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Intergenerational change in children's independent mobility and active transport in New Zealand children and parents

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ABSTRACT

Background: Previous research has indicated a decline in children's independent mobility; however, comparisons between directly-related generations are scarce. This study sought to determine the direct generational change in children's independent mobility and active transport in a large sample of New Zealanders.

Methods: 544 children (mean age 12.2 ± 0.6 years) and 500 parents (43.9 ± 5.8 years) participated in the study. Independent mobility (IM) was measured with IM Licences (parental permission to travel unsupervised) and IM Index (summed score from a questionnaire of destinations independently travelled). Questions on active transport, organsied activities, bicycle and vehicle ownership were also included. Parents recalled their behaviour retrospectively as 10–12-year-olds.

Results: Generalised linear modelling indicated that the proportion of parents who actively transported to and from school was significantly higher than in children (91.8% vs. 49.3% to school; 93.2% vs. 56.9% from school). The IM Index dropped generationally for both males (2.05 to 1.53) and females (1.77 to 1.40). Significant differences in IM Licences were also observed: parents being allowed to travel to school (OR 2.18 95% CI: 1.31, 3.63), cross main roads (OR 2.26 95% CI: 1.34, 3.71.), cycle main roads (OR 4.99 95% CI: 3.62, 6.87), and be out after dark (OR 3.05 95% CI: 2.12, 4.38) compared to children today. Bike ownership increased generationally with adults having an average of 2.5 bikes (95% CI: 2.37, 2.64) and children having 3.3 (95% CI: 3.05, 3.54). The average number of organised activities for adults was 1.8 (95% CI: 1.62, 1.89), which increased in children to an average number of 4.1 activities (95% CI: 3.89, 4.25).

Conclusion: These findings demonstrate a clear generational decline in children's independent mobility and active transport. Greater promotion of active modes of travel and unstructured roaming in the neighbourhood may be an important step in reversing the reduction in this fundamental behaviour.

1. Introduction

Physical inactivity is inextricably linked with lifestyle disease(Archer and Blair, 2011, World Health Organisation, 2010). The global prevalence of physical inactivity in youth(World Health Organisation, 2010, Currie et al., 2012) has prompted investigation into behaviours that may promote physical activity during this important developmental period. Recently, children's independent mobility and its apparent decline in recent years(Marquez et al., 2014, Stone et al., 2014) has gained interest as a potential contributor to low levels of physical activity. Independent mobility (IM) is defined as the ability to play and roam in the neighbourhood

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without adult supervision, either alone or accompanied by peers(Badland et al., 2015). It has been posited that IM provides an important opportunity for physical activity accumulation through spontaneous outdoor play and the use of active modes of transportation, both of which have been linked to a greater probability of achieving recommended levels of physical activity(Duncan et al., 2008, Cooper et al., 2005, Loucaides and Jago, 2008, Cleland et al., 2008, Stone and Faulkner, 2014).

It is widely acknowledged that a number of psycho-social and environmental factors have contributed to the reduction in children's opportunities for independent exploration of the neighbourhood. Potential influences which have been suggested, include increased screen time(Stone et al., 2014), increased media coverage of crime(Miller et al., 2008) and changes in suburban form including a reduction in green spaces(Witten et al., 2013) and urban sprawl with limited public transport(Freeman and Quigg, 2009). In addition, a preferred focus on academic and sporting achievement has potentially lead to an increase in structured afterschool activities(Witten et al., 2013, Badland et al., 2015, Schoeppe et al., 2015a). Parental concerns for their child's safety from fast-moving traffic and the presence of strangers in the streets have consistently been reported as the most significant influences on children's IM (Schoeppe et al., 2015a, Prezza and Pacilli, 2007, Prezza et al., 2001, Tranter and Pawson, 2001). It has also been regularly reported that parents allow boys greater freedom for autonomous roaming than girls(Mackett et al., 2007, Hillman et al., 1990, Tranter and Pawson, 2001, Badland et al., 2011), although emerging research suggests that the overall decline in children's IM is reducing this gender disparity(Shaw et al., 2013, Bhosale et al., 2015). Other potential influencing factors, such as car ownership, bicycle ownership, and the frequency of organised activities has yet to be explored with reference to IM licenses and practices.

Another recent issue which has the potential to significantly influence children's IM has been the drastic increase in car ownership worldwide. Global rates have risen from approximately 500 million in 1986 to 1.015 billion motor vehicles in 2010, and are predicted to reach 2 billion worldwide by 2030(Sperling and Gordon, 2009). Congruently, there has been a severe decrease in the use of walking and cycling as transport (active transport). In children, this has been most apparent in the decreased use of active transport to and from school. Many countries have reported findings that the majority of youth are driven to school including, Australia(van der Ploeg et al., 2007), Canada(Buliung et al., 2009), England and Norway(Fyhri et al., 2011). New Zealand is not immune; more than half of children's transport to and from school is by car(Auckland Regional Transport Authority, 2007), and overall walking in children aged 5–14 has decreased from an average of two hours and ten minutes per week in 1989/1990 to just under an hour and ten minutes per week in 2006/2009 (Ministry of Transport, 2010). It is likely there is a relationship between active transport and children's IM, with emerging evidence to indicate this(Villanueva et al., 2013), however further investigations with clear definitions of these terms are required to comprehensively understand this empirical relationship, especially across generations.

A number of investigations have attempted to quantify the decrease in children's IM. In England considerable decreases in children's IM licences (parental permission to be on their own) have been noted over last 40 years(Shaw et al., 2013). Specifically, the proportion of children aged 7–11 years travelling home from school without adult supervision was found to have dropped from 86% in 1971 to 25% in 2010(Shaw et al., 2013). Similarly, a recent Australian study investigating children's mobility over a 20-year period found the proportion of 8–13-year-olds travelling home from school alone dropped from 68% to 31%(Schoeppe et al., 2015b). Research conducted in Norway(Hjorhol, 2002), Italy(Prezza, 2007), Finland(Kyttä et al., 2015) and in other regions of England (Pooley et al., 2005) have shown comparable results.

Despite the accumulating research in this area, there remains a paucity of research exploring differences between IM across generations with directly related participants. Exploring intergenerational change in IM is crucial to accurately assess the extent of the decline, particularly given the influence of parental perceptions. A recent pilot study assessed differences in IM across three related generations (children, parents and grandparents). IM was measured through parental licences, allowances to go to certain locations (IM Index), and maximum independent roaming distance. Substantial intergenerational decreases were observed in all measures; however, this study was limited by very small sample size that lacked generalisability (Bhosale et al., 2015). In fact, the primary purpose of the pilot was to investigate the use of three distinct measures of IM to examine intergenerational change, but clearly a greater number of participants would be required to formulate generalizable conclusions. Similarly, in England a small study involving three generations from two families explored intergenerational changes in home range and found significant declines across each generation(Woolley and Griffin, 2015). In Australia, changes in neighbourhood use have been assessed between children aged 5–12 years old and their parents(Tandy, 1999). While this investigation did not specifically explore changes in IM, the difference in play-based activities was clearly seen, with children pursing considerably more television- and computer-based interests than their parents.

In addition to a lack of direct intergenerational comparisons, there have been inconsistencies in the conceptual definition and measurement of IM, limiting comparisons between countries even further. While parental licences are a traditional measure of IM (Hillman et al., 1990, Shaw et al., 2013, Tranter and Pawson, 2001, Stone et al., 2014, Shaw et al., 2015), there are disparities in the precise distinction of a parental IM licence, and further elucidation around the level of supervision is required(Bhosale et al., 2015). Similarly, while active transport to and from school has been a popular measure(Mammen et al., 2012, Mackett, 2013, Yang et al., 2014, Schoeppe et al., 2014), it is possible that this journey is not undertaken independently and may not be a sufficient measure of IM on its own(Schoeppe et al., 2015b). Nonetheless, as a potential influencer of children's IM, knowledge of how active transport has declined generationally may offer further insight into the extent of this issue. Emergent investigations using location-based parental licences to form an IM Index have also been used; this has been shown to be correlated with more geographical IM measures via online mapping(Bhosale et al., 2015). It has lately been suggested that a mixed methods approach may provide a more in-depth assessment of IM(Bates and Stone, 2014). Thus, the primary aim of this study was to compare differences in a number of current and historical IM indicators in a large sample of children and their parents. A secondary aim was to explore generational changes in other potential predictors of IM: car ownership, bicycle ownership, and organised activities.

2. Methods

2.1. Participants

A cross-sectional survey was completed across four intermediate schools (school years 7–8) in Auckland, New Zealand in 2013. Schools were purposively selected to obtain participants from a range of socio-demographic and ethnic backgrounds. Two schools had the highest socioeconomic decile rating (10), while the third had a decile rating of 6, and the fourth a decile rating of 3. Written informed consent from parents and assent from children were required for each dyad prior to being involved in the study. Ethical approval was obtained from the host institution's ethics committee (AUTEC 12/257).

All children and their parents from each school were invited to participate in the study. The children were given an information sheet, a questionnaire, and consent and assent forms to take home. Participants who gave assent (children) and consent (parents) returned the completed questionnaire and forms to school.

2.2. Measures

2.2.1. Independent Mobility

Questions that formed three measures of IM were included in both the child and parent questionnaires. The child participants reported their current IM allowances and mobility and parents recalled their personal experiences as a 10–12-year-old.

2.2.1.1. IM Licence. Parental licence questions (IM Licence) were replicated from those used in earlier studies(Hillman et al., 1990, Tranter and Pawson, 2001, Shaw et al., 2013). Participants were asked if they were allowed to do the following either by themselves or with friends (without an adult): travel to and from school, cross main roads, cycle main roads, catch a bus/train, or go out after dark. Participants were given the option of responding with either yes, no or not sure.

2.2.1.2. IM Index. Participants' permission to go to certain locations in their neighbourhood was assessed using a questionnaire previously used in another international study(Page et al., 2009), the responses to which formed a ranked index, trialled in a recent pilot study(Bhosale et al., 2015). Specifically, participants were asked "how often are you allowed to go to the following places on your own or with friends (without an adult)?" For each location (local shops, big shopping centre, park, sports centre, swimming pool, library, school, cinema, friend's house, other outdoor places [beach, river, bush], bus stop or train station and local streets) participants were given the following scale to choose from: never, sometimes, often, or always. Participants were given an additional option of "I do not go there" for locations that are not available in the area. A rank of either never (0), sometimes (1), often (2) or always (3) was assigned and then summed to give a total score. The summed total was divided by the number of places the participant went to (excluding the "I do not go there" responses), which gave an overall IM Index(Bhosale et al., 2015).

2.2.2. Active Transport

Participants reported their usual mode of transport to and from school. They were given five options: walk, car, cycle, bus, scooter or other. These options were categorised into active (walk, cycle or scooter) and non-active (bus or car). Parent's reported their usual travel mode to and from school as 10–12-year-olds.

2.2.3. Family and Demographic

Comprehensive demographic data were collected through the parent questionnaire, including year of the child's birth, gender, ethnicity, and the number of children in the family. The parents were invited to fill in their level of education and had five options to select from: finished primary school, finished high school, obtained university entrance, completed an apprenticeship or diploma, or completed university. Demographic data were also collected through the child's questionnaire (birth year, gender, number of siblings and ethnicity).

2.2.3.1. Bicycle and Vehicle Ownership. The current number of vehicles and bicycles in the household were reported and parents recalled the ownership number of both bicycles and vehicles when they were 10–12-years-old.

2.2.3.2. Organised Activities. Parents were also asked to list the organised sports or other organised activities they participated in during both summer and winter. In addition, children were asked to list the organised sports and other organised activities they participated in during the last full week (Monday to Sunday). The number of activities were totalled and compared to the total number of parent activities during the equivalent season (depending on the month of data collection).

2.3. Data Analysis

The six parental licenses and active transport practices were compared between generations and sexes via generalised linear models using a binomial distribution with a logit link function. This technique enables the odds of a parental license and the odds of active transport to/from school to be evaluated between each generation and sex group while allowing for the paired nature of parent/child dyads. Models were presented unadjusted (generation and sex separately) and adjusted (generation and sex together). Associations of the number of organised activities, the number of bicycles owned, the number of vehicles owned, and IM Index with

Table 1
Associations of parental licenses and active transport with generational group.

	No. of Participants (%)		Odds ratio (95% CI)	
	Yes	No	Unadjusted	Adjusted[a]
Allowed to travel to school unsupervised				
Child	446 (89.4%)	53 (10.6%)	1.00	1.00
Adult	422 (94.4%)	25 (5.6%)	2.01 (1.22, 3.29)*	2.18 (1.31, 3.63)*
Allowed to travel from school unsupervised				
Child	457 (91.6%)	42 (8.4%)	1.00	1.00
Adult	426 (98.3%)	21 (4.7%)	1.86 (1.08, 3.20)	2.01 (1.15, 3.50)
Allowed to cross main roads unsupervised				
Child	423 (88.5%)	55 (11.5%)	1.00	1.00
Adult	418 (93.9%)	27 (6.1%)	2.01 (1.24, 3.26)*	2.26 (1.34, 3.71)*
Allowed to cycle on main roads unsupervised				
Child	181 (43.2%)	238 (56.8%)	1.00	1.00
Adult	319 (76.1%)	100 (23.9%)	4.20 (3.12, 5.64)*	4.99 (3.62, 6.87)*
Allowed to ride a bus or train unsupervised				
Child	266 (62.4%)	160 (37.6%)	1.00	1.00
Adult	264 (67.0%)	130 (33.0%)	1.22 (0.92, 1.63)	1.28 (0.95, 1.72)
Allowed to be out after dark unsupervised				
Child	62 (14.2%)	375 (85.8%)	1.00	1.00
Adult	124 (29.7%)	293 (70.3%)	2.60 (1.82, 3.60)*	3.05 (2.12, 4.38)*
Actively travel to school				
Child	257 (49.3%)	264 (50.7%)	1.00	1.00
Adult	437 (91.8%)	39 (8.2%)	11.5 (7.94, 16.7)*	11.9 (8.15, 17.4)*
Actively travel from school				
Child	291 (56.9%)	220 (43.1%)	1.00	1.00
Adult	442 (93.2%)	32 (6.8%)	10.4 (6.99, 15.6)*	11.4 (7.57,17.2)*

* Significantly different from reference group ($p < 0.05$).
[a] Adjusted for sex.

Table 2
Associations of parental licenses and active transport with sex.

	No. of Participants (%)		Odds ratio (95% CI)	
	Yes	No	Unadjusted	Adjusted[a]
Allowed to travel to school unsupervised				
Female	543 (91.4%)	51 (8.6%)	1.00	1.00
Male	324 (92.3%)	27 (7.7%)	1.19 (0.70, 2.03)	1.39 (0.84, 2.30)
Allowed to travel from school unsupervised				
Female	554 (93.1%)	41 (6.9%)	1.00	1.00
Male	328 (93.7%)	22 (6.3%)	1.14 (0.64, 2.03)	1.33 (0.76, 2.32)*
Allowed to cross main roads unsupervised				
Female	527 (90.4%)	56 (9.6%)	1.00	1.00
Male	313 (92.3%)	26 (7.7%)	1.23 (0.73, 2.08)	1.58 (0.96, 2.61)*
Allowed to cycle on main roads unsupervised				
Female	311 (59.1%)	215 (40.9%)	1.00	1.00
Male	189 (60.8%)	122 (39.2%)	1.08 (0.80, 1.45)	1.78 (1.28, 2.47)*
Allowed to ride a bus or train unsupervised				
Female	331 (63.5%)	190 (36.5%)	1.00	1.00
Male	198 (66.4%)	100 (33.6%)	1.14 (0.84, 1.53)	1.21 (0.89, 1.65)
Allowed to be out after dark unsupervised				
Female	107 (19.6%)	438 (80.4%)	1.00	1.00
Male	79 (25.6%)	230 (74.4%)	1.40 (0.10, 1.20)	1.91 (1.34, 2.74)*
Actively travel to school				
Female	460 (72.9%)	171 (27.1%)	1.00	1.00
Male	234 (64.1%)	131 (35.9%)	0.69 (0.48, 0.98)	1.16 (0.84, 1.59)
Actively travel from school				
Female	474 (76.0%)	150 (24.0%)	1.00	1.00
Male	259 (71.9%)	101 (28.1%)	0.80 (0.54, 1.19)	1.42 (1.02, 1.98)*

* Significantly different from reference group ($p < 0.05$).
[a] Adjusted for generational group.

generational and sex groups (and their interaction) was assessed via generalised linear models using a normal distribution with an identity link. Statistical significance was set at $p < 0.05$, and all analyses were conducted using IBM SPSS Statistics (V. 20).

3. Results

A total of 2030 invitations were sent home with students of participating schools. Of these, 544 children (257 male and 272 female; mean age 12.2 ± 0.6 years) and 500 parents (118 male and 373 female; mean age 43.9 ± 5.8 years) completed the questionnaire (500 dyads of child-parent matched pairs). The ethnic distribution of child participants was European (n = 368, 76%), Asian (n = 50, 10.4%), Maori/Pacific Island (n = 41, 7.5%), and Other (n = 21, 4.4%). Parental ethnicity was European (n = 359, 77%), Asian (n = 53, 11.3%), Maori/Pacific Island (n = 41, 8.8%), and Other (n = 14, 3%).

Table 1 shows parental licenses and active transport practices compared by generational group. The odds of parents being granted permission to travel to school unsupervised was twice that granted to children today. Parents were also twice as likely to be allowed to cross main roads than children. Compared to children, parents were five times more likely to be granted permission to cycle main roads. In addition, parents were three times more likely to be allowed out after dark compared to children today. All differences in odds ratios were statistically significant ($p < 0.05$), even after adjustment for sex. While slightly more parents were allowed to travel from school unsupervised and use public transport, these differences were not statistically significant.

In regard to absolute findings, the majority of parent participants were permitted to travel to and from school, cross main roads, cycle main roads and travel on buses/trains unsupervised. Similarly, the majority of child participants still reported permission to travel to and from school, cross main roads, and travel on buses/trains. In contrast to parents, a minority of children were permitted to cycle main roads. Few parents were permitted out after dark; however, this was double the number of children. The majority of parents took active transport modes to school and from school, whereas the proportion of actively transporting children was significantly lower.

Table 2 displays the comparisons in parental licenses and active transport by sex. More males than females were granted parental licences (in all variables), and permission and to actively travel to and from school. Interestingly, differences between males and females were only significant after adjustment for generational differences. This is likely because sex differences in licenses and active transport were greater in the parent group than in the child group. Males were 1.3 times more likely to be allowed to come home from school along, 1.5 times more likely to be allowed to cross main roads, 1.8 times more likely to cycle main roads and 1.9 times more likely to be allow out after dark. With regard to active transport, males were 1.4 times more likely to use active modes of travel home

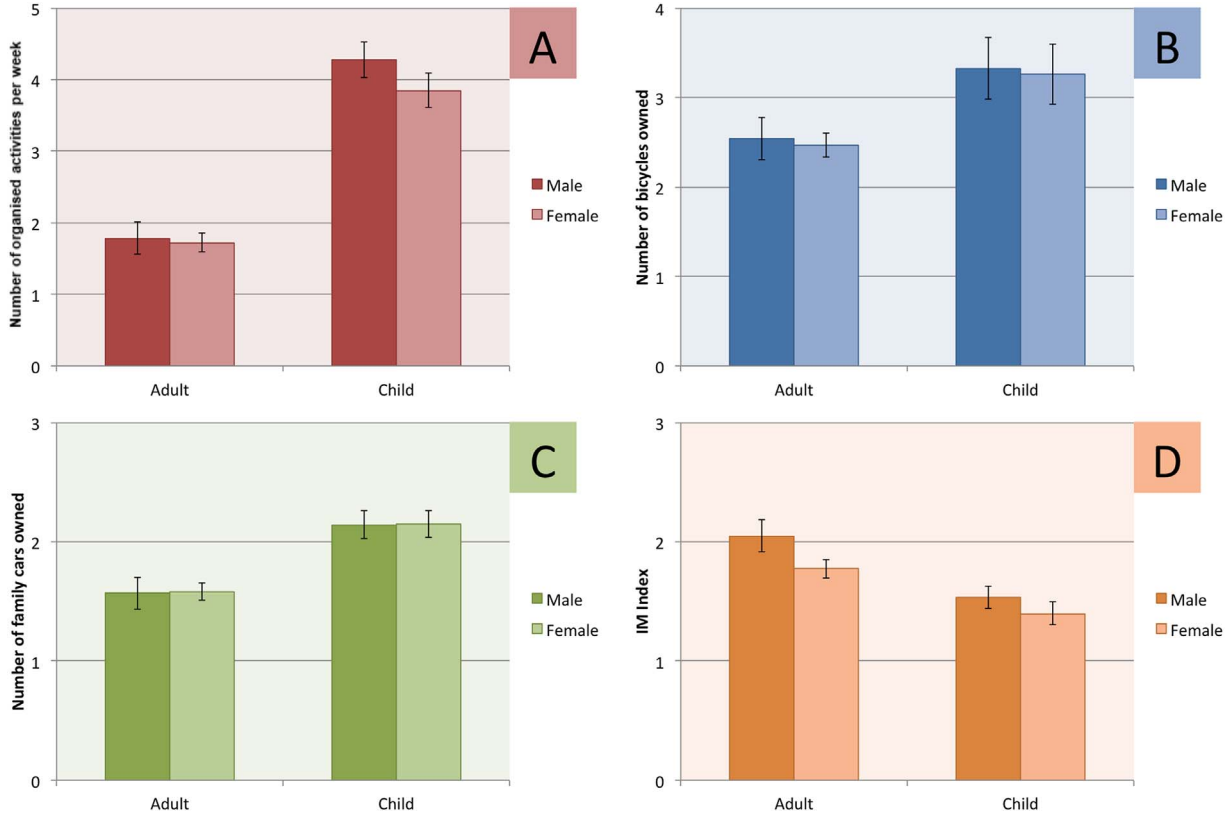

Fig. 1. Generational differences in the number of organised activities (A), the number of bicycles owned (B), the number of family cars owned (C), and IM Index (D) grouped according to sex.

from school than females (OR 1.42 95% CI: 1.02, 1.98).

Fig. 1 shows the generational differences in IM Index, organised activities, and the number of bicycles and vehicles per household. There were no significant effects of ethnicity or education level and these factors were excluded from the analyses. There was a significant decrease in IM Index scores between parents and children for both males (2.05-1.53) and females (1.77-1.40). Boys experienced greater IM Index scores for both generations. In addition, the average number of cars per household for parents was 1.6 (95% CI: 1.50, 1.65), which increased to an average 2.1 for children (95% CI: 2.06, 2.22). Bike ownership also increased generationally with adults having an average of 2.5 bikes (95% CI: 2.37, 2.64) and children having 3.3 (95% CI: 3.05, 3.54). The average number of organised activities for adults was 1.8 (95% CI: 1.62, 1.89), which increased in children to an average number of 4.1 activities (95% CI: 3.89, 4.25). Boys were involved in more organised activities for both children and adults. There was no interaction between generation and sex for any of the outcome variables.

4. Discussion

There is strong evidence to suggest that children's ability to play and roam in the neighbourhood without adult supervision has decreased drastically from previous generations (Hillman et al., 1990, O'Brien et al., 2000, Tranter and Pawson, 2001, Karsten, 2005). However, accurate comparisons between countries and studies has previously been hindered by a lack of research exploring intergenerational differences, especially with a large sample size and inconsistencies with how IM has been defined and measured. It is believed that this is one of the first studies to investigate generational change in IM across a large sample of directly related participants using a number of measurement techniques.

Our findings indicate that there were substantial intergenerational differences in children's IM compared to their parents. The significant generational decreases in IM Index data and a number of IM Licences corresponds with our previous work (Bhosale et al., 2015) and other similar international studies. Not specially using related participants, a recent study in Australia investigating IM changes in 8–13-year-olds found declines in the proportion of children allowed to travel to and from school unsupervised and allowed to go on a bus alone (Schoeppe et al., 2015b). Similarly, in Finland declines were observed in almost identical mobility licences for children aged 7–15 years old (Kyttä et al., 2015).

The data do suggest, however, that despite greater restrictions in parental licences between generations, the majority of the child participants were still granted a number of licences including being allowed to travel to and from school, cross main roads, and travel on buses/trains (62%-91.6%). These findings are similar to a previous New Zealand study (Tranter and Pawson, 2001), which used almost identical parental licences to investigate children's IM in another large city (Christchurch). International investigations of children's parental IM licences have to date reported mixed findings. Studies in England (Hillman et al., 1990), Australia (Schoeppe et al., 2015b), Norway (Hjorhol, 2002) and Italy (Prezza, 2007) have indicated only a small percentage of children are granted parental licences (Hillman et al., 1990, Prezza, 2007, Hjorhol, 2002, Schoeppe et al., 2015b), whereas studies in Germany (Hillman et al., 1990) and Finland (Kyttä et al., 2015) have reported findings similar to ours. (Kyttä et al., 2015, Shaw et al., 2015). Recently, a large comparability study comparing children's IM licenses across 16 countries found significant disparities between countries (Shaw et al., 2015). It is possible that the variation among studies is a reflection of inconsistencies in the term *unsupervised*, with some studies only defining IM as either the presence or absence of an adult (Bhosale et al., 2015) without considering the companionship of siblings or peers, which has been shown to influence parental permission for allowing IM (Prezza and Pacilli, 2007). The higher parental licences observed in this study may have been as a result of participants including licences granted on the proviso of being with a group of friends or siblings. Care in the definition of children's IM data would be important in future studies.

Another key finding was that the sex differences in IM licenses and active transport were not identical between generations. From our data, it appears that boys were given greater license to roam than girls in previous generations. While there appeared to be similar generational differences between mean boys and girls IM index (Fig. 1), these trends were not significant. Nonetheless, the gender disparity in IM and active transport appears to be reducing with the overall decline in IM over time, a finding in line with at least two other studies (Shaw et al., 2013, Bhosale et al., 2015). Whether this is due to greater acceptance of girls' IM among parents or simply a reduction in the overall scale in which IM presently occurs requires further investigation.

There is an extensive global discourse on the reasons for the trending decline in children's IM. Fundamental changes in suburban form, cultural ideologies and technological developments have created significant barriers for children experiencing free range autonomous roaming in their neighbourhoods (Mackett et al., 2007, Karsten, 2005, Foster et al., 2014, Jones et al., 2000). Our findings provide supporting evidence to some of these proposed reasons particularly regarding the dominance of private car ownership (and subsequent motor vehicles reliance for transportation (Mackett et al., 2007). Car ownership nearly doubled from one generation earlier and the number of children using active travel modes to and from school dropped by nearly half from parents to children. Low levels of active school travel in New Zealand have previously been found in other cross-sectional studies (Collins and Kearns, 2001, Duncan et al., 2008, Mitchell et al., 2007) as well as in the most recent National Travel Survey (Ministry of Transport, 2014). A further related finding was that although the odds of being allowed to cycle main roads were four times greater in adults compared with children, children had a much higher bicycle ownership. Widespread re-engagement in cycling as transport may be a way to provide children with an active, independent mode of transport to school, and to promote active transport to activities that are located further than the distance deemed reasonable for children to walk (Duncan et al., 2015).

The significant increase in the number of structured organised activities, was an interesting observation and a trend that has also been cited in other investigations (Hjorthol and Fyhri, 2009, Brockman et al., 2011). A social emphasis away from unstructured play to sporting success (Witten et al., 2013) has seen the rise in structured after-school activities. Moreover, in New Zealand there has been a significant increase in the number of women in the work force and increased dual-working parents(Families Commission,

2013) which can create a complex and time consuming transport schedule which has potentially decreased children's use of active mobility(Witten et al., 2013, Freeman and Quigg, 2009). Concurrently, there has also been dialogue in the literature of conflicting societal attitudes regarding the concept of a "good mother"(Dowling, 2000, Mcpherson, 2006) and it has been suggested that mothers feel they should hold a career and at the same time be home with their children. It is possible that out of this social pressure, mothers in the paid work force feel the need to spend more time with their children and "provide the best"; possibly through organised activities, reducing opportunities for free play(Dowling, 2000, Offer, 2015).

Overall, the significant decline in children's IM from just one generation earlier is disquieting. The long term implications of children experiencing severe restrictions on their autonomous roaming remains largely unknown. Evidence has begun to emerge suggesting a relationship between IM and physical activity (Page et al., 2009, Wen et al., 2009, Carver et al., 2014, De Meester et al., 2014), and the relationship between active travel to school and accumulation of daily physical activity levels has been well documented (Lubans et al., 2011, Schoeppe et al., 2013). The findings from this study would suggest a need for health promotion strategies and public policies at individual, community and government levels supporting parents and children to decrease motorised travel and encourage free roaming in the neighbourhood (Ermagun and Samimi, 2015, Shaw et al., 2015).

4.1. Strengths/Limitations

This study was novel in its exploration of generational changes in IM by using a large sample of directly related participants, crucial for accurate comparisons. In addition, participants from a broad range of socio-economic areas were included, which increases the generalisability of the findings (Schoeppe et al., 2015b). The other major strength of the study was the use of several measurement techniques simultaneously; previously, inconsistent IM definitions and measurement protocols have limited our understanding of the extent to which children's IM has declined (Bates and Stone, 2014, Bhosale et al., 2015). The measures utilised in this study have been correlated with physical roaming distances measured via online mapping and acknowledged for feasible application with a large population sample (Bhosale et al., 2015); although further validation of these measures using global positioning systems (GPS) would be recommended.

It is important to note that this study is cross-sectional in design and the measures are essentially self-reported. In particular, there may have been recall bias of parents retrospectively recalling their IM and active transport habits at 10–12 years of age. In addition, the IM measurement techniques in this study are still largely one dimensional. This means that the data may not take into account other secondary influences on parental allowances for children to travel and roam in the neighbourhood, such as the utility of mobile phones to facilitate children's independent roaming while maintaining a level of indirect supervision (Mikkelsen and Christensen, 2009). There could also be other significant sociodemographic factors influencing IM that have changed over time, such as dog ownership, the number of parents working full-time, the age at which parents choose to have children, and how soon parents return to work after having children. In other words, there is considerable scope for future research to disentangle the major societal trends and how they might affect not only IM, but parenting practices in general. Finally, the data presented in this study are similar to those presented in the earlier pilot study (Bhosale et al., 2015), suggesting that they may be relatively consistent within New Zealand. Nonetheless, intergenerational differences in IM and active transport may differ in other populations with different societal trends.

5. Conclusion

In summary, our findings clearly indicate a considerable decrease in children's IM and active transport between generations, with boys consistently demonstrating greater IM indicators than girls. The use of a combination of IM measurement techniques with directly-related participants enabled a more comprehensive understanding of this decline than previously possible. Health promotion strategies to encourage active transport modes and independent roaming behaviours are now needed to arrest this trend, thereby providing more opportunities for children to be active and enhance their psycho-social development.

Competing Interests

The authors declare that they have no competing interests.

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