Title page - Original Article

Understanding the relationship between dog ownership and children's physical activity and sedentary behavior

Running Title: Dog ownership and children's physical activity

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Christian: Dog ownership and children's physical activity

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What is already known about this subject

- Dog ownership is a catalyst for physical activity in adults.
- Approximately 50-70% of Australian households with children have a dog.
- Dog-facilitated physical activity may be an effective way to increase physical activity and decrease child overweight and obesity.

What this study adds

- Dog ownership was associated with self-reported walking and physical activity, but not parent-report screen use or measured weight status.
- The results highlight the potential for dog ownership to significantly impact children's physical activity levels.
- Within dog owning families, the promotion of walking and active play with a dog may be a strategy to increase children's physical activity and curb obesity.

Abstract

Background: Dog ownership is a catalyst for physical activity in adults. Given 50-70% of Australian households with children have a dog, dog-facilitated physical activity may be an effective way to increase physical activity and decrease child obesity.

Objective: We hypothesized that children with a family dog walk more, are more physically active and are more likely to achieve recommended levels of weekly physical activity compared with children who do not have a dog.

Method: Cross-sectional data from the Western Australian TRravel, Environment, and Kids project (TREK) were analyzed for 1218 children aged 10-12 years. Individual and environment factors, child physical activity, walking, screen use, sedentary behavior and dog ownership status was collected from child and parent questionnaires. Children's height and weight were measured.

Results: Approximately 60% of children had a family dog. Dog ownership was associated with, on average, 29 more minutes of walking and 142 more minutes of physical activity/week ($p \leq .01$). After adjustment, children with a dog were 49% more likely to achieve the recommended level of weekly physical activity (420mins) and 32% more likely to have walked in their neighborhood in the last week, compared with non-dog owners ($p \leq .05$). These relationships varied by gender. Dog ownership was not associated with screen use or weight status.

Conclusions: Dog ownership was associated with walking and physical activity, but not screen use or weight status. Within dog owning families, the promotion of walking and active play with a dog may be a strategy to increase children's physical activity.

MESH-heading keywords:

Canine, Exercise, Neighborhood, Obesity, Walking, Youth.

Introduction

Rising rates of obesity in children, coupled with a decline in physical activity levels and the allure of sedentary pastimes, is cause for concern in many developed countries (1). A significant proportion of children are insufficiently active to reap the health rewards attributable to regular daily physical activity (2-4). In children, physical inactivity has been associated with cardiovascular disease risk factors, overweight/obesity, type II diabetes, and poorer psychosocial outcomes and bone health (5). Given the alarming levels of overweight and obesity in children and the protective role that physical activity plays in children's health, practical, child-friendly and cost-effective physical activity intervention strategies are required.

A potentially important strategy for increasing physical activity in adults is the support and motivation to walk provided through owning a dog (6-9). In adults, dog ownership is associated with more physically activity (6,8-13) and increased likelihood of meeting recommended levels of physical activity (6,8,14,15). While evidence of the relationship between dog ownership, physical activity and health in adults is emerging, the nature of this relationship in children requires further investigation. To date, only four studies have examined the association between dog ownership and children's physical activity (16-19) and two of these studies have been conducted in adolescents (18,19). In addition, only one study has examined the association between dog ownership and weight status in children (20). To our knowledge, no studies of adults or children have examined whether non-dog owners are more sedentary (via screen use) than dog owners and no studies of children have used context-specific outcome measures. Context -specific outcome measures provide a better match between the exposure and the behavior of interest (21). Moreover, in adults dog ownership is associated with a number of known individual and environmental correlates of

physical activity (6), yet the studies to date in children have only examined socio-demographic factors (16-19).

It is plausible that dog ownership influences children's physical activity behavior through increased walking and active play with the family dog, however the nature of these relationships have not been investigated in children. Considering 50-70% of Australian households with children have a dog (16,19,22) and the potential for dog walking and active play with a dog to increase children's physical activity, further investigation of the relationship between dog ownership and physical activity in children is warranted.

In a sample of 10-12 year old children, the aim of this study was to use an ecological model to examine the independent effect of dog ownership on children's physical activity, walking, sedentary behavior and weight status after adjusting for known correlates of physical activity. We hypothesized that children who own a dog would walk more, be more physically active and more likely to achieve the recommended level of weekly physical activity and be less sedentary and less likely to be overweight or obese compared with children who did not own a dog.

Methods

This study analyzed cross-sectional data from the TRavel, Environment, and Kids project (TREK). The overall aim of TREK was to examine the extent to which the urban design of neighborhoods supports active transportation among 10-12 year old children attending public elementary schools in Perth, Western Australia. The research methodology for TREK is presented elsewhere (23), and is briefly described here. Overall, 25 schools approached agreed to participate (69.4% response rate (RR)). One class from each grade (year 5, 6, 7) in

each school was randomly selected until a minimum of 30 children/grade were recruited. Parent and child written informed consent was obtained. The University of Western Australia Human Research Ethics Committee provided ethics approval. In total, 1480 children (57% RR) and 1314 of their parents (89% RR) participated.

Data were collected between July-December 2007 using a child questionnaire, parent questionnaire in addition to other measures (not reported here). Test–retest reliability (1 week) of survey items was assessed (4 schools; n=160 children aged 10-12 years; n=101 parents), and items with acceptable reliability (i.e., kappa or intraclass correlation coefficient [ICC] ≥0.6 or percent agreement ≥60%) were included in the final survey with items <0.6 modified to enhance reliability.

Physical activity and sedentary measures

Children's minutes/week of walking and physical activity outside of school was measured using parent-report of the frequency and duration of vigorous, moderate and sport-related physical activity. Existing items from national physical activity surveys (24) were modified and pilot tested for children (ICC's≥0.6). Sufficient physical activity in children was defined as 420 minutes/week of total physical activity (25). Children self-reported whether they went for a walk in their neighborhood, played in the street or played outside in the yard in the last week (percent agreement's ≥60%). Parents reported the average amount of time/day their child spent using a computer or internet for pleasure, watching television/videos, and playing passive or active electronic games (26. 27).

Weight status

Children's height and weight were measured with calibrated digital scales and portable stadiometers (dressed in light clothing and no shoes). Body Mass Index (BMI, kg/m2) estimates were collapsed into age- and gender-specific categories (i.e., acceptable weight, overweight, or obese) based on internationally recognized cut-points (28).

Individual measures

Children self-reported their sex, age and whether they were confident in their ability to walk to school and the closest shop, without an adult (ICC's≥0.6). Parent's reported their age, gender, highest level of maternal education, number of people living at home and the number of dependents <18 years at home and whether their family had a dog.

Environment measures

Modified versions of previously published items were used to measure physical and social environment factors. Parents reported if their closest park, bush land and beach were less than 10 minutes walk from home (29). Parents also reported how fearful they were and the likelihood of their child being bitten by a dog if they walked or cycled in the neighborhood without an adult (29-31). Children reported their perceptions of their local neighborhood environment with respect to whether: there was a lot of traffic in their neighborhood, the park closest to their house had fun or interesting things for them to do, it was safe for them to play at the park closest to their house without an adult and if it takes too much time to walk to the shops closest to their home (29). A "Positive perception of neighborhood" scale was created from three single-items: i.e., child-perceived 'my neighborhood is friendly', 'my neighborhood is a nice place to walk around', 'you often see people out on walks in my neighborhood,' (Cronbach's α=0.64) (29). Dwelling type (separate house vs. other), home

location with respect to the traffic speed of surrounding roads and whether the backyard is large enough and suitable for children to run around was reported by parents (kappa's≥0.6). Parents reported whether there were safe crossings for their child to use if they walked or cycled to the closest local park and whether they had to drive to get to a park with appealing play equipment for their child (ICC's≥0.6).

Children's self-report measures of the local social environment included whether they had friends in the neighborhood (i.e., many vs. few friends), if they had lots of children their own age to hang out with (yes vs. no) and whether they were worried about strangers in their neighborhood (i.e., not at all fearful to extremely fearful) (29,32).

Statistical analysis

Analyses were undertaken using SPSS v19 and STATA IC 11 and all results were stratified by gender (585 boys and 633 girls). The association between dog ownership and categorical variables was assessed using chi square and 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) and linear regression for continuous variables (minutes of physical activity outside of school and walking). Three models with progressive adjustment were constructed for each of the outcomes: the first was unadjusted, the second adjusted for significant socio-demographic factors only; and the third used backward stepwise deletion of variables identified in bivariate analyses to further adjust for significant intrapersonal and environment factors. All models were a complete case analysis with non-owners as the referent group.

Results

Overall, the mean age of children was 11 (±0.8) years and 48% were male. The mean age of parents was 41.8 (±5.8) years, the majority were female (87.6%) and 16.9% of mothers had a bachelor degree or higher. Almost 60% of children (59% boys and 60% girls) had a dog.

Socio-demographic, intrapersonal and environment factors associated with dog ownership in children

Only one socio-demographic and one intrapersonal factor was significantly different between dog owners and non-dog owners overall and for boys and girls separately (Table 1). A significantly higher proportion of children who owned a dog were of a lower socio-economic status; i.e., their mothers had an education level of secondary school or lower (all children and boys $p \leq .01$; girls $p \leq .10$) and were significantly more confident in their ability to walk to the closest shop without an adult (all children $p \leq .05$; boys and girls $p \leq .10$).

Insert Table 1 here

Overall, dog owners and non-owners had different perceptions of their environment (Table 2). Compared with non-dog owners, a significantly greater proportion of parents of children with dogs reported living in a separate house (all children $p \leq .01$; boys and girls $p \leq .05$) and perceived their backyard was large enough and suitable for children to run around (all children and boys $p \leq .05$). In contrast, more non-dog owning parents reported living near a highway or busy road (all children $p \leq .05$).

Insert Table 2 here

Overall, children (and their parents) who had a dog had significantly more positive perceptions of their neighborhood environment than non-dog owners (Table 2): i.e., significantly more parents of children who owned a dog reported that the closest natural bush land or beach was less than 10 minutes walk away from their home (all children $p \leq .05$; boys $p \leq .10$); were less likely to perceive they have to drive to get to a park that provides appealing play equipment (all children and girls $p \leq .05$); less likely to perceive that it takes too much time to walk to the closest shop from their home (all children and girls $p \leq .05$); and more likely to report their child had many friends in their neighborhood (all children and boys $p \leq .05$). These parents were also less fearful of (all children $p \leq .001$; boys $p \leq .01$; girls $p \leq .05$) and perceived it less likely that (all children $p \leq .05$; boys $p \leq .01$) their child would be bitten by a dog if they walked or cycled in the neighborhood without an adult.

Association between children's physical activity, sedentary behavior, weight status and dog ownership

Children's screen use and weight status (overweight or obese) did not significantly differ by dog ownership status with and without adjustment (Table 3). After adjusting for socio-demographic and environment factors children who had a dog walked on average 29 more minutes/week (95% confidence interval (CI): 8.66-49.05) and did 142 more minutes/week (95% CI: 66.97-217.57) of physical activity than non-dog owners (Table 4). After adjustment, children who owned a dog were 49% (95% CI: 1.15-1.92) more likely than non-

dog owners to achieve the weekly recommended level of physical activity (420mins) and 32% (95% CI: 1.03-1.70) more likely to have walked in their neighborhood in the last week.

Insert Table 3 & 4 about here

The relationship between physical activity measures and dog ownership status varied when stratified by gender (Table 4). After adjusting for socio-demographic and environment factors, boys who had a dog walked on average 35 more minutes/week (95% CI: 5.26-65.40) and did 129 more minutes/week (95% CI: 13.59-244.40) of physical activity than non-dog owners. After adjustment, boys who owned a dog were 77% (95% CI: 1.24-2.54) more likely than non-dog owners to have walked in their neighborhood in the last week. After adjusting for socio-demographic factors, girls who owned a dog reported 164 more mean minutes/week (95% CI: 66.94-261.28) of physical activity than non-dog owners. After adjusting for socio-demographic and environment factors girls who owned a dog were 77% (95% CI: 1.25-2.50) more likely than non-dog owners to achieve the weekly recommended level of physical activity.

Progressive adjustment influenced the effect size and level of significance of associations between dog ownership and physical activity outcomes for all children, boys and girls differently. Overall, there were small variations in the effect sizes between the unadjusted and fully adjusted models and except for 'minutes of walking/week' (all children), 'walk in neighborhood in last week' (all children and boys) and sufficient physical activity (girls only) the significance level remained the same. Notably, for all children and boys, after full adjustment dog ownership was associated with higher average minutes/week of walking,

however the odds of walking in the neighborhood in the last week decreased in the final model.'

Discussion

In children, dog ownership was associated with significantly more minutes of walking and physical activity and increased likelihood of walking in the neighborhood and achieving sufficient physical activity. These results support a similar study in children (16) as well as numerous studies in adults (6,8-13,15,33). These differences could not be explained by socio-demographic or intrapersonal factors or variation in perceptions of the child's environment. Dog ownership was not associated with screen use or measured overweight or obesity.

The importance of controlling for socio-demographic and intrapersonal differences between pet owners and non-owners when measuring health-related behaviors is recognized (34-36). The current study used a comprehensive social-ecological model (37) to examine the individual and environment factors associated with dog ownership in children. Overall, children (and their parents) who owned a dog perceived their neighborhood environment more favorably than non-dog owners. In support of these findings, a study in adults reported that dog owners perceived their neighborhoods as more attractive than non-owners (7). Moreover, similar to Owen et al (17) we found almost no socio-demographic differences by dog ownership status in children. These findings are in contrast to the studies in adults in which dog owners are significantly more likely than non-owners to be female, to have been born in their country of residence, to have older children, to live in a single-family home, and to work in clerical, sales, or service occupations (6).

Significant gender differences existed across all measures of physical activity. Boy, but not girl, dog owners walked significantly more minutes/week and were more likely to walk in their neighborhood than non-dog owners. In contrast, girl, but not boy, dog owners were more likely to achieve the recommended level of physical activity and did more minutes of physical activity than non-dog owners. It is likely that the nature of the relationship and the interaction that boys and girls have with their dog may influence physical activity and walking measures in different ways. For example, boys may be more independently mobile and allowed to walk with their dog on their own and this would have a greater impact on their overall walking levels. Girls may be involved in more active play with their dog and this would make a greater contribution to their overall physical activity. Future research should include objective measures of children's physical activity and walking as well as specific measures of dog-facilitated physical activity (e.g., walking the dog) and active play with a dog.

The relationship between dog ownership and screen use has not been examined in adults or children. We hypothesized that children who own a dog have lower levels of sedentary screen time than children who do not have a dog. Nevertheless, we found no association between dog ownership status and screen use, even after adjustment. Similarly, Owen and colleagues found no significant association between accelerometer measured sedentary time and dog ownership in 9-10 year olds (17). These findings are consistent with research indicating that the determinants of physical activity are different from those for sedentary behavior (38).

Only one study to date has examined the association between dog ownership and overweight and obesity in children (20). Timperio et al found that dog ownership was associated with decreased odds (OR=0.5) of overweight/obesity in 5-6yo boys and girls (20). In contrast, we

found no association between dog ownership and overweight and obesity in 10-12 year old children, even after adjusting for socio-demographic factors. A possible explanation for these results is that the relationship between dog ownership and weight status is mediated by physical activity in younger but not older children (16).

Further research is needed to explore the nature of these relationships and examine strategies for encouraging older children to be active *with* their dog. Considering a large proportion of households with children own a dog, future research should focus its efforts on intervention research to encourage these families to be more active with their dog rather than promoting dog ownership *per se*. Moreover, future research should explore the contribution of dog ownership, dog walking and active play with a dog to children's unstructured physical activity and active play and examine these relationships objectively, by gender and across different child ages. It is also plausible that in young children the type of physical activity facilitated by dog ownership is more likely to be active play *with* a dog rather than taking the dog for a walk. In older children, the benefits of dog ownership in terms of increased physical activity, may relate to active play as well as walking *with* a dog. The next phase of our research aims to examine the effect of dog ownership on children's independent mobility.

Study limitations

This study was limited by its cross-sectional design and lack of information on non-responders. Furthermore, this study relied on parent and child report measures of physical activity, walking and sedentary behavior (39), however measured height and weight were used to determine weight status. Dog owners may have over-reported the amount of physical activity and walking they do and this may have influenced the study findings. Thus, future studies should include self-report and objective measures of physical activity, measure the

types of dog-facilitated physical activity (e.g., dog walking, active play) and the contribution of different types of dog-facilitated physical activities to children's overall physical activity levels. This study examined a limited number of social environment and intrapersonal factors and included only self-report measures of the physical environment. Moreover, studies in adults have highlighted that dog-specific factors such as the level of attachment and the sense of responsibility associated with walking a dog are important factors affecting the amount of dog walking owners undertake (6,11,40,41). Future research on the relationship between dog ownership and children's physical activity 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) and their sense of responsibility to walk their dog (16-19). Finally, this study highlights the importance of examining these relationships separately for boys and girls.

Conclusion

This research adds to the existing literature by using an ecological model that enables adjustment for individual and environment factors. Over and above all of these correlates, in children, dog ownership was associated with walking and physical activity but not screen use or weight status. The results of this study highlight the potential for dog ownership to significantly impact children's physical activity levels. The promotion of dog walking in families as well as the switch from sedentary screen play to active play with a family dog are potential intervention strategies that could increase children's physical activity and help curb the obesity epidemic. Considering 50-70% of Australian households with children have a dog (16,19, 22), further research is required to explore the nature of the relationship between dog ownership, dog walking and active play in children as well as intervention research to examine if strategies aimed at increasing the amount of walking and active play children

participate in with their dog may be an effective way to increase physical activity and decrease obesity in children.

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).

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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 the study analyses and drafted the methods section. CL contributed to interpretation of the data and drafted the introduction section. KW contributed to the design of the study analyses, conducted preliminary analyses and contributed to the introduction and results sections. 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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Tables

Table 1: Individual socio-demographic and intrapersonal factors for dog owners and non-dog owners

	All children		Boys		Girls	
Characteristic	Dog owners (n=729)	Non-owners (n=489)	Dog owners (n=348)	Non-owners (n=237)	Dog owners (n=381)	Non-owners (n=252)
Socio-demographic						
Child gender (% Female)	52.3	51.5	-	-	-	-
Mean age of child, years (SD)	11.0 (0.8)	11.0 (0.8)	11.0 (0.8)	11.0 (0.8)	11.0 (0.8)	11.0 (0.8)
Parent gender (% Female)[1]	88.5	86.3	87.1	85.2	89.7	87.3
Mean age of parent, years (SD)[2]	40.8 (5.9)	40.9 (5.8)	40.7 (5.9)	40.6 (5.6)	40.9 (5.9)	41.1 (6.0)
Maternal education (%)						
Less than Secondary	30.2	24.5**	27.6	24.5**	32.5	24.6#
Secondary/trade/diploma	55.7	54.4	59.8	52.3	52.0	56.3
Bachelor degree or higher	14.1	21.1	12.6	23.2	15.5	19.0
Mean number of people living in house (SD)[3]	4.3 (1.2)	4.2 (1.2)	4.2 (1.3)	4.1 (1.2)	4.3 (1.2)	4.2 (1.2)

Christian: Dog ownership and children's physical activity

Table 1: Individual socio-demographic and intrapersonal factors for dog owners and non-dog owners (cont)

	All children		Boys		Girls	
Characteristic	Dog owners (n=729)	Non-owners (n=489)	Dog owners (n=348)	Non-owners (n=237)	Dog owners (n=381)	Non-owners (n=252)
Mean number of children under 18 years living at home (SD)[4]	2.4 (1.0)	2.4 (0.9)	2.4 (1.0)	2.4 (1.0)	2.5 (0.9)	2.4 (0.9)
Intrapersonal						
Confident in ability to walk to school without adult (SD)[c5]	4.0 (0.1)	3.9 (1.1)	4.2 (1.0)	4.1 (1.1)	3.9 (1.1)	3.8 (1.1)
Confident in ability to walk to the closest shop without adult (SD)[c5]	3.9 (1.1)	3.8 (1.2)*	4.2 (1.0)	4.0 (1.1)#	3.7 (1.1)	3.6 (1.2)#

[#]$p \leq 0.10$ *$p \leq 0.05$ **$p \leq 0.01$, [c]based on child self-report
Missing cases: [1]N=2; [2]N=20; [3]N=6; [4]N=16
[5]Measured on a 5-point Likert scale: 1=strongly disagree; 5=strongly agree

Table 2: Physical and social environment factors for dog owners and non-dog owners

	All children		Boys		Girls	
Characteristic	Dog owners (n=729)	Non-owners (n=489)	Dog owners (n=348)	Non-owners (n=237)	Dog owners (n=381)	Non-owners (n=252)
Physical environment						
Dwelling type (%)[p]						
Separate house	95.5	91.0**	95.7	91.1*	95.3	90.9*
Other (e.g. duplex, townhouse, flat, caravan)	4.5	9.0	4.3	8.9	4.7	9.1
Home location (%)[p]						
Highway or busy road	9.9	14.7*	10.9	15.2	8.9	14.3
Minor road (50km/hr)	48.8	50.5	48.0	50.6	49.6	50.4
Cul-de-sac	32.5	26.6	33.6	26.6	31.5	26.6
Within school zone (40km/hr)	8.8	8.2	7.5	7.6	10.0	8.7

Christian: Dog ownership and children's physical activity

Table 2: Physical and social environment factors for dog owners and non-dog owners (cont)

	All children		Boys		Girls	
Characteristic	Dog owners (n=729)	Non-owners (n=489)	Dog owners (n=348)	Non-owners (n=237)	Dog owners (n=381)	Non-owners (n=252)
Backyard is large enough and suitable for children to run around (%)[p]	88.5	84.3*	88.5	82.7*	88.5	85.7
There are no safe crossings for my child to use if he/she walked or cycled to the closest local park (SD)[p1]	2.6 (1.2)	2.7 (1.1)	2.6 (1.1)	2.6 (1.1)	2.6 (1.2)	2.7 (1.1)
Closest park is 1 to 10 minute walk away (%)[p]	87.8	89.4	88.8	92.4	86.9	86.5
Closest natural bush land is 1 to 10 minute walk away (%)[p]	54.7	48.3*	59.2	52.3#	50.7	44.4
Closest beach is 1 to 10 minute walk away (%)[p]	8.8	5.7*	10.1	5.9#	7.6	5.6

Christian: Dog ownership and children's physical activity

Table 2: Physical and social environment factors for dog owners and non-dog owners (cont)

	All children		Boys		Girls	
Characteristic	Dog owners (n=729)	Non-owners (n=489)	Dog owners (n=348)	Non-owners (n=237)	Dog owners (n=381)	Non-owners (n=252)
Parent has to drive to get to a park that provides play equipment that appeals to my child (SD)[p1]	2.4 (1.2)	2.6 (1.2)*	2.5 (1.2)	2.6 (1.2)	2.4 (1.2)	2.6 (1.3)*
Fearfulness of child being bitten by a dog if they walked or cycled in the neighborhood without an adult (SD)[p2]	2.5 (1.0)	2.7 (1.1)***	2.3 (0.9)	2.6 (1.1)**	2.6 (1.1)	2.8 (1.1)*
Likelihood of child being bitten by a dog if they walked or cycled in the neighborhood without an adult (SD)[p3]	2.3 (0.9)	2.4 (0.9)*	2.3 (0.8)	2.5 (0.9)**	2.4 (0.9)	2.4 (0.9)
Positive neighborhood perception (i.e., friendly, nice to walk around, often see people walking) (SD)[c1]	3.9 (0.7)	3.9 (0.8)	3.9 (0.8)	3.9 (0.8)	3.9 (0.7)	4.0 (0.7)#

Table 2: Physical and social environment factors for dog owners and non-dog owners (cont)

	All children		Boys		Girls	
Characteristic	Dog owners (n=729)	Non-owners (n=489)	Dog owners (n=348)	Non-owners (n=237)	Dog owners (n=381)	Non-owners (n=252)
There is a lot of traffic in my neighborhood (SD)[c1]	2.4 (1.2)	2.4 (1.2)	2.4 (1.2)	2.5 (1.3)	2.5 (1.2)	2.4 (1.1)
The park closest to my house has fun or interesting things for me to do (SD)[c1]	3.3 (1.2)	3.3 (1.2)	3.3 (1.3)	3.2 (1.3)	3.3 (1.1)	3.4 (1.1)
It is safe for me to play at the park closest to my house without an adult (SD)[c1]	3.5 (1.2)	3.5 (1.2)	3.7 (1.2)	3.7 (1.2)	3.3 (1.2)	3.2 (1.2)
It takes too much time to walk to the shop closest to my home (SD)[c1]	2.0 (1.0)	2.1 (1.1)*	2.0 (1.1)	2.1 (1.1)	2.0 (0.9)	2.2 (1.0)*
Social environment						
Child worried about strangers in the neighborhood (SD)[c1]	2.8 (1.2)	2.8 (1.3)	2.6 (1.2)	2.7 (1.3)	3.1 (1.2)	2.9 (1.2)

Christian: Dog ownership and children's physical activity

Table 2: Physical and social environment factors for dog owners and non-dog owners (cont)

	All children		Boys		Girls	
Characteristic	Dog owners (n=729)	Non-owners (n=489)	Dog owners (n=348)	Non-owners (n=237)	Dog owners (n=381)	Non-owners (n=252)
Child has many friends in the neighborhood (%)[c]	71.7	65.8*	74.7	66.2*	69.0	65.5
There are lots of children my own age to hang out with in my neighborhood (%)[c]	58.2	57.3	58.3	59.5	58.0	55.2

[#]$p \leq 0.10$ *$p \leq 0.05$ **$p \leq 0.01$ ***$p \leq 0.001$, [c]based on child self-report, [p]based on parent self-report
[1]Measured on a 5-point Likert scale: 1=strongly disagree; 5=strongly agree
[2]Measured on a 5-point Likert scale: 1=not at all fearful; 5=extremely fearful
[3]Measured on a 5-point Likert scale:1=very unlikely; 5=very likely

Table 3: Physical activity, sedentary behavior and weight status of dog owners and non-dog owners

	All children		Boys		Girls	
Characteristic	Dog owners (n=729)	Non-owners (n=489)	Dog owners (n=348)	Non-owners (n=237)	Dog owners (n=381)	Non-owners (n=252)
PHYSICAL ACTIVITY BEHAVIOR:						
Mean total minutes of walking/week (SD)[p1]	165.6 (171.3)	140.6 (157.5)*	178.1 (157.8)	147.7 (167.8)*	153.9 (166.5)	133.7 (147.1)
Mean total minutes of physical activity outside of school/week (SD)[p]	848.2 (677.8)	704.4 (603.7)***	930.9 (727.9)	800.2 (648.3)*	772.6 (619.9)	614.3 (544.6)***
Sufficient physical activity (420 min/week) (%)[p]	71.5	63.2**	74.7	70.0	68.5	56.7**
Went for a walk in neighborhood last week (%)[c]	62.6	53.0***	62.4	46.4***	62.7	59.1
Played in the street last week (%)[c]	53.5	54.2	58.0	52.7	49.3	55.6
Played outside in the yard last week (%)[c]	87.9	88.1	85.6	87.8	90.0	88.5

Christian: Dog ownership and children's physical activity

Table 3: Physical activity, sedentary behavior and weight status of dog owners and non-dog owners (cont)

	All children		Boys		Girls	
Characteristic	Dog owners (n=729)	Non-owners (n=489)	Dog owners (n=348)	Non-owners (n=237)	Dog owners (n=381)	Non-owners (n=252)
SEDENTARY BEHAVIOR:						
Mean total minutes of screen use/day[p]	218.05	216.99	232.78	229.21	204.59	205.45
WEIGHT STATUS:						
Child overweight or obese BMI (%)[2]	23.3	23.3	22.1	23.3	24.6	23.3

*$p \leq 0.05$ **$p \leq 0.01$ ***$p \leq 0.001$, [p]based on parent self-report
Missing cases: [1]N=85;
[2]Children refused to have their height and weight measured (N=227)

Table 4: Regression models examining associations between dog ownership and children's walking and physical activity

	Unadjusted B (95% CI)	Model 1 B (95% CI)	Model 2 B (95% CI)
All children			
Mean total minutes of walking/week	25.00 (5.21, 44.80)*	26.50 (6.38, 46.63)*[1]	28.85 (8.66, 49.05)**[2]
Mean total minutes of physical activity outside of school/week	143.78 (69.34, 218.21)***	147.47 (72.24, 222.69)***[1]	142.27 (66.97, 217.57)***[3]
Sufficient physical activity (420 min/week)[∞]	1.46 (1.14, 1.86)**	1.54 (1.20, 1.99)**[1]	1.49 (1.15, 1.92)**[4]
Went for a walk in neighborhood last week[∞]	1.48 (1.18, 1.87)***	1.52 (1.19, 1.93)***[1]	1.32 (1.03, 1.70)*[5]

Christian: Dog ownership and children's physical activity

Table 4: Regression models examining associations between dog ownership and children's walking and physical activity (cont)

	Unadjusted B (95% CI)	Model 1 B (95% CI)	Model 2 B (95% CI)
Boys			
Mean total minutes of walking/week	30.43 (0.87, 60.00)*	31.65 (1.70, 61.59)*[6]	35.33 (5.26, 65.40)*[2]
Mean total minutes of physical activity outside of school/week	130.62 (15.37, 245.88)*	135.81 (19.91, 251.71)*[6]	128.99 (13.59, 244.40)*[3]
Sufficient physical activity (420 min/week)[∞]	1.26 (0.87, 1.83)	1.39 (0.95, 2.04)[6]	1.31 (0.89, 1.93)[7]
Went for a walk in neighborhood last week[∞]	1.91 (1.37, 2.67)***	2.00 (1.42, 2.83)***[6]	1.77 (1.24, 2.54)**[8]

Christian: Dog ownership and children's physical activity

Table 4: Regression models examining associations between dog ownership and children's walking and physical activity (cont)

	Unadjusted B (95% CI)	Model 1 B (95% CI)	Model 2 B (95% CI)
Girls			
Mean total minutes of walking/week	20.15 (-6.35, 46.64)	22.38 (-4.72, 49.48)[6]	-
Mean total minutes of physical activity outside of school/week	158.38 (64.13, 252.64)***	164.11 (66.94, 261.28)***[6]	-
Sufficient physical activity (420 min/wk)[∞]	1.66 (1.19, 2.31)**	1.73 (1.23, 2.43)**[6]	1.77 (1.25, 2.50)***[9]
Went for a walk in neighborhood last week[∞]	1.16 (0.84, 1.61)	1.18 (0.84, 1.65)[6]	1.21 (0.85, 1.72)[10]

*$p \leq 0.05$ **$p \leq 0.01$ ***$p \leq 0.001$
[∞]Odds Ratio (95% CI)
[1]Adjusted for socio-demographic factors: child gender and age, parent gender and age, maternal education, number of people and children in household
[2]Adjusted for socio-demographic factors in model 1 plus physical environment factor: dwelling type
[3]Adjusted for socio-demographic factors in model 1 plus physical environment factor: parent has to drive to get to a park that provides play equipment that appeals to their child
[4]Adjusted for socio-demographic factors in model 1 plus physical environment factor: parent fearfulness of child being bitten by a dog if they walked or cycled in the neighborhood without an adult
[5]Adjusted for socio-demographic factors in model 1 plus intrapersonal factor: child confident in ability to walk to the closest shop without adult; social environment factor: child has many friends in the neighborhood; physical environment factors: home location, parent report closest natural bush land is 1-10 minute walk away, parent has to drive to get to a park that provides play equipment that appeals to their child, child perceives it takes too much time to walk to the shop closest from my home
[6]Adjusted for socio-demographic factors: child age, parent gender and age, maternal education, number of people and children in household

[7]Adjusted for socio-demographic factors in model 1 plus social environment factor: child has many friends in the neighborhood; physical environment factor: parent has to drive to get to a park that provides play equipment that appeals to their child
[8]Adjusted for socio-demographic factors in model 1 plus intrapersonal factor: child confident in ability to walk to the closest shop without adult; social environment factor: child has many friends in the neighborhood; physical environment factors: parent report closest natural bush land is 1-10 minute walk away, parent has to drive to get to a park that provides play equipment that appeals to their child
[9]Adjusted for socio-demographic factors in model 1 plus physical environment factor: child positive neighborhood perception
[10]Adjusted for socio-demographic factors in model 1 plus physical environment factors: child perceives it takes too much time to walk to the shop closest from my home, child positive neighborhood perception