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Individual, family, and neighborhood correlates of independent mobility among 7 to 11-year-olds

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ABSTRACT

Objective. Independent mobility refers to the freedom that children have to move around their neighborhood without adult supervision. It is related to their physical activity and health. We examined the intrapersonal, family, and neighborhood correlates of independent mobility within children. *Methods.* 497 American parents of 6.9–11.9 year olds completed a survey (November, 2014) that assessed their child's independent mobility range, several intrapersonal characteristics of their child (gender, age, race, etc.), several characteristics of their family (family structure, socioeconomic status, parental physical activity, etc.), and their perceptions of the safety of their neighborhood (18 questions reduced to 4 components). Associations were determined using ordinal logistic regression. *Results.* Children's age, parent's perception that their neighborhood is safe for children, and parent's fear of neighborhood crime were the independent correlates of independent mobility. Compared to 6.9–7.9 year olds, the odds ratio (95% CI) for increasing independent mobility were 2.31 (1.47–3.64) in 8.0–9.9 year olds and 3.38 (2.13–5.36) in 10.0–11.9 year olds. Compared to children whose parents who did not perceive that their neighborhood was safe for children, the odds ratio for increasing independent mobility was 4.24 (2.68–6.70) for children whose parents perceived their neighborhood was safe for children. Compared to children whose parents had the lowest fear of neighborhood crime, the odds ratio for increasing independent mobility was 0.41 (0.27–0.62) for children whose parents had the highest fear of crime. *Conclusions.* Children's independent mobility was associated with their age, their parent's perception that their neighborhood was safe for children, and their parent's fear of crime.

Introduction

Independent mobility refers to the freedom that children have to move around their neighborhood without adult supervision. Independent mobility influences several behavioral and health outcomes. Specifically, children's independent mobility is positively related to their active outdoor play and active transportation (Mackett et al., 2007; Page et al., 2010; Prezza et al., 2011). Children with a greater independent mobility have better social skills and stronger bonds with their peers and community (Joshi et al., 1999; Malone and Rudner, 2011; Prezza et al., 2011). They are also better equipped to navigate and interact with the physical environment (Bixler et al., 2002; Rissotto and Tonucci, 2002). Providing children with the freedom to move around their neighborhood can help build their confidence and self-esteem (Hillman et al., 1990; Joshi et al., 1999).

Present-day children have a more confined independent mobility range than children of previous generations (Fyhri et al., 2011). Recent Australian data indicate that 32% of 8–12 year olds are not allowed to roam more than 100 m from their home without an adult, and that 64% are not allowed to roam more than 1 km from their home (Veitch et al., 2008). The limited independent mobility range of most children may be contributing to the low physical activity levels in the pediatric population.

Ecological models are commonly used in physical activity behavior research (Sallis et al., 2006). These models postulate that physical activity is influenced by factors at multiple levels including intrapersonal (e.g., age, gender, cultural beliefs), interpersonal (e.g., relationships and characteristics of family), and neighborhood levels (e.g., social conditions, built environment) (Stokols, 1992). Ecological models also provide a framework to study the factors that influence independent mobility. Although information is limited, there is some evidence that boys have a greater independent mobility than girls (Brockman et al., 2011; Foster et al., 2014), that independent mobility increases as children get older (Veitch et al., 2008), and that parent's perceptions of neighborhood traffic safety and stranger danger (Foster et al., 2014; Santos et al., 2013) correlate with their children's independent mobility. Although the correlates of independent mobility occur at multiple

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ecological levels, existing studies have not simultaneously considered multiple correlates at the various levels.

Therefore, the purpose of this study was to examine the correlates of independent mobility within children. We examined several correlates at the intrapersonal, interpersonal/family, and neighborhood levels. Such research could help identify the strongest correlates of independent mobility, which in the short term may be identified for more focused study, and in the long-term may be addressed via interventions. Although our choices of potential correlates to study were governed by existing literature, this study was exploratory and no a priori hypotheses were assumed.

Methods

Study design and participants

The study received ethics approval from the Queen's University General Research Ethics Board. This was a cross-sectional study of children born from 2002–2007 and aged 6.9–11.9 years at the time of participation. All data were obtained by parent/guardian (hereafter referred to as parents) proxy report and were collected on November 24, 2014. Parents were recruited from the CINT panel, a heterogeneous group of adults from over 60 countries who participate in a variety of web-based surveys. Aside from being the parent of a child born between 2002 and 2007, the only other inclusion criteria were residing in the United States and ability to complete the survey in English. A total of 1310 panel members met these criteria. Only a single panelist from any given internet protocol (IP) address was allowed to complete the survey. If the parent had more than one child in the age group of interest, the parent completed the survey based on the oldest child. After reading the letter of information and providing consent, the survey was administered using FluidSurvey™ online survey software. A total of 560 parents started the survey and 515 completed it. Eighteen responded "prefer not to say" to one or more question and were removed from the analyses. Thus, the final sample size used here was 497. The majority of parents completing the survey were female (74%) and a biological parent (92%) of the child. There was at least one participant from each state with the exception of Hawaii, New Hampshire, New Mexico, and North Dakota. The urban/rural distribution of the sample is shown in Table 1. Because the online survey was closed shortly after the targeted number (N = 500) of CINT panelists completed the survey, which occurred approximately 24 h after the survey was launched and email invitations were distributed to eligible panelists, the response rate among panelists who were initially invited to participate cannot be determined.

Table 1
Descriptive characteristics of study sample

Characteristic	N	%
Gender of child		
Male	245	49.3
Female	252	50.7
Age of child		
6.9–7.9 years	97	19.5
8.0–9.9 years	202	40.6
10.0–11.9 years	198	39.8
Race of child		
White	344	69.2
Non-white (including mixed)	153	30.8
Activity limitations of child		
No	413	83.1
Yes	84	16.9
Number of siblings in household		
0	123	24.8
1	201	40.4
≥2	173	34.8
Number of parents in household		
Dual	405	81.5
Single	92	18.5
Parent education		
High school or less	114	22.9
2-year college	125	25.2
4-year college/university	187	37.6
Graduate university	71	14.3
Annual household income		
<$25,000	61	12.3
$25,000–$50,000	118	23.7
$50,001–$75,000	105	21.1
$75,001–$100,000	115	23.1
>$100,000	98	19.7
Population size of municipality		
<10,000 people	116	23.3
10,000–99,999 people	134	27.0
100,000–499,999 people	126	25.4
≥500,000 people	121	24.4

Independent mobility

The independent mobility range of the children was measured by asking their parents the following questions (Veitch et al., 2014): "How far is your child allowed to roam *on his or her own* without adult accompaniment?" and "How far is your child allowed to roam *with friends*, but without adult accompaniment?" Response options to these questions were: "My child is not allowed out alone", "My child is allowed out within my yard and/or driveway", "My child is allowed out within my street", "within 2–3 streets from home", "within a 15 minute walk from home", and "more than a 15 minute walk from home". The last two response options were combined for the analyses due to the low number of responses for the last option (3%). Responses to the two independent mobility questions were merged, with the highest response being kept. It has previously been shown that the test–retest reliability for these two independent mobility questions is modest (K = 0.59 and 0.52) (Veitch et al., 2014). It is noteworthy that responses to the two independent mobility questions were the same in most instances in our study, and the correlates of independent mobility were identical irrespective of whether the highest response or average response from the two questions was used.

Intrapersonal correlates

Demographics

The children's gender, age (6.9–7.9 years, 8.0–9.9 years, 10.0–11.9 years), and race (white and non-white including mixed race) were considered.

Activity limitations

Parents were asked whether a physical condition or health problem reduced the amount or kind of physical activity their child could do. Responses were used to create "yes" and "no" groups.

Family correlates

Sociodemographics

A number of sociodemographic variables were considered: dual vs. single parent household, number of siblings in the household (0, 1, 2 or more), annual household income (< $25,000, $25,000-$50,000, $50,001–$75,000, $75,001–100,000, >$100,000), and highest completed education of the parent completing the survey (high school or less, 2-year college, 4-year college/university, graduate school).

Parent physical activity

Using a 5-point scale that ranged from "strongly agree" to "strongly disagree", parents were asked to what extent they agreed with the following statements: "I enjoy physical activity", "I am physically active on a regular basis", and "I attempt to set an example for my child by being physically active". These questions are from The Activity Support

Scale for Multiple Groups (Davison et al., 2011). Scores of 0 to 4 were assigned to the different response options, scores were summed for the three questions, and the summed score was divided into tertiles to create low, medium, and high groups.

Parent physical activity with child

Using a 5-point scale that ranged from "strongly agree" to "strongly disagree", parents were asked to what extent they agreed with the following statements: "I regularly take my child to places where he/she can be active", "We routinely have family outings that include physical activity (such as going for a walk, bike riding, or ice skating)" and "I try to include my child when I do something active". These questions are from The Activity Support Scale for Multiple Groups (Davison et al., 2011). Tertiles were created as explained above for parent physical activity.

Neighborhood correlates

Potential neighborhood correlates focused on safety. Parent's perceptions of the safety of their neighborhood was determined by asking 18 questions adopted from a number of validated questionnaires and scales, as previously explained (Carver et al., 2008). We used principal component analysis with an oblique rotation to create summary neighborhood safety scores based upon responses to these 18 questions. Four distinct components emerged. Component 1, which we have labeled the traffic problems component, was based on the questions (with corresponding factor loadings) "My child would have to cross several roads to get to areas where he/she can play" (0.83), "There is heavy traffic in our local streets" (0.83), "There are major barriers to walking/cycling in my local neighborhood that make it hard for my child to get from place to place" (0.79), and "Road safety is a concern in our neighborhood" (0.71). Component 2, which we have labeled the traffic calming component, was based on the questions "There are traffic slowing devices (e.g. speed humps) in our local streets" (0.76), "The speed of traffic in our local streets is usually slow (35 MPH or less)" (0.76), and "There are sidewalks on most streets in our local neighborhood" (0.72). Component 3, which we have labeled the safe for children component, was based on the questions "My neighborhood is safe for my child to walk/cycle around the block alone in the daytime" (0.82), "It is safe for my child to play or hang out in the street outside our house" (0.82), "My child would be safe walking home from a bus or train stop at night" (0.76), and "Lots of children play or hang out in our street" (0.74). Component 4, which we have labeled the fear of crime component, was based on the questions "I am worried that my child might be assaulted when out alone in our neighborhood" (0.83), "I am worried about trouble-makers hanging around my neighborhood" (0.80), "There is a high crime rate in our local neighborhood" (0.72), and "Stranger danger is a concern of mine" (0.70). The component scores were divided into tertiles to create low, medium, and high groups for each component.

Statistical analysis

Statistical analyses were performed using SAS version 9.4 (SAS Inc., Carry, NC). Potential correlates of independent mobility were described using conventional descriptive statistics. All statistical models were fit as ordinal logistic regression models. Because of the exploratory nature of our study, a backwards selection approach was employed for retention of potential correlates of independent mobility. Our objective was to create a parsimonious list of correlates of independent mobility. We performed the statistical modeling in steps, and these steps corresponded to the levels in an ecological model. We started by building a model using the individual correlates. This was followed by the introduction of family correlates and then neighborhood correlates.

The following hierarchal approach was used to build our models: 1) all intrapersonal correlates were considered in the same model to form multivariate model 1; 2) backwards selection methods were performed, with a cut-off value of $p < 0.1$ for retention of intrapersonal correlates; 3) all of the family correlates were added to the significant intrapersonal correlates to form multivariate model 2; 4) backwards selection was performed for the retention of family correlates; 5) all of the neighborhood correlates were added to the significant intrapersonal and family correlates to form multivariate model 3; 5) backwards selection was performed for the retention of neighborhood factors to create the final model, multivariate model 4. At the backwards selection stages, if any dummy variable or the test for linear trend had a $p < 0.10$, that variable was retained. We used a $p < 0.10$ to ensure that we did not exclude variables in the model building process that could achieve significance, but only after controlling for other variables considered in later stages of the model building process.

There was evidence that the proportional odds assumption was violated for children's age and the safe for children component. For these variables the analyses were repeated using logistic regression wherein independent mobility was modeled as a dichotomous outcome (<2–3 streets from homes vs. ≥2–3 streets from home). The results from the ordinal logistic regression and logistic regression analyses were extremely similar, and we therefore have presented the findings from the ordinal logistic regression to remain consistent with the presentation of results for the other correlates.

Results

Table 1 contains the descriptive information on the 497 participants. About half of the children were male and 41% were aged 8–9 years. The majority were White (69%), from dual parent homes (82%), lived with at least one sibling (75%), and did not have an activity limitation (83%). The independent mobility of the children is described in Table 2. Twelve percent were not allowed out alone, 33% were allowed within their yard and/or driveway, 29% were allowed out within their own street, 17% were allowed to roam 2–3 streets from home, and 9% were allowed to roam more than 3 streets from home.

Table 3 summarizes bivariate, then adjusted (multivariate model 1) associations between the intrapersonal correlates of the children and their independent mobility. Table 4 extends the results through the examination of family level correlates, and Table 5 extends the results through the examination of neighborhood level correlates. The final multivariate model that considered all relevant correlates is presented in Table 6.

The final multivariate model indicated that the children's age, their parent's perception that their neighborhood is safe for children, and their parent's perceived fear of crime in their neighborhood were the significant independent correlates of independent mobility based on a p value of <.05. These associations were in the positive direction, with the exception of parent's fear of crime. There was also evidence that being a girl ($p = .18$), from a household with a single parent ($p = .14$), and parent's perception that there is more traffic calming in their neighborhood (p trend = .07) were associated with independent mobility if a more liberal p value was used.

With the exception of the medium group for the traffic calming component, there was no statistical evidence of an interaction between the gender of the parent responding to the survey and the correlates of independent mobility that were examined. For this single exception, the odds ratio for the medium group for the traffic calming component was 0.49 (0.20–1.20) when the father was the respondent and 1.49 (0.94–2.38) when the mother was the respondent.

Discussion

We examined the intrapersonal, family, and neighborhood correlates of independent mobility within 7 to 11-year-olds. Children's age and their parent's perceptions of safety and crime in their

Table 2
Independent mobility range of study sample.

Age range of child	Independent mobility range				
	Not allowed out alone	Within own yard/driveway	Within own street	Within 2–3 streets from home	>3 streets from home
	N (%)	N (%)	N (%)	N (%)	N (%)
6.9–7.9 years	17 (17.5)	50 (51.2)	19 (19.6)	6 (6.2)	5 (5.2)
8.0–9.9 years	20 (9.9)	65 (32.2)	71 (35.2)	33 (16.3)	13 (6.4)
10.0–11.9 years	22 (11.1)	48 (24.2)	55 (27.8)	47 (23.7)	26 (13.1)
6.9–11.9 years	59 (11.9)	163 (32.8)	145 (29.2)	86 (17.3)	44 (8.9)

neighborhood were the strongest correlates of independent mobility. None of the family factors were independently related to independent mobility.

Our finding that children's independent mobility range increased as they got older is consistent with previous findings (Veitch et al., 2008). Innately, as children get older they should have more awareness, knowledge, and ability to navigate and interact with their neighborhood environment and parents will feel more comfortable letting them wonder from home. Although there are no guidelines on what an appropriate independent mobility range is, the independent mobility range was limited when compared to historical norms (Fyhri et al., 2011). For instance, only 37% of 10 and 11-year-olds were allowed to roam farther than their own street.

Previous research has demonstrated that parent's perceptions of neighborhood traffic risk and stranger danger correlate with children's independent mobility (Foster et al., 2014; Santos et al., 2013). Similarly, we found that parent's perceptions of safety were strongly correlated with independent mobility. While some might argue that using parental perceptions of safety is a limitation of our study and that it would have been preferable to use objective measures, we consider the use of perceptions of safety as a strength. Recent research found that perceptions of safety are more strongly related to physical activity behaviors than are objective measures of safety such as crime statistics (Janssen, 2014). Other research has highlighted that there is minimal agreement between perceived and objective measures of safety (Jago et al., 2006; McGinn et al., 2008), and that measures of safety and risk, such as injury and crime rates, have improved substantially in the past decade or two (The Federal Bureau of Investigation, 2015). Collectively, these findings imply that to intervene upon independent mobility it would be pertinent to address the misinformed perceptions of many parents that their neighborhood is unsafe. This does not mean that objective measures of safety are not important. Future research should include objective measures of safety to add additional perspective to parent's perceptions.

It could be argued that because it is intuitively obvious that children's age and parent's perceptions of neighborhood safety and crime would influence independent mobility, it is not necessary to conduct a research study on these associations. We believe that it was important to confirm these intuitively obvious assertions with research as interventions and policies should be grounded on research and not intuition alone. As a case in point, some of the child (eg, gender) and family (eg, parental education, income) factors that many would believe to be important determinants of independent mobility, were in fact not identified as independent correlates in our study. By examining several intrapersonal, family, and neighborhood correlates simultaneously, we were also able to identify the strongest correlates amongst the many candidates. These strongest correlates would be the best targets for more focused research in this field of study.

In addition to the breadth of potential correlates of independent mobility that were studied, a strength of our study was the heterogeneous nature of the sample. Because participants were sampled from across the US and lived in geographically diverse conditions (eg, urban and rural areas), the findings should be generalizable to most 7–11 year old American children and their parents. With that being said, this was not a representative sample and parents with no internet access and who could not complete the survey in English would have been

Table 3
Associations between individual correlates and independent mobility.[a]

Variable	Bivariate models	[a]Multivariate model 1
Gender of child		
Male	1.00	1.00
Female	0.71 (0.52–0.98)	0.74 (0.54–1.01)
Age of child		
6.9–7.9 years	1.00	1.00
8.0–9.9 years	2.34 (1.50–3.66)	2.30 (1.47–3.59)
10.0–11.9 years	3.55 (2.26–5.58)	3.58 (2.27–5.64)
p *trend*	p < .001	p < .001
Race of child		
White	1.00	1.00
Non-white (including mixed)	0.78 (0.56–1.10)	0.77 (0.54–1.08)
Activity limitations of child		
No	1.00	1.00
Yes	1.26 (0.83–1.91)	1.32 (0.87–2.02)

Data presented as odds ratio (95% confidence interval).
[a] Multivariate model 1 included all of the individual correlates listed in the table.

Table 4
Association between family correlates and independent mobility.*[a]

Variable	Bivariate models	[a]Multivariate Model 2
Number of siblings in household		
0	1.00	1.00
1	1.35 (0.90–2.03)	1.24 (0.82–1.88)
≥2	1.33 (0.88–2.02)	1.14 (0.74–1.76)
p *trend*	p = .22	p = .58
Number of parents in household		
Dual	1.00	1.00
Single	0.61 (0.40–0.91)	0.69 (0.43–1.09)
Parent education		
High school or less	1.00	1.00
2-year college	0.84 (0.53–1.32)	0.97 (0.61–1.55)
4-year college/university	0.99 (0.65–1.50)	0.83 (0.52–1.32)
Graduate university	1.44 (0.85–2.45)	1.20 (0.66–2.19)
p *trend*	p = .23	p = .99
Annual household income		
<$25,000	1.00	1.00
$25,000–$50,000	1.32 (0.76–2.31)	1.18 (0.65–2.14)
$50,001–$75,000	1.43 (0.81–2.53)	1.20 (0.64–2.25)
$75,001–$100,000	1.65 (0.94–2.90)	1.34 (0.69–2.58)
>$100,000	2.29 (1.28–4.08)	1.77 (0.89–3.51)
p *trend*	p < .01	p = .10
Parent physical activity		
Low	1.00	1.00
Medium	1.08 (0.73–1.60)	1.01 (0.66–1.55)
High	1.22 (0.82–1.81)	1.21 (0.75–1.96)
p *trend*	p = .33	p = .47
Parent activity with child		
Low	1.00	1.00
Medium	0.95 (0.64–1.42)	0.95 (0.62–1.45)
High	0.97 (0.67–1.40)	0.87 (0.56–1.36)
p *trend*	p = .87	p = .56

Data presented as odds ratio (95% confidence interval).
[a] Multivariate model 2 included all of the family correlates listed in the table as well as the significant variables by backwards selection from multivariate model 1 (age and gender). Note that the displayed 95% confidence intervals do not reflect the actual cut-off p values that were used for retaining predictors from Multivariate Model 1.

Table 5
Association between neighborhood correlates and independent mobility.[a]

Variable	Bivariate models	[a]Multivariate model 3
Traffic problems component		
Low (less of a problem)	1.00	1.00
Medium	0.70 (0.48–1.03)	1.14 (0.76–1.72)
High (more of a problem)	0.50 (0.34–0.74)	0.91 (0.58–1.42)
p *trend*	p < .001	p = .83
Traffic calming component		
Low	1.00	1.00
Medium	1.31 (0.88–1.93)	1.12 (0.74–1.69)
High	2.04 (1.38–3.02)	1.47 (0.95–2.27)
p *trend*	p < .001	p = .07
Safe for children component		
Low (least safe)	1.00	1.00
Medium	2.67 (1.78–3.99)	2.16 (1.42–3.29)
High (most safe)	6.41 (4.21–9.76)	4.28 (2.70–6.79)
p *trend*	p < .001	p < .001
Fear of crime component		
Low (most safe)	1.00	1.00
Medium	0.41 (0.27–0.60)	0.49 (0.32–0.74)
High (least safe)	0.36 (0.24–0.53)	0.43 (0.27–0.68)
p *trend*	p < .001	p < .001

Data presented as odds ratio (95% confidence interval).
[a] Multivariate model 3 included all of the neighborhood correlates listed in the table as well as the significant variables by backwards selection from multivariate model 1 and multivariate model 2 (age, gender, and number of parents in the household). Note that the displayed 95% confidence intervals do not reflect the actual cut-off p values that were used for retaining predictors from multivariate models 1 and 2.

excluded. Our sample was of a higher socioeconomic status than the national average (eg, 77% were college or university graduates). Other limitations are the use of self-reported measures, although an accepted objective approach for measuring independent mobility does not exist. The modest sample size of 497 also precluded us from detecting weak associations. For example, the odds ratio of 0.73 (95% CI: 0.48–1.11) for single parent households that was observed in the final multivariate model may have some practical significance; however, it did not reach statistical significance (p = .14).

Table 6
Final multivariate model of the associations between individual, family, and neighborhood correlates with independent mobility.

Variable	Multivariate model 4
Intrapersonal correlates	
Gender of child	
Male	1.00
Female	0.80 (0.58–1.11)
Age of child	
6.9–7.9 years	1.00
8.0–9.9 years	2.31 (1.47–3.64)
10.0–11.9 years	3.38 (2.13–5.36)
p *trend*	p < .001
Family correlates	
Number of parents in household	
Dual	1.00
Single	0.73 (0.48–1.11)
Neighborhood correlates	
Traffic calming component	
Low	1.00
Medium	1.16 (0.77–1.74)
High	1.49 (0.97–2.30)
p *trend*	p = .07
Safe for children component	
Low (least safe)	1.00
Medium	2.17 (1.43–3.29)
High (most safe)	4.24 (2.68–6.70)
p *trend*	p < .001
Fear of crime component	
Low (most safe)	1.00
Medium	0.49 (0.33–0.74)
High (least safe)	0.41 (0.27–0.62)
p *trend*	p < .001

Data presented as odds ratio (95% confidence interval). Note that the displayed 95% confidence intervals do not reflect the actual cut-off p values that were used for retaining predictors.

Conclusion

Potential intrapersonal, family, and neighborhood correlates of independent mobility were examined among 7 to 11-year-olds. We found that children's independent mobility range was positively associated with their age, positively associated with their parent's perception that their neighborhood was a safe place for children, and negatively associated with their parent's fear of crime. We hope that our cross-sectional findings will inform the development of future intervention and policy-based research aimed at increasing independent mobility and ultimately physical activity and health among children.

Conflicts of interest statement

The authors declare that there are no conflicts of interest.

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