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Playing it safe: The influence of neighbourhood safety on children's physical activity—A review

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Abstract

Compared with previous generations, children spend less time playing outdoors and have lower participation rates in active transport. Many studies have identified lack of neighbourhood safety as a potential barrier to children's physical activity. This review describes concerns regarding 'stranger danger' and road safety, and discusses empirical studies that examine associations between neighbourhood safety and physical activity among youth. Variability of perceptions of safety between parents and youth are examined; 'social traps' are identified; and physical/social environmental interventions aimed at improving neighbourhood safety are discussed. A research agenda is suggested for further study of perceived and objective measures of neighbourhood safety and their associations with children's physical activity.

Keywords: Children; Adolescents; Physical activity; Neighbourhood; Safety; Risk

Introduction

Is the outdoor child an endangered species? Research conducted in the developed, highly urbanised, 'western' world suggests that, compared with previous generations, children spend less time playing outdoors (Tranter and Doyle, 1996; Karsten, 2005), and the sight of children meeting friends informally or running errands in the neighbourhood has become increasingly uncommon (Hillman, 2006). In addition, the home has become a more frequent venue for children's play, while outdoor play tends to be organised and supervised by adults (Tandy, 1999; Karsten, 2005). Clearly opportunities for physical activity are being missed since time spent outdoors is positively associated with increased physical activity (Klesges et al., 1990; Sallis et al., 1993). This is of concern because the benefits of regular physical activity during childhood and adolescence are well-documented (Raitakari et al., 1994; Bailey and Martin, 1994), while inactivity during childhood has been associated with increased risk of hypertension, obesity, insulin resistance and dyslipidaemia (Guillaume et al., 1997; Katzmarzyk et al., 1999; Rabbia et al., 1994; Suter and Hawes, 1993). In recognition of the health benefits of regular physical activity among children, health authorities in many developed countries have issued guidelines that recommend children spend at least 1 h per day in physical activity of moderate-to-vigorous

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intensity (Australian Government Department of Health and Ageing, 2004; National Association for Sport and Physical Education, 2004; Strong et al., 2005; Department of Health, 2004).

In addition to spending less time playing outdoors than children in previous decades, there is evidence that children have lower participation rates in active transport, such as walking and cycling, and are increasingly chauffeured to/from school and other destinations. For example, an Australian study found that between 1985 and 2001, the proportion of children aged 9–13 years who walked to school in areas of high socioeconomic status (SES) declined by around 50%, while the proportion of children who cycled to school at least once per week declined by 77% in areas of low SES (Salmon et al., 2005). Similarly an English study found that the proportion of 7–11-year-old children who walked to school dropped by around 25% between 1971 and 1990 (Hillman et al., 1990). Considering the value of physical activity among children, it is important to understand why the neighbourhood appears neglected as a venue for this.

Much research examining neighbourhoods and physical activity identifies safety as a potential influence. This review of studies primarily from the UK, Australia, New Zealand, USA and Europe aims to explore which aspects of neighbourhood safety are associated with the physical activity of children and adolescents there. In particular, harm from strangers ('stranger danger') and road safety are identified as major causes of concern. Initially, adults' concerns about 'stranger danger' will be discussed, followed by those of children and adolescents. The findings of descriptive studies as well as empirical evidence of associations between 'stranger danger' and physical activity among youth will then be examined. This is followed by a review of concerns about road safety and of empirical evidence of associations between road safety and physical activity among youth. Key tensions and variability of perceptions between parents and youth will be examined, and related social traps to which parents may be susceptible will be identified, followed by a discussion of physical and social environmental interventions aimed at improving related aspects of neighbourhood safety. A research agenda will be suggested for further study of perceived and objective measures of neighbourhood safety and their associations with children's physical activity.

The neighbourhood as a venue for physical activity

In the context of physical activity, the neighbourhood is important for a number of reasons. Firstly, the neighbourhood is a key setting for outdoor play and there is evidence that the time children spend outdoors is a strong determinant of overall physical activity (Klesges et al., 1990; Sallis et al., 1993, 2000). Secondly, because some teenagers, particularly girls, consider formal physical activity options as placing too much emphasis on competition and ability (Cormack, 1999; Brooks and Magnusson, 2007), neighbourhoods are potentially important because they can provide opportunities for less structured, more social opportunities for physical activity (Cormack, 1999, Humbert et al., 2006). Thirdly, the neighbourhood provides opportunities for inexpensive forms of physical activity, such as walking and cycling, which may be particularly important in areas of low SES (Humbert et al., 2006). Finally, physical activity in the neighbourhood may be more accessible to children as they may not need to rely on parents to provide transport.

Despite the opportunities provided by the neighbourhood for children's physical activity, many children, nowadays, may be classified as 'indoor children' who play predominantly within the confines of the home (Karsten, 2005). Access to electronic entertainment media at home, as well as restriction of play venues by parents have resulted in the home becoming a popular play space (Tandy, 1999; Karsten, 2005). While there are still children who could be described as 'outdoor children' who play on neighbourhood streets, others may be classified as children of the 'backseat generation' who are chauffeured regularly to structured activities, supervised by adults (Karsten, 2005). Although relatively few studies have examined the influence of the neighbourhood environment on children's physical activity, most consider some aspect of neighbourhood safety. In a comprehensive review of physical environmental influences on children's physical activity (Davison and Lawson, 2006), positive associations were identified between children's physical activity and pedestrian safety, access to and availability of recreational facilities, as well as availability of public transport. In contrast, traffic volume and local crime were negatively associated with children's physical activity (Davison and Lawson, 2006).

Concerns about neighbourhood safety

Safety is a complex concept and may include diverse components such as harm from strangers ('stranger danger'), personal injury, road safety and bullying. Studies examining parents' fears for their children's safety, however, highlight that the key concerns for parents are road safety and 'stranger danger' (Hillman et al., 1990; Scott et al., 2000; Mullan, 2003; Matthews, 1995; Burman et al., 2000; Valentine and McKendrick, 1997). For example, a qualitative study involving 400 households in England found that the overriding cause of restriction of children's unsupervised play was parental concern about road safety and 'stranger danger', regardless of whether adequate local play facilities were present (Valentine and McKendrick, 1997). With reference to their own childhood, parents believed that children now faced more risk, mainly from traffic and strangers (Valentine and McKendrick, 1997; Scott et al., 2000).

Concerns about strangers among parents

'Stranger danger' is, clearly, a major concern for parents (Timperio et al., 2004; Morris et al., 2001; Valentine 1997a). In an Australian study of perceptions of the neighbourhood and children's walking and cycling, 88% of parents of 5–6-year-olds and 81% of parents of 10–12-year-olds agreed that 'stranger danger' was of concern to them (Timperio et al., 2004). Such concern exists despite statistics demonstrating that sexual assault is less likely than other crimes against children to be inflicted by a stranger (Finkelhor and Ormrod, 2000). Although, a child is more likely to be assaulted by a family member or acquaintance (Finkelhor and Ormrod, 2000), random assault by a stranger is feared more (Ferraro, 1995). An Australian report by the Criminology Research Council (1998, p9) highlights a 'risk-victimisation paradox' whereby parents are overly anxious about their children's safety and exaggerate the risk of 'stranger danger'. There are multiple manifestations of 'stranger danger', such as unwelcome approaches by strangers, abduction, assault, molestation, even murder. Perpetrators may be adults, teenagers, or older children. For instance, teenagers meeting in parks may be viewed as unwelcome strangers and considered by parents and younger children as intruders in children's play venues (Scott et al., 2000; Veitch et al., 2006).

Concerns about strangers among youth

Research suggests that children and adolescents perceive public places to be less safe than the home. Burman et al. (2000) surveyed almost 700 Scottish girls aged 13–16 years about violence and violent behaviour. Over half (58%) expressed concerns about sexual assault by a stranger. The public arena (e.g. on the street, in parks, at a dance, at school) was considered the most likely venue for risk of witnessing violence. Furthermore, Scott et al. (2000) studied the impact of risk and parental anxiety on Scottish children aged 9–15 years and found that most children perceived risk to exist in the public arena, rather than at home. Perception of risk was inversely related to distance from home and protection of parents. Unlike their parents, children younger than 13 years made no connection between strangers and sexual risk, and instead were concerned about the risk of abduction, physical violence or murder (Scott et al., 2000).

Empirical studies of 'stranger danger' and physical activity

There is little empirical evidence that demonstrates direct associations between concerns about 'stranger danger' and children's physical activity. No associations were found between parents' concern about strangers and walking or cycling among children in the study by Timperio et al. (2004). While that finding may at first appear surprising, it may reflect the high proportion ($>80\%$) of parents who expressed this view. Furthermore, in another Australian study (Carver et al., 2005) no associations were found between adolescents' concerns about strangers, or concerns about older youths, and adolescents' walking and cycling in their neighbourhood. Among those adolescents, 39% of boys and 40% of girls were worried about strangers, while 16% of boys and 18% of girls were worried about older youths. For adolescent girls, however, perceived interaction with neighbours and friends was positively associated with walking to school and other neighbourhood destinations (Carver et al., 2005). Other research suggests such social interaction may contribute to a sense of safety (Burman et al. 2000; Valentine, 1997b).

Most studies that have examined neighbourhood safety have focused on perceptions of safety rather than objective measures (Carver et al., 2005;

Timperio et al., 2004; Mota et al., 2005). Kawachi and Berkman (2003) highlight the importance of collecting both subjective and objective ratings of neighbourhood attributes such as crime rates. They argue that 'subjective rating of crime (and fear of crime) is a stronger predictor of behaviour (e.g. reluctance to go outdoors to exercise) than are actual crime rates' (Kawachi and Berkman, 2003, p. 14). For example, parents' perceptions of neighbourhood safety may be shaped by signs of physical degradation rather than crime statistics and these perceptions may influence whether or not parents take a child to a playground (Burdette and Whitaker, 2004).

Two empirical studies have examined both perceived and objective measures of neighbourhood safety and their associations with adolescents' physical activity (Gomez et al, 2004; Molnar et al., 2004). While neither study focused specifically on 'stranger danger', the first examined violent crime (which may include attack by strangers) in the neighbourhood (Gomez et al., 2004), and the second study measured physical- and social disorder, as well as perceptions of the neighbourhood as a safe place to play (Molnar et al., 2004). Gomez et al. (2004) examined associations between violent crime in the neighbourhood and non-school-based outdoor physical activity among inner-city Mexican-American adolescents. Participants responded to the statement 'Not feeling safe in my neighbourhood keeps me from exercising', and mean bouts per week were calculated for a range of outdoor physical activities using their self-reported data. For adolescent girls, the number of violent crimes committed within a radius of 0.5 miles of their home during the past year was negatively associated with their outdoor physical activity. Girls who did not consider neighbourhood safety as a barrier to exercise had higher levels of outdoor physical activity. There were no significant associations between these variables for boys (Gomez et al., 2004).

Molnar et al. (2004) examined the effect of living in unsafe, disordered neighbourhoods on the physical activity of adolescents (aged 11–16 years) using video recordings to assess 'social disorder' (e.g. public drunkenness) and site visits to assess 'physical disorder' (e.g. wrecked vehicles). Perceptions of the availability and safety of parks/playgrounds, maintenance of play facilities and the reliability of adults for surveillance were collated to assess each neighbourhood as a safe place for children to play. After controlling for SES, sex, age, body mass index and ethnicity; 'social disorder' and residents' perception of the neighbourhood as 'unsafe to play' were negatively associated with time spent engaged in recreational physical activity. The association between 'physical disorder' and physical activity was negative also, but non-significant.

Concerns about road safety among parents

It appears that some parents may be more concerned about road safety than about 'stranger danger', although in New Zealand this was shown to vary by suburb (Tranter and Pawson, 2001). Hillman et al. (1990) found that over 40% of English parents restricted schoolchildren aged 7–11 years from coming home alone from school because of traffic danger, while around 20% of parents enforced this restriction due to fear of assault or molestation by an adult. While parents' concerns about strangers are unrelated to the actual frequency of abductions or molestation of children by strangers, concerns regarding child pedestrian injury may be substantiated by accident statistics. Between 1991 and 1995, 'transport accident' was the leading cause of death by injury among 1–14-year-old children in the world's more developed countries (UNICEF, 2001) and most children injured in road accidents are pedestrians (Hillman et al., 1990). In an Australian study, local streets were identified as the most frequent venue for child pedestrian injuries (Stevenson et al., 1992), while an English study found that over 60% of such injuries are sustained within 500 m of the victims' homes (Petch and Henson, 2000). Hence, road safety in the neighbourhood may be a valid concern.

Parental restriction of their children's independent mobility may be influenced by parental perceptions of local road safety, as well as the occurrence of accidents within the neighbourhood. For example, two Australian studies found that parental perceptions of unsafe road environments were negatively associated with walking and cycling among 10–12-year-olds (Timperio et al., 2004) and adolescents (Carver et al., 2005). Furthermore, a study in Maryland, USA (Gielen et al., 2004) found that 70% of parents of junior schoolchildren restricted their children's outdoor play venues because of 'unsafe cars and trucks', regardless of rate of child pedestrian injury there.

Concerns about road safety among youth

Road safety was found to be a major concern among children in a study of English children aged 9–11 years (Matthews, 1995). When asked to describe locations outside home that they considered 'scary and dangerous', 91% of children cited the main road (Matthews, 1995). Further perceptions of the neighbourhood were recorded in Mullan's study (2003) involving over 5000 Welsh schoolchildren aged 11–16 years. Those children who reported more traffic and/or parked cars on their local streets were less likely to perceive their neighbourhood as a favourable place in which to grow up (in terms of general safety), a safe environment for outdoor play or for walking alone, a venue for social interaction with neighbours and a place with pleasant parks and playgrounds. The results were unaffected by SES (Mullan, 2003).

Few studies have examined associations between adolescents' perceptions of road safety and their physical activity. One such study, in Australia, reported that adolescent girls' perception of local road safety was positively associated with their walking for exercise and for transport (Carver et al., 2005). By contrast, a Portuguese study found no associations between adolescents' perceptions of road safety and their physical activity (Mota et al., 2005). In that study, self-reported physical activity included participation in organised sport outside school hours, which often takes place in a supervised environment within a sports facility and may be affected less by local road safety.

Empirical studies of road safety and physical activity

To date, there is limited empirical evidence of the impact of road safety on physical activity in the neighbourhood. In a New York study (Weir et al., 2006), parents of 5–10-year-old children residing in either a low SES inner city area or a medium SES suburb completed a questionnaire on concerns about neighbourhood safety and reported how physically active their children were in various settings. Overall, inner-city parents were more worried about neighbourhood safety than suburban parents and this concern was negatively associated with children's levels of physical activity (Weir et al., 2006). In particular, 60% of inner-city parents considered the traffic volume in the neighbourhood to be too great for their children to play outdoors, compared with 27% of suburban parents who held this view. Among empirical studies there is growing interest in objective measures of road safety. For example, the need to cross a busy road on the most direct route to school, identified using a Geographical Information System (GIS), was negatively associated with walking/cycling to school among 5–6-year-olds and 10–12-year-olds in Melbourne, Australia (Timperio et al., 2006).

To date, most of the studies that have examined associations between neighbourhood safety and physical activity among children or adolescents are cross-sectional. A 1-year longitudinal study of adolescent girls in the USA found that perceptions of neighbourhood safety had no direct influence on their physical activity (Motl et al., 2005). However, perceptions of neighbourhood safety were measured by posing a question regarding the safety of the neighbourhood for solitary walking/running and another single question on whether barriers such as traffic, lack of walking paths, and the presence of stray dogs or gangs reduced ease of walking/running. Thus, Motl et al. (2005) assessed neighbourhood safety generally, rather than asking separate questions regarding individual barriers to walking, such as the presence of gangs, and the questions were specific to walking/running. Furthermore, most girls reported high perceptions of neighbourhood safety and this homogeneity may have contributed to the lack of direct association between neighbourhood safety and physical activity.

Comparison of parents' and children's perceptions of neighbourhood safety

It is worthwhile to compare parents' and children's perceptions of neighbourhood safety and to discuss key tensions. Road safety is, clearly, a concern for both parents and children (Hillman et al., 1990; Tranter and Pawson, 2001; Gielen et al., 2004; Timperio et al., 2004 Mullan, 2003; Matthews, 1995), but few studies have compared perceptions of parents with those of their children. One such study (Timperio et al., 2004) found that Australian children aged 10–12 years were less concerned about road safety than their parents. However, parental perceptions rather than children's perceptions of road safety had stronger associations with children's walking and cycling in the neighbourhood suggesting that parents influence and/or control these behaviours. The study by Hillman et al. (1990) demonstrated that parents' concerns about road safety result in the restriction of children from

coming home from school unaccompanied. However, parents of older rather than younger children are less concerned about road safety (Timperio et al., 2004; Hillman et al., 1990), possibly because children's traffic negotiation skills improve with increasing age (Ampofo-Boateng and Thomson, 1991).

The findings of Timperio et al. (2004) and Hillman et al. (1990) suggest that due to the perceived risk of child pedestrian injury, parents may engage in 'constrained behaviour' with regard to their children's physical activity. 'Constrained behaviour' is described as the modification of routine habits and activities by Ferraro (1995) who identifies 'fear' and 'constrained behaviour' as possible responses to risk of victimisation. Depending on the degree of perceived risk, either 'defensive' or 'avoidance' behaviour may result (Ferraro, 1995). Examples of 'defensive behaviour' include parental accompaniment while walking to school and restriction of outdoor play to the backyard, while examples of 'avoidance behaviour' include driving the child to school instead of allowing the child to walk or cycle, or forbidding unsupervised outdoor play. Although descriptive studies exist, there is little empirical evidence of the extent and type of parental restrictions on children's physical activity and the effect of these restrictions on their children's physical activity in the neighbourhood. Furthermore, there is little empirical evidence of how much children constrain their own behaviour in response to their own perceptions of risk.

Parents, children and adolescents are concerned about strangers (Timperio et al., 2004; Morris et al., 2001; Scott et al., 2000; Burman et al., 2000; Valentine, 1997a) but the level of concern is greater among parents (Timperio et al., 2004). Valentine (1997b) reports that, even prior to adolescence, boys and girls demonstrate a degree of perceived invincibility. While boys are confident about looking after themselves, girls rely more on the company of friends and familiarity with their surroundings in order to feel safe (Valentine, 1997b). As discussed earlier, a Scottish study found that children aged up to 12 years did not share their parents' concern about sexual assault by strangers, instead worrying more about the risk of abduction, physical violence or murder (Scott et al., 2000). By contrast, teenage girls have shown concern about being attacked or sexually assaulted in public (Burman et al. 2000).

Parental concerns about strangers appear to vary by sex of the child. An English study found that almost twice as many parents of adolescent girls as boys restricted their child from venturing out alone due to fears of molestation or assault (Hillman et al., 1990), and such concerns were reported further by girls' parents in a New Zealand study (Tranter and Pawson, 2001). Valentine (1997a) reports similar levels of parental concern about sons and daughters being assaulted, with teenage daughters being perceived to be at risk of sexual assault, while teenage sons are perceived to be at risk from public brawls. A qualitative study by Valentine (1997b) demonstrates that parents and children often hold conflicting views regarding children's abilities to remain safe in public when unaccompanied by adults. This may prompt regular renegotiation of parental rules governing their children's independent mobility according to age, maturity and demonstrated ability to avoid danger in public (Valentine, 1997b).

Social traps

In relation to parental concerns about neighbourhood safety, Tranter and Pawson (2001) describe parents' vulnerability to 'social traps'. For example, by chauffeuring their children to school, parents aim to protect their children from the traffic danger to which they are contributing. Furthermore, Mullan (2003) suggests that road safety concerns may heighten anxiety about strangers, since road safety concerns may lead to less outdoor play, cycling or walking. This in turn may result in fewer people being out and about in the neighbourhood, less familiarity with people living locally and increased fear of 'stranger danger'. Parents, in turn, sense a need to chauffeur their children, but the subsequent increase in traffic volume accentuates road safety fears thus creating a 'downward spiral of fear' (Mullan, 2003). By contrast, greater social interaction may be related to increased independent mobility among children. For example, in Italy, positive associations have been demonstrated between mothers who interact with neighbours and feel part of the community and their children's independent mobility (Prezza et al., 2001, 2005).

Interventions to improve road safety

Concerns about road safety are pervasive and appear to impact on children's physical activity. Several physical- and social environmental

interventions have been trialled to improve neighbourhood safety, however little is known about the impact of such interventions on physical activity. While the effectiveness of traditional child road safety education in reducing child pedestrian injuries is debated (White et al., 2000; Posner et al., 2002; Thomson, 1997), recent research has shifted emphasis to the modification of road/neighbourhood environments to increase the safety of pedestrians, cyclists and children at play. Petch and Henson (2000) state that it is now generally accepted that road accidents involving children are the result of a combination of factors including the behaviour of the driver and/or child and the physical/social environment. As a consequence, child road safety policy in Great Britain has concentrated on the adaptation of the physical and social environment of the transport network to the needs of the child, rather than attempting to alter the child's behaviour (Petch and Henson, 2000). It is possible that passive road safety interventions, that involve modifying the road environment to improve safety, may be more beneficial to all residents of a neighbourhood.

One such passive, environmental, road safety intervention is traffic calming, which involves measures to reduce speed and/or volume of traffic where appropriate. This idea evolved from the design of the Dutch 'Woonerf' or 'street for living' which promoted the coexistence of pedestrians, cyclists and motor cars, facilitated by reengineering of the residential streetscape to include speed humps, vegetation and narrow sections of road (Petch and Henson, 1999; Harvey, 1992). Kerbs were removed, so there was no longer segregation between walkways and the road, which was deemed fit for children's play. Vehicles were permitted to enter this pedestrian-oriented space, but were subject to speed restrictions and prohibition of on-street parking (Petch and Henson, 1999; Harvey, 1992). The success of such pedestrian safety interventions is reflected in low child pedestrian injury rates in the Netherlands, despite the country's high population density (Petch and Henson, 1999; Preston, 1995) and high participation rates in active transport (Pucher and Dijkstra, 2003).

While the physical restructuring of residential streets proved costly, Woonerf initiatives such as low speed limits in built-up areas (e.g. 50 km/h in Victoria, Australia) (Vicroads, 2002) and speed humps have been introduced internationally (Harvey, 1992). Speed humps, in particular, are associated with reduced risk of child pedestrian injury. A Californian study (Tester et al., 2004) found that the odds of a child being injured or killed when struck by a motor vehicle were reduced by 53–60% if the child lived in a street on which a speed hump was located. A recent adaptation of the 'Woonerf', known as a 'home zone' has been pilot tested in UK. Although yet to be independently evaluated, early indications suggest that parents' concerns about road safety have decreased and children's outdoor play and independent mobility have increased in areas which have been restructured as home zones (Gill, 2006).

Physical environmental interventions which aimed to encourage walking and cycling to school, in particular, have been funded by the California Safe Routes to School (SR2S) program (Boarnet et al., 2005). An evaluation of the program in ten schools located in areas with varied demographics and urban design found that the frequency of children's active transport increased following the construction and maintenance of sidewalks and the installation of traffic lights on the way to school (Boarnet et al., 2005). An earlier evaluation of the Safe Routes to School program in Marin County, California reported substantial increases in walking (64%) and cycling (114%) trips between home and school following mapping and promotion of safe routes for walking and cycling to school, as well as education on active transport (Staunton et al., 2003). While infrastructure changes to promote road safety in Marin County had been funded, they were not included in this evaluation (Staunton et al., 2003).

In addition to physical environmental interventions, several social interventions have aimed to promote active transport to school. These include designated days on which walking to school is encouraged, as well as walking- and cycling-school buses. For example, in Australia Walk Safely to School Day (Pedestrian Council of Australia, 2007) is an annual event to encourage safe active transport to school among primary school children. Tranter and Pawson (2001) argue, however, that although increased walking to school has been demonstrated on similar walk-to-school days in New Zealand and UK, parents may succumb to the social trap discussed earlier, unless most parents commit to the maintenance of their children's habitual active transport. Parents often return to driving their children to school rather than encouraging active

transport, if they suspect that other families are no longer engaging in active transport (Tranter and Pawson, 2001).

By contrast, a Walking School Bus aims to promote safe walking to/from school on a regular basis. The 'bus' comprises a group of children who walk together to school along a set route, led by an adult 'driver' with an adult 'conductor' at the rear (VicHealth, 2007). Children are picked up or dropped off at 'bus stops', which are often outside the children's homes. Such an initiative provides regular physical activity opportunities not only for children, but also for 'drivers' and 'conductors' who are often volunteer parents (Tudor-Locke et al., 2001). Furthermore, it is possible to expand this concept to create cycling school buses, known as 'Pedal Pods' in Victoria, Australia. Participating children must be competent cyclists and wear appropriate reflective clothing and helmets, while adult volunteers must complete training on bicycle education (Bicycle Victoria, 2007).

While the Walking School Bus program was first introduced in the late 1990s in UK and New Zealand (Collins and Kearns, 2005), a pilot-test of the Walking School Bus program in Victoria, Australia between 2001 and 2002 found that as well as increasing physical activity levels among participants, other benefits included opportunities for social interaction among children and the easing of traffic congestion around schools (Vichealth, 2007). Similar benefits were identified by a study of Walking School Buses in Auckland, New Zealand (Collins and Kearns, 2005), but Walking School Buses were found to be less prevalent in low SES areas than in high SES areas, due to a lack of volunteer parents. This is of concern as low SES areas have been associated with increased risk of child pedestrian injury (Laflamme and Diderichsen, 2000).

Not all transportation researchers, however, praise initiatives such as the Walking School Bus (Tranter and Malone, 2003). For example, Hillman (2006) argues that such programs promote feelings of irresponsibility among parents if they do not always accompany children when outside the home, or arrange for another adult to do so. Furthermore, he identifies the emphasis of safety initiatives on the journey to school, rather than on other leisure-time trips, as overly simplistic as children's lives are not only focused on school (Hillman, 2006).

Conclusions

Evidence suggests that low levels of active transport and physical activity among children in their neighbourhood are associated with lack of perceived neighbourhood safety. Most studies that demonstrate these associations, however, are cross-sectional and causality thus cannot be inferred. Many studies have recorded only perceptions of safety rather than objective measures, with a focus on overall safety, or safety from a variety of factors rather than specific aspects, such as the existence of traffic calming measures. There is a distinct lack of empirical studies that explore associations between specific aspects of neighbourhood safety and children's physical activity. In particular, there is a need for longitudinal studies to explore these associations over time to determine causality.

Road safety and 'stranger danger' appear to be major causes of parental anxiety in relation to their children's safety in the neighbourhood. Such concerns may cause parents to restrict their children's outdoor play and active transport. In addition, parents may fall victim to social traps, in their desire to be considered as responsible parents by conforming with the practices of other parents who, for example, drive their children to school and make sure they are accompanied by adults at all times. The limited evidence suggests that parents' views rather than children's are stronger influences on children's physical activity, including independent free play and active transport within the neighbourhood. Adolescence, however, has been identified as a period of renegotiation of scope for independent mobility. Further research is needed to objectively measure neighbourhood road safety by analysing road characteristics and traffic calming measures in detail, and to examine its influence on children's physical activity and active transport. It is unclear whether objectively measured road safety has more impact on children's physical activity in the neighbourhood than perceptions of road safety or 'stranger danger'. As discussed earlier, perceptions of 'stranger danger' are not generally supported by statistics on abduction or assault, but cannot be ignored if habitual physical activity is constrained as a result.

In addition, perceptions of risk of child pedestrian injury or 'stranger danger' and consequential behavioural constraints should be examined in relation to children's physical activity in the neighbourhood. It is unclear to what extent these

perceptions are shaped by possible influences such as local crime rates, traffic conditions, neighbourhood incivilities (e.g. graffiti; presence of inebriates) and direct or indirect experience of victimisation. Such research may guide public health interventions to increase children's physical activity in the neighbourhood. A multi-disciplinary approach may be required considering the breadth of interest in the subject matter across diverse fields such as public health, accident prevention, transport and urban planning.

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