist injuries than changes in cyclist volume. A 1% increase in traffic volume increased the number of front seat car passengers killed or seriously injured by 0.32%. There was 0.68% increase in the number of drivers killed for every 1% increase in traffic.

Regional differences in traffic injury rates were studied in the Netherlands using 9,339 deaths that were registered between 1980 and 1984. [32] A model was used to identify differences between the regions. Traffic density was associated with the injury rate and explained the regional differences to some extent. It explained the differences between the injury rates of cyclists better than the differences for vehicle occupants.

The rate of child pedestrian deaths in New Zealand was compared with traffic volumes between 1967 and 1987. [33] There were three distinct phases that were consistent with traffic volume explaining the number of child pedestrian deaths. Between 1967 and 1975, traffic volume increased by 57.1% and was accompanied by a 69.7% increase in the child pedestrian death rate, whereas between 1975 and 1981, following the energy crisis, there was a 5.2% increase in traffic volume and the death rate fell by 46.4%. During the period after 1982 traffic volume rose by 27.6% and the death rate by 53.7%.

This trend was also seen in the USA. A comparison between annual changes in child pedestrian injury mortality rates and changes in the annual number of vehicle kilometres travelled from 1970 to 1988 showed that the two were well correlated. [34] There was an 80% correlation, which is conventionally taken to mean that there is a strong relationship.

Many authors have used the volume of petrol sold as a proxy for traffic volume. One study gathered monthly accident counts from Denmark, Finland, Norway and Sweden, along with information on petrol sales, weather conditions, the duration of daylight and changes in legislation – including changes in how injuries were reported. [35] Exposure as measured by petrol sales explained 65% – 85% of the variation in injury accidents and 70% of the systematic variation in fatal accidents.

USA data between 1981 and 2003 was used to compare the change in transport fuel consumption and changes in the number of traffic fatalities.[36] This found that 22% of the variation in deaths could be explained by the yearly change in fuel consumption.

Data on petrol price and traffic crashes in Alabama between 1999 and 2009 have also been used to study the relationship between exposure and injury. [37] Changes in the price of petrol influence the amount used and the distance travelled. [38] Increased petrol prices have a strong effect at reducing crashes amongst drivers aged 16-20 years.

Observational studies
Another approach to measuring the influence of traffic volume is observational epidemiology that looks at the relationship between traffic volumes and injury. Typically, a design called the case-control study has been used, which compares the circumstances of people injured in collisions with a control group of people who have not. The differences between the circumstances can be used to identify what is associated with injury at an individual level.

A study in Kings County, Washington, identified children under the age of 15 who were hospitalised or fatally injured as a pedestrian during 1985 and 1986. [39] For comparison, two control groups were identified – one from children admitted to hospital for an appendectomy and one which was randomly selected from the population. Control participants were matched on age and sex, so that these characteristics would not be responsible for any findings. The risk of a child being injured on a road with a mean weekday traffic volume of more than 15,000 vehicles was 3.5 times higher than on sites with a traffic volume of under 5,000 cars. This relationship was still present even after adjusting the results to see if they were due to the income level of the local census area.

A "case-crossover design" was used to study the association between traffic volume and injury risk.[40] This design uses the injured children as their own controls by comparing the road that they were injured on with roads that they had previously crossed. 46 injuries to child pedestrians under the age of 15 were identified in the Auckland region between the start of 1992 and the end of 1993. The injuries were severe enough to be fatal or require hospital treatment. The risk of child pedestrian injury was six times greater when crossing a high volume road with a traffic volume of more than 1,000 vehicles per hour.

A later study was carried out in Auckland over a similar period and using the same definition of injury. [41] Separate controls, matched on age and gender, were randomly recruited through school registers. The risk of an injury occurring on a road with a traffic volume greater than 750 vehicles per hour 12.5 times greater than on a road with fewer than 250. There was a clear relationship where the risk of injury increased with the traffic volume of the road.

A comparable approach was taken in a study during a similar time frame in Australia. [42] Factors of interest such as traffic volume and speed were measured at 100 sites where an injury had occurred between December 1991 and December 1993. These sites were compared with 200 sites that were of equal distance from an address of a matched control. Differences in the factors of interest were compared. The volume of traffic at the injury sites was 474 vehicles per hour – this was substantially greater than 162 vehicles per hour at the control sites.

Most recently, traffic volume was shown to explain differences in injury rates between the 521 census tracts on the Island of Montreal. [43] Traffic volume for intersections was estimated from a travel survey and then validated against traffic counts at more than 500 intersections. In total there were just under 17,500 intersections included in the study. Injury data was taken from the ambulance service between the start of 1999 and the end of 2003.

There was a relationship between traffic volume and the number of injuries. An increase of 1,000 vehicles a day was associated with a 6% increase in pedestrian injuries, a 5% increase in cyclist injuries, and a 7% increase in vehicle occupant injuries. The traffic volume at intersections was significantly higher in the least affluent areas, and there was a steep difference between the injury risks between the poorest and richest 20%. On average, 6.3 more pedestrians, 3.9 more cyclists and 4.3 times more motor vehicle occupants were injured in the poorest 20% despite much lower levels of car use and ownership. After controlling for traffic volume the relationship was much less pronounced, meaning that this is responsible for some of the difference in injury rates between the most and least affluent.

Reducing traffic volume

There is a road safety argument for reducing traffic volume, and there is also the potential to do so. The British Social Attitudes Survey [44] found that on average people made four journeys in a week which were less than two miles. 42% of people agreed that they could just as easily walk for these journeys, 33% said that they can just as easily use the bus and 38% agreed that they could just as easily cycle, if they had a bicycle. There are several approaches that can be taken to reduce traffic volume.

Reducing the demand for car use through urban design

During the last 60 years car ownership has become more necessary to access a range of services. Many new developments such as out of town shopping centres, retail parks and business parks have decentralised functions away from better connected city centres. When new roads are built, they often encourage further developments along the route which can lead to more traffic than anticipated and further congestion. [45]

Development density, as measured by the number of inhabitants per hectare, is closely linked to traffic volume and the distance driven by inhabitants. [46] A meta-analysis of the available literature suggests that compacting towns from 600m^2 per inhabitant to 300m^2 per inhabitant reduces traffic volume by 33% and accidents by 30%.[47]

Reversing the long-term trend of increasing car dependency will require consideration in spatial planning documents, such as local Development Plan Documents. A review of DPDs found that unintentional injury was rarely one of the top health issues considered. [48] There are several barriers and facilitators to including these, based on four areas:

Knowledge and conceptual understanding
Health was often considered by spatial planners, but there was a narrow view which focussed on air and water quality, for example, rather than the wider determinants of health. This definition concentrates attention solely towards mitigating negative health impacts of developments rather than revising designs to enhance their positive impacts on health. On the other side, health professionals have little knowledge of how the planning system works, which helps to prevent their engagement. Conducting health impact assessments was identified as a way of bringing the two perspectives together, as well as using wider and more positive definitions of health.

Partnership
Time and resources have been barriers to partnership working between public health and spatial planning professionals, as were the differing cultures of the organisations where they worked. This meant that there was a lack of understanding between the two sectors.

Health impact assessments were again cited as a way of encouraging partnership working, but common areas such as community development were also cited.

Management and resources
The lack of structures which integrate both public health and spatial planning has been a barrier. There were very few formal opportunities for collaboration, for example, on shared projects or functions. Developing cross organisational links were cited as a facilitator.

Policy process
There were often only short windows of time where health professionals could engage with spatial planners due to the timing and length of the planning assessments. This meant there was little opportunity to influence any plans. Current legislation did not encourage engagement, especially as many of the tools, such as health impact assessments, were non-statutory. Linking prospective evaluations of health impacts with the planning cycle and incorporating health indicators into plans facilitated the engagement of health professionals and spatial planners.

To address many of the barriers, formal processes for evaluating policy or development such as strategic environmental assessment and health impact assessments were suggested as tools and could be used to assess the impacts of specific developments or whether policies encourage car dependency.

Substitution of mode

Over time, changes in the proportion of journeys made by different modes of travel have an impact on the health of a population. Encouraging the shift to modes of transport with a lower risk of injury is a good road safety intervention.

Greater use of public transport is associated with reduced numbers of injury. Some studies have examined the effect of fare increases on road casualties and found that when this happens there is less use of public transport and an increase in car and cyclist casualties. [49]

Several studies have modelled the impact of modal shifts on injury. One author found that while increases in walking and cycling accompanied by a corresponding decrease in car use were safety neutral or resulted in a small change in the number of accidents, larger decreases in car use should result in road safety benefits. [50] This study did not examine "single vehicle" cycle accidents. This was examined in another study which just looked at the road safety effect if 10% of car trips shorter than 7.5 km were replaced by bicycle trips. This was found to be safety neutral due to an increase in single vehicle cycle injuries. Cycle infrastructure can be designed to prevent single vehicle cycle injuries. [51] [52]

The shift to active forms of transport such as walking and cycling has a wide range of health benefits. There is a Health Economic Assessment Tool (HEAT) for walking and cycling which helps transport planners to assess the economic benefits of a shift to active travel. [53]

NICE has issued guidance about how local policies and programmes can encourage people to increase the amount they walk or cycle. [54] There are ten cost-effective recommendations based on available evidence, these include the need for high-level support from the health sector and increasing opportunities to build cycling and walking into local joint health and wellbeing strategies and joint strategic needs assessments. Several opportunities for local action were recommended, such as addressing infrastructure issues that discourage cycling and walking, for example a lack of cycle routes and parking or lack of convenient road crossings for pedestrians. Personalised travel planning is recommended as a way of helping people to change their travel behaviour.

There were several recommendations for encouraging active travel to and from schools, such as developing school travel plans and introducing walking buses or other initiatives to encourage children to walk. Employers are recommended to develop strategies that encourage more walking and cycling in consultation with staff, and to work with local authority transport departments to improve walking and cycle access to sites.

Meeting the demand through other means

Travel behaviour is influenced by social changes outside of the transport or spatial planning sector. The largest influence is technology, which can influence trip frequency, trip length and choice of mode. For instance, fridge freezers and developments in the construction of large steel framed buildings have meant that many households now do weekly shops at supermarkets rather than daily shops locally. [55] This has an impact on travel patterns and, therefore, traffic volume.

One of the possible explanations for the peak car use theory is that communications technology is increasingly being used as a replacement for personal travel. [56] This has been seen in several European countries. [57] Similarly in recent years there has been an increasing trend to order goods – including groceries – online rather than travel to the shops to get them. Companies have a legal responsibility for the safety of this work-related travel created through online delivery. [58]

The early adoption of technology can be encouraged, especially by employers. For instance, employers can examine the business case for home working to eliminate the need for some journeys during the rush hour. Good journey planning policies look at the need for the journey in the first instance and whether technology can act as a substitute. [59]

Road safety as a social equity issue

WHO argues that road safety is a social equity issue, as traffic injury is linked with poverty and deprivation. This is as true within countries as it is between them. In the UK the burden of injury falls most heavily on the worse off. This can only be explained by understanding the contribution of wider social inequalities to injury causation.

Why there are traffic injury inequalities

There are many mechanisms which link poverty and road injury, these relate to the exposure to risk, the social environment, and the physical environment.

Differences in the exposure to injury risk as a vulnerable road user can be measured by several different methods. One approach has been to compare the number of roads crossed by children in different social groups. A New Zealand study found that children aged 5-9 in families in the lowest quarter of income cross 50% more roads than those with families in the highest quarter. [60]

Car ownership is another measure of exposure to injury. A UK questionnaire found that 84% of adults from socio-economic groups ABC1 had "access to a car" compared with 57% of adults from socio-economic groups DE. [61] Children who were categorised in lower socioeconomic groups were more likely to walk and more likely to walk to school. [62]

There are several ways that the social environment influences risk of injury. Family structures can be an important cause of injury. Single parent families are at risk of becoming socially isolated[63] and being caught in a "poverty trap" due to the high cost of child care. This increases childhood injuries.

The physical environment includes both the road and housing. Overcrowded housing, [64] and the lack of garden space, [65] are factors that influence children's road injury risk. The provision of local parks and activities can provide safe play areas for children, although often parents are not made aware of organised activities and perceive local parks as unsafe environments for their children. [66]

Addressing injury inequalities

Social inequalities are linked with injury inequalities, and finding approaches to prevent these is a way of preventing injury. The transport system is an important mediator between the two and can also mitigate the injury inequalities.

Multidisciplinary approaches which combine the two are required to prevent traffic injury. By working alongside partners from different sectors, social interventions – for example to provide activities for children – can be coordinated with education and road engineering approaches. [67 68]

Addressing social determinants

Social determinants can have a long-term effect on the risk of injury and it has been argued that a "life-course" approach can be adopted in injury prevention. [69] This approach seeks to address these social determinants of injury at all stages of life, and in doing so can have a long-term influence on injury risk.

Health impact assessments have been used on transport strategies, [70] and urban regeneration projects, [71] to mitigate or enhance the effect of the policy on road injury. Their use to prospectively evaluate the impact of policy on the wider social determinants of health should have road safety benefits.

Addressing the transport system

The vulnerability of children who are exposed to traffic through walking is more to do with the road environment and transport use than with the individual. The two approaches to reduce the traffic volume and introducing the safe system model have the potential to decrease injury inequalities.

When applying the safe system approach to road design, as the potential for fatal injury decreases in all groups, injury inequality is reduced. Large differences in injury rates between different modes of road use are an indicator that a safe system is not present or that there are inequities in the way that it is provided. Road engineering measures have shown their potential to reduce injury inequalities. [72 73 74] High traffic volume is a cause of injury inequalities. [41 43] Measures to reduce traffic volume should also reduce injury inequalities.

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