

# ***Dog walking is associated with more outdoor play and independent mobility for children***

***Short title: Dog walking and children's independent mobility***

**Hayley Christian<sup>ab</sup>, PhD**

**Georgina Trapp<sup>ab</sup>, PhD**

**Karen Villanueva<sup>c</sup>, PhD**

**Stephen R. Zubrick<sup>b</sup>, PhD**

**Rachelle Koekemoer<sup>a</sup>, MA**

**Billie Giles-Corti<sup>c</sup>, PhD**

<sup>a</sup>Centre for the Built Environment and Health, School of Population Health, The University of Western Australia, Crawley, Western Australia; <sup>b</sup>Telethon Institute for Child Health Research, The University of Western Australia, Crawley, Western Australia, Australia; <sup>c</sup>McCaughey VicHealth Centre for Community Wellbeing, Melbourne School of Population and Global Health, University of Melbourne, Melbourne, Australia.

Author email addresses:

hayley.christian@uwa.edu.au

[gtrapp@ichr.uwa.edu.au](mailto:gtrapp@ichr.uwa.edu.au)

[k.villanueva@unimelb.edu.au](mailto:k.villanueva@unimelb.edu.au)

steve@ichr.uwa.edu.au

rachelle.koekemoer@uwa.edu.au

b.giles-corti@unimelb.edu.au

## **Author responsible for correspondence:**

Asst/Prof Hayley Christian

Centre for the Built Environment and Health

School of Population Health (M707)

The University of Western Australia

35 Stirling Highway

Crawley WA 6009 Australia

Email: [hayley.christian@uwa.edu.au](mailto:hayley.christian@uwa.edu.au)

Telephone: 61-8-6488-8501

Fax: 61-8-6488-1188

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## Abstract

**Objective:** Dog ownership is positively associated with children's physical activity. It is plausible that dog-facilitated activity rather than dog ownership *per se* encourages children's physical activity behaviors. We examined relationships between dog walking, and children's physical activity, outdoor play and independent mobility.

**Method:** Cross-sectional survey data from the 2007 Perth (Western Australia) TRavel, Environment, and Kids (TREK) project were analyzed for 727 10-12 year olds with a family dog. Weekly minutes of overall physical activity and walking, local walking and outdoor play were collected from children and parents. Children's weekly pedometer steps were measured. Independent mobility was determined by active independent travel to 15 local destinations.

**Results:** Overall, 55% of children walked their dog. After adjustment, more dog walkers than non-dog walkers walked in the neighborhood (75% vs. 47%), played in the street (60% vs. 45%) and played in the yard (91% vs. 84%) (all  $p \leq 0.05$ ). Dog walkers were more independently mobile than non-dog walkers ( $p \leq 0.001$ ). Dog walking status was not associated with overall physical activity, walking, or pedometer steps ( $p > 0.05$ ).

**Conclusions:** Dog-facilitated play and physical activity can be an effective strategy for increasing children's physical activity. Dog walking may provide a readily accessible and safe option for improving levels of independent mobility.

## Introduction

Physical inactivity in children is a significant public health concern (World Health Organization, 2010, 2012) and is a modifiable risk factor for chronic diseases such as cardiovascular disease and type II diabetes as well as children's psychosocial outcomes and bone health (Biddle et al., 2004; Goldfield et al., 2002; Janssen and LeBlanc, 2010; Timmons et al., 2007). Evidence suggests that physical inactivity tracks from the early years through to adulthood (Azevedo et al., 2007; Jones et al., 2013; Pate et al., 1996; Telama et al., 2005) highlighting the importance of maintaining good, and improving poor early physical activity behaviours for later adult health benefits. Cost-effective strategies for increasing physical activity in children are required. One possible innovative and cost-effective strategy for increasing children's physical activity may be the physical activity facilitated through owning, playing and walking with a family dog (Christian et al., 2012; Owen et al., 2010).

Dog ownership and dog walking is a catalyst for physical activity and is associated with increased likelihood of achieving the recommended level of physical activity in adults (Christian et al., 2013; Cutt et al., 2008a; Moudon et al., 2007; Schofield et al., 2005; Thorpe et al., 2006). Only a handful of studies (Christian et al., 2012; Mathers et al., 2010; Owen et al., 2010; Salmon et al., 2010; Sirard et al., 2011) explore dog ownership in relation to youth physical activity. These studies have found that dog ownership positively influences children's physical activity (Christian et al., 2012; Owen et al., 2010; Salmon et al., 2010). For example, a recent study found that children who had a family dog, walked approximately 30 more minutes per week and were almost 50% more likely to achieve the recommended level of physical activity compared with non-dog owners (Christian et al., 2012). While it appears that there is potential for dog ownership to significantly impact children's physical activity levels, it is unknown whether dog-facilitated physical activity (i.e., walking with a dog) rather than dog ownership *per se* is important for children's physical activity behaviors. Indeed, Salmon et al (2010) found no association between children's objectively-measured physical activity and frequency of walking the dog in the last week (Salmon et al., 2010). Further studies are required to determine the relationship between dog walking and physical activity in children.

Furthermore, no studies to date appear to have investigated the relationship between dog walking and other physical activity behaviors such as **outdoor** play, and independent

mobility. **Outdoor** play is recognized as being vital for children's health and wellbeing because it is a significant source of physical activity (Page et al., 2010) and encourages healthy child development (Ginsburg, 2007; Joshi et al., 1999; Pellegrini and Smith, 1998). **Outdoor** play encourages social interaction, supports creativity, and facilitates problem solving (McCurdy et al., 2010). Moreover, children's independent mobility, that is walking or cycling without adult supervision, is an important mechanism through which children accumulate physical activity as well as other psychosocial benefits such as the opportunity to learn about their environment, improve spatial and way-finding abilities and develop social relationships with other children and adults in their local community (Gale et al., 1990; Herman, 1980; Joshi et al., 1999; Rissotto and Tonucci, 2002; Schoeppe et al., 2013; Villanueva et al., 2012). Among other factors, previous studies suggest that walking with an older sibling or friends is associated with increased independent mobility, particularly in girls (Jones et al., 2000; Zwerts et al., 2010). This may be because travelling with others may contribute to perceptions of safety and personal protection, resulting in more freedom granted by parents. Dogs are often considered important family members (Albert and Bulcroft, 1988; Cutt et al., 2008b). In adults for example, walking with a dog provides greater feelings of safety, particularly when walking at night (Cutt et al., 2007; Cutt et al., 2008b; Wood and Giles-Corti, 2005). Thus, walking with a dog may provide children with more opportunity to be independently mobile because a family dog plays a role similar to that of an older sibling or friend (i.e., a protector and guardian). **Compared with a child walking alone, walking with a dog (unaccompanied by an adult) may improve parent and child feelings of safety.**

Given that approximately 50-70% of US and Australian households with children own a dog (American Veterinary Medical Association, 1997; Christian et al., 2012; Mathers et al., 2010; Salmon et al., 2010) dog walking may potentially provide a readily accessible option for improving levels of independent mobility, outdoor play and physical activity. The aim of this study was to investigate the relationship between children's dog walking, physical activity, outdoor play and independent mobility. **We postulated that 'dog walking' status is a proxy for other dog-facilitated physical activity behaviors such as playing outdoors with a dog and being independently mobile with a dog.** We hypothesized that children who walked their dog had higher levels of outdoor play, independent mobility and physical activity compared with children who had a dog but did not walk it.

## Methods

Cross-sectional data from the TRavel, Environment, and Kids project (TREK) was used. The research methodology for TREK is described fully elsewhere (Giles-Corti et al., 2011). In 2007, 36 government primary schools in Perth, Western Australia were invited to participate; 25 participated (69.4% response rate (RR)). In each school, one class from each grade (year 5, 6, 7) was randomly selected until at least 30 children per grade were recruited. In total, 1480 children (57% RR) and 1314 of their parents (89% RR) participated. We analyzed data for 727 (49%) children who had a family dog.

Data were collected between July-December 2007 using a child and parent questionnaire in addition to other measures (not reported here). Test-retest reliability (1 week) of survey items was assessed (4 schools; n=160 10-12 year-olds; n=101 parents), and items with acceptable reliability (i.e., kappa or intraclass correlation coefficient [ICC]  $\geq 0.6$  or percent agreement  $\geq 60\%$ ) were included in the final survey (not reported here) (Wood et al., 2010).

### Socio-demographic measures

Children self-reported their sex and age. Parent's reported their age, sex, highest level of education, number of people and dependents <18 years living at home.

### Dog-related measures

Parents reported whether their family had a dog. Dog walking status was determined by children reporting whether they had taken their dog for a walk in the last week (yes/no) (Cutt et al., 2008b). Children also reported whether they did this activity with an adult (yes/no/sometimes).

### Physical activity, play and independent mobility measures

Children's minutes/week of walking and non-school physical activity was measured using parent-reported frequency and duration of vigorous, moderate and sport-related physical activity. Existing items from national physical activity surveys (Milligan et al., 2007) were modified and pilot tested for children (ICC's  $\geq 0.6$ ). Sufficient physical activity in children was defined as  $\geq 420$  minutes/week of total physical activity (Commonwealth Department Health and Ageing, 2004). Children self-reported whether they went for a walk in their

neighborhood, took their dog for a walk, played in the street or played outside in the yard in the last week (percent agreement  $\geq 60\%$ ; yes/no). Accusplit AH120 pedometers (Accusplit, Inc., Livermore, CA, USA) recorded children's step counts. Counts were considered valid if they were between 1000 and 30000 steps per day (Rowe et al., 2004). Average weekly steps were calculated for children recording steps for at least four days (McCormack et al., 2011; Strycker et al., 2007) as well as the proportion achieving the 12,000 (boys) and 15,000 (girls) steps/day recommended to reduce the likelihood of overweight and obesity (Tudor-Locke et al., 2011).

To determine children's independent mobility behavior, an Independent Mobility Index was computed using questions from both parent and child questionnaires. This index has been described elsewhere (Villanueva et al., 2012; Villanueva et al., 2013b). Briefly, children were asked if they actively travelled to 15 local activities/destinations (excluding trips to school) in the week prior to the survey (no, sometimes, yes). The activities (n=6) included playing a team sport; swimming; going to a club or youth group; watching sport; music lessons; and catching a bus. The destinations (n=9) included visiting a park, playground or playing field; own friend's house; family/family friend's house; local shop; other shops; post-box; local library (not school library); movie cinema; Sunday school/church. Parents were also asked if they allowed their child to attend these 15 activities/destinations without an adult (no, yes). An independent mobility score was computed by summing the activities/destinations children actively travelled to and if they were allowed to do so without an adult (range 0-15).

### **Statistical analysis**

Associations between dog walking status and categorical variables were assessed using chi-square tests. Independent sample t-tests were used for continuous variables. Logistic regression was used for multivariate analyses involving categorical outcome variables (sufficient physical activity, walked in neighborhood, played outside in the yard and played in the street) and linear regression for continuous variables (minutes of physical activity and walking outside of school, step counts and Independent Mobility Index score). All models adjusted for child age and sex, parent age, sex and maternal education, number of people and dependents in the household.

## Results

Overall, 60% of children had a family dog. The mean age of children who had a family dog was 11 ( $\pm 0.8$ ) years, 48% were male and 55% were classified as dog walkers. **Forty five percent of children who walked their dog did so without an adult.** The mean age of parents was 40.8 ( $\pm 5.9$ ) years, the majority were female (88%) and 14% of mothers had a bachelor degree or higher. Parents of children who walked their dog were on average slightly older (41 vs. 40 years) and less likely to be female (86% vs. 92%), compared with parents of non-dog walkers (both  $p \leq 0.05$ ) (Table 1).

Table 1. Socio-demographic factors by dog walking status for participants in the TREK study, Perth, Western Australia (2007).

	Non-dog walkers (n=324)	Dog walkers (n=403)	p-value
Child gender (% Female)	51.2	53.1	0.616
Mean age of child, years (SD)	11.0 (0.8)	11.0 (0.8)	0.820
Parent gender (% Female) <sup>a</sup>	92.3	85.6	<b>0.005</b>
Mean age of parent, years (SD) <sup>b</sup>	39.9 (6.2)	41.4 (5.5)	<b>0.001</b>
Maternal education (%)			0.186
Less than Secondary	33.3	27.5	
Secondary/trade/diploma	52.2	58.6	
Bachelor degree or higher	14.5	13.9	
Mean number of people living in house (SD) <sup>c</sup>	4.4 (1.3)	4.2 (1.2)	0.097
Mean number of children <18 years living at home (SD) <sup>d</sup>	2.5 (1.0)	2.4 (0.9)	0.276

Missing cases: <sup>a</sup>n=1; <sup>b</sup>n=10; <sup>c</sup>n=5; <sup>d</sup>n=10

SD=Standard Deviation

## **Relationship between dog walking status, physical activity, play and independent mobility**

After adjustment for child and parent socio-demographic factors, the odds of going for a walk in the neighborhood (OR=3.55; 95% CI=2.56-4.91), playing in the street (OR=2.02; 95% CI=1.48-2.76) and playing outside in the yard (OR=1.97; 95% CI=1.23-3.13) were significantly higher for dog walkers, compared with non-dog walkers (Table 2). Girls (but not boys) had greater odds of playing in the yard if they walked their dog (OR=2.73; 95% CI=1.32-5.68) (results not shown). On average, children who walked their dog were more independently mobile than those who did not walk their dog. Dog walkers had an independent mobility score of 1.9 compared with a score of 1.4 for non-dog walkers ( $p \leq 0.001$ ). Dog walking status was not significantly associated with weekly minutes of physical activity or walking, sufficient physical activity, weekly pedometer steps or recommended daily pedometer steps required to reduce the likelihood of overweight/obesity ( $p > 0.05$ ).

Table 2. Physical activity, play and independent mobility by dog walking status for children participating in the TREK study, Perth, Western Australia (2007).

	Non-dog walkers (n=324)	Dog walkers (n=403)	
	Mean (SE) Reference Group	Mean (SE)	$\beta$ (p-value)
Total pedometer steps/week <sup>a</sup>	66 068.6 (2 229.3)	66 751.3 (2 015.8)	682.66 (0.756)
Total minutes of physical activity outside of school/week <sup>c</sup>	828.8 (52.0)	867.6 (47.2)	38.82 (0.443)
Total minutes of walking/week <sup>be</sup>	164.6 (13.61)	179.9 (12.33)	15.32 (0.251)
Independent Mobility Index score <sup>cde</sup>	1.4 (0.1)	1.9 (0.1)	<b>0.47</b> <b>(0.000)</b>
	%	%	OR (95% CI)
Achieve recommended steps/day			
Boys (15000 steps/day)	19.7	18.2	0.94 (0.51-1.74)
Girls (12000 steps/day)	28.0	35.1	1.34 (0.82-2.20)
Sufficient physical activity (420 min/week) <sup>c</sup>	71.6	71.5	0.97 (0.69-1.37)
Went for a walk in neighborhood last week <sup>d</sup>	46.6	75.2	<b>3.55</b> <b>(2.56-4.91)</b>
Played in the street last week <sup>d</sup>	44.8	60.3	<b>2.02</b> <b>(1.48-2.76)</b>
Played outside in the yard last week <sup>d</sup>	84.3	90.8	<b>1.97</b> <b>(1.23-3.13)</b>

Missing cases: <sup>a</sup>n=102; <sup>b</sup>n=44; <sup>c</sup>n=15

<sup>d</sup>Based on child self-report; <sup>e</sup>Based on parent self-report

All models adjusted for child gender and age, parent gender and age, maternal education, number of people and children in household.

SE=Standard Error; OR=Odds Ratio; CI=Confidence Interval

## Discussion

Over half of children (55%) walked their dog in the last week. Children who walked their dog were significantly more likely to play outside in the yard and the street, walk in the neighborhood and were more independently mobile compared with non-dog walkers. There were no significant differences between dog walking and non-dog walking children for weekly minutes of physical activity, walking or pedometer steps.

Only one other study appears to have examined the relationship between dog walking and children's physical activity (Salmon et al., 2010). Similar to our findings, Salmon and colleagues (2010) reported that 59% of children aged 5-6 and 10-12 years who owned a dog walked their dog (Salmon et al., 2010; Timperio et al., 2008). In support of our findings, they also found that neither child-report frequency of dog walking/week or 'family dog walking' was associated with increased accelerometer-measured moderate-vigorous physical activity (Salmon et al., 2010). Based on findings from adult studies, we hypothesized that dog walking rather than dog ownership *per se* would be associated with children's physical activity behaviors, however this was not supported in terms of levels of weekly walking and physical activity. Our findings differ to the handful of studies reporting positive associations between dog ownership (vs. dog walking) and children's physical activity (Christian et al., 2012; Owen et al., 2010; Salmon et al., 2010). It is possible that the measure of dog walking behavior used in our study and by Salmon et al (2010) was insufficient to detect differences in overall levels of weekly walking and physical activity. It is also likely that in children, dog walking is not the main avenue through which children accumulate physical activity with their dog and active play in the home and yard may be more common ways that they are active with their dog.

Indeed, we found that dog walkers were more likely to play (outside in the yard and the street) and also walk in the neighborhood compared with non-dog walkers. This suggests that dog walking may be associated with lower intensity play based activity and thus make a relatively small contribution to physical activity levels. It also suggests that dog walking is undertaken in close proximity to home (outdoors in the yard and local neighborhood streets), and thus is only one part of overall walking level. The findings highlight the need for context-specific measures of children's dog-related physical activity and play behaviors, and further research on the amount of activity undertaken with dogs in these contexts (i.e., frequency,

duration and intensity of dog-facilitated active play in different settings such as inside/outside the home and park), not simply whether the behavior occurs.

This study provides a rare observation of the relationship between dog walking and children's independent mobility in an otherwise scant empirical literature. Children who walked their dog had greater independent mobility compared with non-dog walkers. The mean difference in the Independent Mobility Index score (Villanueva et al., 2013a) between dog walkers and non-dog walkers appeared small (0.5), however this is a significant effect when we consider that for all children in the TREK study (regardless of dog ownership status), the mean score was 1.57. Thus a mean difference in the Independent Mobility Index score of approximately 0.5 represents 30% more independent mobility in dog walkers compared with non-dog walkers. **These findings suggest that dog walking provides children with opportunities to develop or increase their independent mobility. Parents may be more likely to allow their child to walk on their own if they are accompanied by the family dog. Thus, independent walking with a dog** may be a mechanism through which children can develop a greater awareness and familiarity of their neighborhood, interact with other local children and adults in the community and improve their health and well-being through increased active transport and recreational physical activity (Underwood, 2011). Given that parents can restrict children's travel decisions and physical activity behavior, parental perceptions about children's personal safety in the neighborhood are important. As 'stranger danger' is among the highest cited concern that parents have about their children's outdoor safety (Carver et al., 2008; Hillman et al., 1990; Joshi et al., 1999; Nayak, 2003; O'Brien et al., 2000; Prezza and Pacilli, 2007; Tandy, 1999; Valentine and McKendrick, 1997), it may be that parents perceive dogs as a form of protection or guardianship for children when outdoors. Indeed, children are more likely to be independently mobile when accompanied by siblings, peers or friends (Jones et al., 2000; Mackett et al., 2007; Zwerts et al., 2010). Travelling with others, in this case a dog, may contribute to parent (and child) perceptions of safety, potentially resulting in parents granting more freedom to children. Travelling with a dog may therefore provide the added benefits of safety (Cutt et al., 2007; Cutt et al., 2008b) and companionship (Christian et al., 2010; Cutt et al., 2008a; Cutt et al., 2007; Cutt et al., 2008b), which in turn facilitate the likelihood of being independently mobile and physically active. Further research is needed to explore the nature of these relationships and examine strategies for encouraging more children to be physically active as well as independently mobile *with* their dog.

## Study limitations

This study was limited by its cross-sectional design and lack of information on non-responders. Dog walkers may have over-reported their physical activity. However our study included an objective measure of physical activity – pedometer steps/week. Our study used a binary measure of dog walking status. Information on dog walking frequency and duration would assist in understanding the contribution of dog walking to overall physical activity levels. Future research on the relationship between dog walking and children’s play, physical activity and independent mobility should consider dog-related factors such as breed, size, age and health status as well as the child’s relationship with their dog (i.e., level of attachment) (Westgarth et al., 2013) and their sense of responsibility to walk their dog (Christian et al., 2012). Finally, research should use objective context-specific measures of dog-related physical activity behaviors and examine these relationships across different child ages.

## Conclusion

Children who walked their dog were significantly more likely to play outside, walk locally and were more independently mobile compared with non-dog walkers. Our findings suggest outdoor play near home and walking in the neighborhood are important sources of dog-facilitated activity for children who have a dog. Dog walking status may also be a marker for children’s overall independent mobility and a mechanism through which children can increase active transport and recreational physical activity. Moreover, independent travel with a dog may provide the added benefits of safety and companionship. Given a large proportion of households with children own a dog and up to 50% do not walk with their dog, further research is warranted to understand the contribution of different types of dog-facilitated activity to children’s physical activity. Strategies aimed at encouraging more children to play outdoors, and walk with their dog in their neighborhood (with family and independently) have the potential to positively affect children’s physical activity levels, health and development.

## **Conflict of Interest Statement**

The authors declare that there are no potential, perceived or real conflicts of interest. The TREK study received funding from the Australian National Health and Medical Research Council (NHMRC). The funding body did not have any involvement in the study.

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## **Author contributions**

HC designed and directed the study analyses, interpreted the data and drafted the article. GT coordinated the data collection, conducted analyses and contributed to the discussion. KV coordinated the data collection, developed the Independent Mobility Index score and contributed to the interpretation of results and discussion section. SZ contributed to interpretation of the data and discussion section. RK conducted analyses and drafted the introduction section. BGC led the conception, design and acquisition of data for the main study, contributed to the interpretation of the data and contributed to editing the final manuscript. All authors revised the article critically for important intellectual content at each stage, and gave final approval of the version to be published.

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