

The Influence of Vehicular Traffic Upon Physical Activity in Children

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INTRODUCTION

Despite universal agreement that physical activity is an important priority for health (World Health Organisation, 2002), our understanding of those factors that influence physical activity behaviour remains incomplete. Unsafe roads and increased use of motorised transport have been associated with escalating levels of obesity worldwide (Bhave et al., 2004; Frank et al., 2004). It has been suggested that vehicular traffic is a substantial impediment to a child's ability to be physically active during daily life, such as commuting to school or social play outside of the home (Hillman, 2000; Hillman et al., 1991; Tudor-Locke et al., 2001). Davis and Jones (1997) suggested that those children who live in areas with high volumes of traffic may suffer from traffic-induced social exclusion. This situation results in youngsters spending most of their time indoors because of parental fears of traffic accidents and 'stranger-danger'. Unfortunately for many children living in highly urbanised cities, the indoor home environment is physically restricted, affording little opportunity to be active (Johns and Ha, 1999). Restrictions on children's ability to engage in active and independent play appear more marked in younger children and in girls, with distinct ethnic differences apparent (Karsten, 1998; Katz, 1993; Kyttä, 2004; Prezda et al., 2001). In contrast, traffic calming or traffic reduction has been associated with an increase in children's play activity (Nakahara et al., 2004).

This study explored whether complete absence of vehicular traffic would result in higher levels of physical activity in children. Two neighbourhoods within the Hong Kong Special Administrative Region of China (HKSAR), with similar socio-economic and ethnic mix, were chosen to test the hypothesis that children living without exposure to vehicular traffic would be more physically active.

METHODOLOGY

Two districts were selected within the HKSAR. Detailed description of the district, population, amenities and traffic flow were obtained from the

Planning Department, Leisure and Cultural Services Department and Transport Department of the HKSAR government respectively.

The first district is a highly urbanized 'new town'. It has a population density of approximately 10,000 per km². There are various public recreation facilities available in the district including two swimming pools, four parks, seven outdoor basketball courts, twenty tennis courts, one full-size athletics track and four indoor sports centres, and these are all accessible by public transport. This is a high-rise residential district, as well as an active commercial town, with low levels of inter-personal crime. There are major two- and three-lane roads throughout this district, with a large volume of buses, minibuses, taxis and private cars. Schools were chosen around three road junctions, which recorded average daily vehicle traffic flow of 27,450 at road one, 36,570 at road two and 43,610 at road three. Streets are well paved and well lit, but have little tree coverage and join directly to the road. There are no cycle paths, and cycling is not common. This district is labelled the Traffic District (TD) throughout this paper.

The second district, an outlying island, is situated 10 km southwest of Hong Kong Island, accessible by high-speed ferry. It has a population density of approximately 12,000 per km², housed largely in high-rise accommodation. Commercial activities on the island revolve around the fishing industry and tourism. Many adults work off the island. There are no motor vehicles on the island, with the exception of a small fire engine and ambulance. Public recreation facilities include two gazetted beaches, twenty one small maintained playgrounds/gardens, four outdoor basketball courts, three tennis courts, one half size (250m) athletics track and two indoor sports centres, all within a 10 minute walk from schools or residential areas. There are well-lit paved paths connecting residential areas. Whilst cycling can occur safely, the high population of residents, small land mass and lack of separate cycling paths means walking is the dominant mode of transport. As with the TD, inter-personal crime is very low. This district is labelled the No-Traffic District (NTD) throughout the paper.

Morning section primary schools in the TD and NTD districts were recruited. Eligible 8-11 year old children in each school were randomly selected from those who volunteered. Ethical consent was obtained from the institutional committee and written informed consent to participate in the project was obtained from the parents. Height, body mass and date of birth of the participants were recorded at the schools.

The frequency, intensity and duration of physical activity were assessed using heart-rate telemetry. Heart rate was continuously recorded for 12 hour periods during the waking day (0730am to 1930pm) during three normal school days using a Polar computerized telemetry system. Two heart-rate thresholds were chosen to express the data, one which corresponds to moderate activity (>139 and <159 b.min⁻¹) and one for vigorous activity (>159 b.min⁻¹). These were chosen on the basis of laboratory work with Chinese children (McManus et al., 2004). Sustained bouts of 5, 10, and 20 minutes, as well as the percent time spent in each threshold, were computed.

DATA ANALYSES

Only children with all three days of data were included in the final analyses. Descriptive statistics (mean, SD) were determined for all variables. ANOVA was used to examine differences in age, height and body mass. The number of TD and NTD girls and boys who achieved 5, 10 and 20 minute bouts at the two heart-rate thresholds was compared using Chi-square (χ^2). The percent time spent above the two heart-rate thresholds was compared by district and sex using a 2 x 2 analysis of variance (ANOVA). Data were analysed with SPSS 11.0 software. The threshold for statistical significance was set at $p < 0.05$.

RESULTS

There were no significant differences ($P > 0.05$)

in age, height and weight between the two districts or by sex (see Table 1).

The χ^2 analyses showed the number of children who sustained 5, 10 or 20 minute periods with heart rates above 139 b.min⁻¹ or 159 b.min⁻¹ were similar between the two districts (see Tables 2 and 3). When the number of sustained bouts achieved at the two heart-rate cut-offs were compared by sex, the only significant difference was between the TD girls and boys, with more boys achieving 10 minute bouts above 139 b.min⁻¹ (χ^2 (4, $n=20$)=10.33, $p < 0.05$).

In the NTD, there was no significant difference ($P > 0.05$) between the girls and boys in the percentage of time they spent with heart rates above 139 b.min⁻¹ (boys 3.23% versus girls 2.8%). The ANOVA analyses revealed that the NTD boys spent a significantly ($p < 0.05$) greater percentage of time with heart rate above 159 b.min⁻¹ compared to the girls (boys 1.59% versus girls 0.64%). In the TD, the boys spent a significantly greater percent of their time with heart rate above 139 b.min⁻¹ compared to the girls (boys 4.1% versus girls 1.3%).

When the NTD and TD were compared, there was no difference in the percentage of time with heart rate above 139 b.min⁻¹ for the boys. However, the girls from the TD spent significantly less time ($p < 0.05$) with heart rate above 139 b.min⁻¹ compared to those in the NTD.

DISCUSSION

In contrast to the expected outcome, there was only marginal evidence of any difference in physical activity between those living in a traffic-free environment compared to those living with traffic. Neither group of children could be classified as 'active' based on either sustained or accumulated guidelines for physical activity in children and adolescents (Biddle et al., 1998; Sallis and Patrick, 1994). The two groups of children attended a half-day primary school, which would imply ample opportunity to be physically active, yet it would appear from these data that considerable restrictions

Table 1: Physical characteristics of the children in the Traffic District (TD) and No Traffic District (NTD). Values are expressed as mean (SD)

	Boys		Girls	
	TD ($n=21$)	NTD ($n=20$)	TD ($n=14$)	NTD ($n=20$)
Age (years)	8.90 (1.20)	9.67 (0.89)	9.10 (0.60)	9.62 (1.01)
Height (m)	1.31 (0.06)	1.38 (0.08)	1.29 (0.05)	1.35 (0.08)
Weight (kg)	28.81 (6.27)	31.20 (7.85)	27.34 (4.71)	29.86 (7.67)

Table 2: Number (%) of boys from the Traffic (TD) and No Traffic District (NTD) who sustained periods with heart rate either >139 b.min⁻¹ or >159 b.min⁻¹ during three school days of monitoring

Period	No.	139 b.min ⁻¹		159 b.min ⁻¹	
		TD (n=21)	NTD (n=20)	TD (n=21)	NTD (n=20)
5 min	0	3 (14)	2 (10)	11 (52)	50 (50)
	1	6 (29)	6 (30)	6 (29)	5 (25)
	2	2 (10)	2 (10)	3 (14)	2 (10)
	> 3	10 (48)	10 (50)	1 (5)	3 (15)
10 min	0	7 (33)	8 (40)	16 (76)	19 (95)
	1	8 (38)	6 (30)	3 (14)	1 (5)
	2	4 (19)	5 (25)	2 (10)	0
	> 3	2 (10)	1 (5)	0	0
20 min	0	18 (86)	17 (85)	20 (95)	19 (95)
	1	3 (14)	2 (10)	1 (5)	1 (5)
	2	0	1 (5)	0	0
	> 3	0	0	0	0

Table 3: Number (%) of girls from the Traffic district (TD) and No Traffic district (NTD) who sustained periods with heart rate either >139 b.min⁻¹ or >159 b.min⁻¹ during three school days of monitoring

Period	No.	139 b.min ⁻¹		159 b.min ⁻¹	
		TD (n=14)	NTD (n=20)	TD (n=14)	NTD (n=20)
5 min	0	8 (57)	5 (25)	13 (93)	16 (80)
	1	3 (21)	6 (30)	1 (7)	4 (20)
	2	0	2 (10)	0	0
	> 3	3 (21)	7 (35)	0	0
10 min	0	12 (86)	13 (65)	14 (100)	20 (100)
	1	1 (7)	3 (15)	0	0
	2	1 (7)	2 (10)	0	0
	> 3	0	2 (10)	0	0
20 min	0	14 (100)	14 (100)	20 (100)	0
	1	0	1 (5)	0	0
	2	0	0	0	0
	> 3	0	0	0	0

on the mobility of the children exist.

It is interesting to note that gender differences existed in both districts. Twenty-nine percent of the traffic district boys compared to only 7% of the girls achieved two or more 10 minute bouts of moderate intensity activity. Over a 12-hour day the traffic district boys spent approximately 21 minutes more than the girls with a heart-rate within the moderate intensity threshold. In the non traffic district, only the percentage of time spent within the vigorous intensity threshold was greater in the boys; the boys spending 6.9 minutes more in this upper threshold than the girls. These results support much of the literature on the independent mobility of children in urban areas, which shows girls are underrepresented

in outside play regardless of ethnic group (Hillman, 2000; Karsten, 2003; Katz, 1993; Thorne, 1993). It has been suggested that the location of and facilities within the activity space, as well as issues of safety (both road and social) are particularly important for optimising girls' chances of being active (Karsten, 2003). The girls in the traffic district recorded the lowest physical activity levels, spending nearly 11 minutes less in moderate intensity activity than the non traffic district girls. This may suggest that heavy traffic places a burden specifically on girls in terms of restricting active behaviour.

There are a number of contextual features of the typical Hong Kong child's home life that may bear considerable influence on the opportunity to be physically active which should be considered. Many Hong Kong children are cared for by an elderly grandparent or a foreign domestic helper until parents return home from work. The adult care-giver may not be able or be allowed to take the child out. Recent research has indicated that the caregiver plays a crucial role in the modelling of physically active behaviour, as well as in the influence they have over household choices (Gordon-Larson et al., 2004). Children who are always accompanied by an adult have been found to play less with their peer group, either indoors or outdoors (Prezza et al., 2001). We know little about high-rise living and the sort of neighbourhood cohesion that such living produces. However, in their observational study, Johns and Ha (1999) found that despite living in very close proximity to other children, Hong Kong children rarely engaged in any social interaction because they were not allowed to leave the apartment unaccompanied.

Much emphasis is placed on academic achievement in Hong Kong Chinese society. The resultant pressure for children to perform well academically has led to the suggestion that other equally important components of development, such as physical or emotional development, are neglected (Salili et al., 2004). It is normal for children of this age to have at least 2 hours homework each day, and it is quite likely that these children return home immediately from school and spend the afternoon completing their homework tasks.

A weakness of this study is that no detailed assessment of actual or perceived neighbourhood characteristics or the home environment was made. Saelens et al. (2003) argue that when investigating the influence of neighbourhood characteristics on physical activity spatial multicollinearity, or the interaction between various characteristics should

be accounted for. They highlighted these kinds of interactions when they found that neighbourhoods with the highest population density had the highest number of walkers/cyclists. This co-related to the land mix, with the greatest connectivity between commercial and residential areas producing the highest levels of walking or cycling.

This study has highlighted that children in Hong Kong are inactive, regardless of whether they live in a traffic-free environment or not. Girls in urban areas with high traffic density appear to be particularly vulnerable to low levels of activity, suggesting a gender specific connection between traffic and physical activity. More detailed study of neighbourhood environments, as well as cultural and social measures of the family environment are needed to reveal how child-family-environment interactions mould physical activity habits and ultimately health in our younger population.

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KEYWORDS Children. Physical Activity. Traffic

ABSTRACT It is believed that vehicular traffic is a substantial impediment to a child's ability to be physically active. This study examined whether children who live in an environment free from vehicular traffic would be more physically active than those living with traffic. Two groups of children were selected from morning only primary schools in two distinct districts of Hong Kong: one with high vehicular traffic volume (TD), the other with none (NTD). Physical activity was assessed using heart-rate telemetry for three normal school days. No significant differences were found between the two districts in sustained bouts of physical activity. Significant ($p < 0.05$) gender differences were apparent in both the traffic and non traffic districts, with the girls consistently less active than the boys. The girls in the TD were the least active, spending 20 minutes less time ($p < 0.05$) within the moderate intensity threshold compared to the boys in that district, as well as 11 minutes less time in the same threshold compared to the girls in the NTD. This study concludes that the role traffic plays in the activity behaviour of Hong Kong primary school children is weak, however the girls in the TD appear to have a more restricted pattern of activity, which may suggest an interaction with high volumes of vehicular traffic.

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