



## POPULATION STUDY ARTICLE

# The relationship between dog ownership, dog play, family dog walking, and pre-schooler social–emotional development: findings from the PLAYCE observational study

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**BACKGROUND:** Regular physical activity provides children with health and developmental benefits. This study investigated if active play and walking with the family dog was associated with better social–emotional development in young children.

**METHODS:** We surveyed 1646 parents to ascertain if families with pre-schoolers owned a dog, and the frequency per week their child went on family dog walks or actively played with their dog. The parent-report version of the Strengths and Difficulties Questionnaire (SDQ) was used to measure children's social–emotional development.

**RESULTS:** Children from dog-owning households had reduced likelihood of conduct problems (odds ratio (OR) = 0.70; 95% confidence interval (CI): 0.54, 0.90), peer problems (OR = 0.60; 95% CI: 0.46, 0.79), and total difficulties (OR = 0.77; 95% CI: 0.59, 0.99) and increased likelihood of prosocial behavior (OR = 1.34; 95% CI: 1.06, 1.68) compared with children without a dog. Within dog-owning households, family dog walking at least once/week (OR = 1.45; 95% CI: 1.02, 2.08) and active play with the family dog three or more times/week (OR = 1.74; 95% CI: 1.16, 2.59) increased the likelihood of prosocial behaviors. Family dog walking at least once/week also reduced the likelihood of total difficulties (OR = 0.64; 95% CI: 0.42, 0.96).

**CONCLUSIONS:** Our findings highlight the possible physical activity and social–emotional developmental benefits of family dog ownership for pre-schoolers, and that these benefits may present in early childhood.

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**IMPACT:**

- Young children from dog-owning families had lower peer problems and conduct problems, and higher prosocial behaviors than children from non-dog-owning families.
- Children of dog-owning families who walked or played with their dog more often also had better prosocial behaviors.
- Positive social–emotional development was associated with dog ownership, family dog walking, and dog play in young children.
- Highlights that the social–emotional benefits of owning a dog may begin early in childhood.
- Due to the high level of pet ownership in households with children, these findings suggest having a dog and interacting with it through play and walking may be important mechanisms for facilitating young children's social–emotional development.

**INTRODUCTION**

Physical inactivity and increasing sedentary behaviors in childhood are major public health issues that require effective and targeted family and child friendly strategies.<sup>1,2</sup> Objective measures of physical activity show less than a third of 2–5 year olds achieve 3 h of physical activity each day,<sup>1,3</sup> as recommended by national and international 24-h movement guidelines.<sup>3–7</sup> Similar trends of physical inactivity in young children are seen in countries such as Australia,<sup>1,3</sup> Finland,<sup>8</sup> USA and UK,<sup>9</sup> Canada,<sup>10</sup> and New Zealand.<sup>11</sup> Given that regular physical activity provides children with health and developmental benefits, including healthy weight, improved bone health, cardiovascular fitness, and enhanced motor, cognitive, social, and emotional development,<sup>2,12–15</sup> innovative and

effective strategies are required to improve physical activity levels in the early years. One such strategy may be lying right at our feet.

There is mounting evidence that dog ownership provides motivation and support for dog-facilitated physical activity in adults;<sup>14,16,17</sup> however, few studies have investigated this relationship in children. The development of physical activity habits in early childhood is important as these types of behaviors typically continue in adulthood.<sup>12,14,18</sup> There is some evidence, however, that children of dog-owning families who spend time with their pet dog may benefit in terms of increased physical activity as well as their social and emotional development. For example, in an Australian study, children who walked with the family dog accumulated on average 29 min more physical activity per week<sup>12</sup>

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than children in families without dogs. Likewise, studies from the USA<sup>19</sup> and UK<sup>20</sup> have reported similar results.

Other research has highlighted the developmental benefits of pet, in particular dog, ownership for children. For example, dogs may help children learn responsibility, develop a sense of identity and independence, provide unconditional love and loyalty, and may help with language development and verbal skills.<sup>14</sup> Furthermore, positive child–pet interactions may increase the social and emotional development of young children in areas such as self-esteem, autonomy, empathy, trust, self-confidence,<sup>14,21,22</sup> and in action, as social enablers.<sup>14,23,24</sup> Notably, much of the published research has been conducted with older children,<sup>14,25</sup> and thus we do not know if having a family dog is associated with similar developmental benefits for children of a younger age (i.e., under the age of 5 years).

Given that physical activity has the potential to improve social, emotional, and physical health outcomes in children<sup>2,13,14,22–24,26</sup> and there are indications that dog ownership may be associated with increased levels of physical activity in children,<sup>12,27,28</sup> it is plausible that dog-facilitated physical activity may act as the mechanism to enhanced psychosocial and emotional benefits in early childhood. Thus, the aims of this study were to investigate: (1) the relationship between dog ownership status and social–emotional development in pre-school children; and (2) if active play and walking with the family dog were associated with better social–emotional development in young children. We hypothesized that children from dog-owning families would have better social–emotional development than children without a dog, and within dog-owning families, higher levels of active play and walking with the family dog would be associated with better social–emotional development in young children.

## METHODS

This study was a secondary analysis of data from the “Play Spaces and Environments for Children’s Physical Activity” (PLAYCE) study cohort (2015–2018). The PLAYCE study investigated early childhood education and care (ECEC), home, and neighborhood influences on pre-schoolers’ physical activity.<sup>29</sup> The PLAYCE study was a 3-year cross-sectional observational study of children aged 2–5 years ( $n = 2119$ ), who attended ECEC centers ( $n = 115$ ; response rate 46%) in the Perth metropolitan area, Western Australia.<sup>3</sup> ECEC centers were recruited based on size (small and large based on the number of approved child places) and across low, medium, and high socio-economic status.<sup>29</sup> Exclusion criteria for children included having a recognized physical, intellectual, or behavioral disability that was likely to impact physical activity levels; and attending school full time. Further details of the study protocol and methods have been previously described and published.<sup>29</sup>

### Measures

Data were collected as part of the PLAYCE parent survey<sup>29</sup> ( $n = 1646$ ), which included measures of socio-demographic factors (child sex, age, and siblings, parent highest level of education, work status, and family structure), sleep<sup>30</sup> and screen time,<sup>31</sup> family dog ownership, active play with the dog, family dog walking, and child social–emotional development.

Family dog ownership was measured by a single parent-report item asking parents if they had a family dog (yes/no).<sup>32</sup> Active play and family dog walking were measured by parent-reported frequency (“never/rarely,” less than once/week, 1–2 times/week, 3–4 times/week, 5–6 times/week, daily) of playing with the family dog and walking with the family dog in a typical week. Both variables were collapsed into dichotomous variables: frequency of playing with the dog ( $\geq 3$  times/week,  $< 3$  times/week) and frequency of family dog walking ( $\geq 1$  time/week,  $< 1$  time/week).

Children’s social–emotional development was measured using the parent-report Strengths and Difficulties Questionnaire (SDQ) for 2–4 year olds.<sup>33</sup> The SDQ is a validated and commonly used, 25-item instrument (five questions per construct) that measures the social and emotional well-being of children aged 2–17 years. Each question has a three-point Likert response scale of “not true” (0), “somewhat true” (1), or “certainly true” (2). Questions were combined into the SDQ mean-scored sub-scales based on Goodman and Goodman.<sup>33</sup> These sub-scales include emotional symptoms, conduct problems, hyperactivity, peer problems, prosocial behavior, and a total difficulties score.<sup>33</sup> The mean scores for each sub-scale were categorized using the established SDQ group score categorization of: (1) “close to average,” (2) “Slightly raised,” (3) “High,” and (4) “Very high.”<sup>34</sup> Based on the distribution of the data, the “Slightly raised,” “High,” and “Very high” categories were combined to form a binary variable that indicated whether a child was in the abnormal (above-average) range for a particular behavior (yes/no). Above-average scores represented poorer development, except for the prosocial behavior sub-scales whereby an “above-average” score represented better development.

### Analyses

Chi-square analysis was used to test for unadjusted associations between dog ownership and socio-demographic characteristics and SDQ sub-scales variables, and Mann–Whitney was used to determine differences in age. Logistic regression analyses using SPSS v23 were first conducted with the whole sample ( $n = 1646$ ) to test for the association between dog ownership status and children’s social–emotional development as measured by the parent-reported SDQ. A second set of analyses involved the subset of dog-owning families ( $n = 686$ ) only and tested for associations between (a) dog play and (b) family dog walking with children’s social–emotional development. Both sets of analyses were conducted using logistic regression models adjusting for child age, sex, sleep, and screen time and parent education. The main effect of physical activity and the interaction between physical activity and dog ownership was also examined; however, it was non-significant and thus not included in the models.

## RESULTS

### Sample characteristics

Approximately half of the sample were boys (52%) ( $p = 0.749$ ) (Table 1). Children were on average 3.3 years old and two-thirds (67%) had siblings. The majority of parents had a partner (89%), 56% had a postgraduate education, and 81% were in either full-time or part-time employment. Parent education level was significantly higher in the non-dog-owning group compared with the dog-owning group ( $p < 0.001$ ). There were no other significant socio-demographic differences by dog ownership status.

Family dog ownership was 42% (Table 1). Within dog owners, parents reported that 77% of their pre-school-aged children engaged in play with the family dog three or more times per week and 53% went for a walk with the dog once or more per week.

Overall, parents of pre-schoolers reported that 20% of their children had an above-average score (representing poorer development) for the total SDQ scale, 18% had an above-average emotional difficulties score, 22% had an above-average score for conduct problems, 22% had an above-average score for hyperactivity, 19% had an above-average score for peer problems, and 30% had a lower than average score for prosocial behaviors (representing poorer development) (Table 1).

### Association between dog ownership and pre-schooler social–emotional development

There were significant unadjusted differences between pre-schoolers from dog-owning and non-dog-owning families for

**Table 1.** Sample characteristics overall and by dog ownership.

	Overall sample <i>n</i> = 1646 % ( <i>n</i> )	Dog owners <i>n</i> = 686 % ( <i>n</i> )	Non-dog owners <i>n</i> = 960 % ( <i>n</i> )	<i>p</i> Value
<b>Socio-demographic factors</b>				
Child mean age (SD)	3.3 (0.75)	3.3 (0.74)	3.3 (0.77)	0.739
Child sex (boys)	52.1 (853)	53.2 (364)	51.3 (489)	0.447
Parent education				
Secondary level	16.0 (262)	20.1 (137)	13.0 (125)	<0.001*
Trade/diploma	27.8 (456)	32.2 (220)	24.6 (236)	
Postgraduate	56.2 (924)	47.7 (326)	62.4 (598)	
Work status				
Full-time	33.4 (548)	32.7 (223)	33.9 (325)	0.358
Part-time	47.5 (781)	48.9 (334)	46.6 (447)	
Not working	8.0 (131)	6.7 (46)	8.9 (85)	
Home duties	11.1 (183)	11.7 (80)	10.7 (103)	
Family structure				
Partnered	88.6 (1452)	89.3 (609)	88.2 (843)	0.483
Single parent	11.4 (186)	10.7 (73)	11.8 (113)	
Siblings	66.8 (1094)	66.4 (452)	67.1 (642)	
<b>Social-emotional development</b>				
SDQ total difficulties <sup>a</sup>	19.9 (320)	18.2 (123)	21.0 (197)	0.157
Emotional difficulties <sup>a</sup>	17.9 (290)	17.0 (115)	18.6 (175)	0.394
Conduct problems <sup>a</sup>	22.2 (358)	19.5 (132)	24.1 (226)	0.028*
Hyperactivity <sup>a</sup>	21.6 (348)	21.6 (146)	21.6 (202)	0.997
Peer problems <sup>a</sup>	19.2 (309)	15.5 (105)	21.8 (204)	0.002*
Prosocial behaviors (lower than average) <sup>b</sup>	30.4 (492)	27.0 (183)	32.9 (309)	0.011*
<b>Dog-related physical activity</b>				
Active play with family dog <sup>c</sup>	N/A	76.7 (516)	N/A	
Family dog walking <sup>d</sup>	N/A	52.8 (352)	N/A	

\**P* < 0.05.<sup>a</sup>Above-average score, close to average score = reference group.<sup>b</sup>Lower than average score, close to average score = reference group.<sup>c</sup>Three times per week or more, less than three times per week = reference category.<sup>d</sup>Once per week or more, less than once per week = reference category.

the conduct problems, peer problems and prosocial behaviors sub-scales. A significantly smaller percentage of pre-schoolers from dog-owning than non-dog-owning families had above-average scores for conduct problems (20% and 24%, respectively) and peer problems (16% and 22%, respectively) (both *p* < 0.05). A significantly smaller percentage of pre-schoolers from dog-owning than non-dog-owning families had lower than average scores for prosocial behaviors (27% vs. 33%; *p* < 0.05). No significant differences between pre-schoolers from dog-owning and non-dog-owning families were observed for the total SDQ, emotional difficulties or hyperactivity sub-scales.

After adjusting for child age, sex, sleep and screen time and parent education, pre-schoolers from dog-owning families had reduced odds of having a poor total SDQ score, compared with pre-schoolers from non-dog-owning families (odds ratio (OR) = 0.77; 95% confidence interval (CI): 0.59, 0.99) (Table 2). Dog-owning pre-schoolers also had 30% reduced odds of having conduct problems (OR = 0.70; 95% CI: 0.54, 0.90) and peer problems (OR = 0.60; 95% CI: 0.46, 0.79), compared with non-dog-owning pre-schoolers. Finally, pre-schoolers from dog-owning families had significantly increased odds of having an "above-average" score on the prosocial behaviors sub-scale, compared with non-dog-owning pre-schoolers (OR = 1.34; 95%

CI: 1.06, 1.68). There were no significant differences by dog ownership status for the emotional difficulties or hyperactivity sub-scales.

#### Association between family dog walking and pre-schooler social-emotional development (dog owners only)

Within dog owners, pre-schoolers who walked with their family dog one or more times per week had reduced odds of having a poor total SDQ score, compared with dog owners who walked with their family dog less than once per week (OR = 0.64; 95% CI: 0.42, 0.96) (Table 3). Children who took part in family dog walking at least once per week had 1.45 higher odds of having an "above-average" score on the prosocial behaviors sub-scale, compared with dog owners who walked with their dog less than once per week (OR = 1.45; 95% CI: 1.02, 2.08). There were no significant differences for emotional difficulties, conduct problems, hyperactivity, or peer problems sub-scales based on the frequency of family dog walking per week.

#### Association between playing with the family dog and pre-schooler social-emotional development (dog owners only)

Within dog owners, pre-schoolers who played with the family dog three or more times per week had 1.74 odds of having an "above-

**Table 2.** Adjusted associations between family dog ownership and pre-schooler social–emotional development.

	SDQ total score	Emotional difficulties	Conduct problems	Hyperactivity	Peer problems	Prosocial behaviors
	OR <sup>a</sup> (95% CI)					
Dog ownership <sup>b</sup>	0.77* (0.59, 0.99)	0.86 (0.66, 1.12)	0.70* (0.54, 0.90)	0.96 (0.75, 1.23)	0.60* (0.46, 0.79)	1.34* (1.06, 1.68)
Adjustment variables						
Boy	1.52* (1.17, 1.96)	0.82 (0.63, 1.06)	1.45* (1.13, 1.85)	1.56* (1.22, 2.00)	1.23 (0.95, 1.59)	0.53* (0.42, 0.66)
Age	0.90 (0.75, 1.08)	1.14 (0.96, 1.37)	0.99 (0.84, 1.18)	0.92 (0.77, 1.09)	0.68* (0.56, 0.82)	1.27* (1.08, 1.48)
Screen time (h/week)	1.03* (1.02, 1.04)	1.02* (1.01, 1.03)	1.02* (1.01, 1.03)	1.02* (1.01, 1.03)	1.03* (1.01, 1.04)	0.98* (0.97, 0.99)
Sleep time (h/24 h)	0.95* (0.91, 0.99)	0.99 (0.94, 1.04)	1.01 (0.96, 1.06)	0.97 (0.92, 1.01)	0.93* (0.89, 0.98)	1.02 (0.97, 1.06)
Parent education						
University or postgraduate	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Trade/diploma	1.57* (1.18, 2.10)	0.99 (0.73, 1.34)	1.55* (1.17, 2.05)	1.33* (1.00, 1.76)	1.21 (0.90, 1.63)	1.14 (0.88, 1.48)
Year 12 or lower	1.74* (1.22, 2.47)	1.10 (0.75, 1.58)	1.82* (1.30, 2.55)	1.41* (1.00, 1.99)	1.17 (0.81, 1.69)	0.82 (0.60, 1.13)

\**P* < 0.05; model adjusted for: child age, sex, sleep and screen time, and parent education.  
<sup>a</sup>Odds ratio of having an above-average score for a SDQ sub-scale (“above-average” represents poorer development, except for prosocial behaviors, where “above average” represents better development).  
<sup>b</sup>Reference category is “non-dog ownership.”

**Table 3.** Associations between family dog walking and pre-schooler social–emotional development.

	SDQ total score	Emotional difficulties	Conduct problems	Hyperactivity	Peer problems	Prosocial behaviors
	OR <sup>a</sup> (95% CI)					
Family dog walking ≥ 1 time/week <sup>b</sup>	0.64* (0.42, 0.96)	1.02 (0.67, 1.56)	0.74 (0.49, 1.10)	0.99 (0.67, 1.45)	0.79 (0.51, 1.24)	1.45* (1.02, 2.08)
Adjustment variables						
Boy	1.42 (0.93, 2.15)	1.00 (0.65, 1.52)	1.37 (0.91, 2.05)	1.55* (1.05, 2.28)	1.07 (0.69, 1.67)	0.66* (0.46, 0.95)
Age	0.73* (0.54, 0.99)	0.94 (0.69, 1.28)	0.97 (0.72, 1.29)	0.80 (0.61, 1.06)	0.65* (0.46, 0.91)	1.54* (1.18, 2.00)
Screen time (h/week)	1.02 (0.99, 1.04)	1.01 (0.98, 1.03)	1.01 (0.99, 1.04)	1.03* (1.01, 1.05)	1.02* (1.01, 1.05)	0.99 (0.97, 1.01)
Sleep time (h/24 h)	0.98 (0.90, 1.06)	1.02 (0.93, 1.11)	1.01 (0.93, 1.10)	0.96 (0.89, 1.03)	0.94 (0.87, 1.03)	0.99 (0.92, 1.07)
Parent education						
University or postgraduate	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Trade/diploma	1.02 (0.64, 1.63)	0.89 (0.55, 1.42)	1.64* (1.04, 2.59)	1.15 (0.74, 1.78)	1.00 (0.60, 1.65)	1.39 (0.92, 2.09)
Year 12 or lower	1.29 (0.75, 2.20)	0.78 (0.43, 1.40)	1.86* (1.12, 3.14)	1.50 (0.91, 2.46)	1.14 (0.64, 2.04)	0.99 (0.62, 1.58)

\**P* < 0.05; model adjusted for: child age, sex, sleep and screen time, and parent education.  
<sup>a</sup>Odds ratio of having an above-average score for a SDQ sub-scale (“above-average” represents poorer development, except for prosocial behaviors, where “above-average” represents better development).  
<sup>b</sup>Reference category is “dog walking < 1 time/week.”

average” score on the prosocial behaviors sub-scale, compared with those who played with the family dog less than three times per week (OR = 1.74; 95% CI: 1.16, 2.59) (Table 4). There were no significant differences for the total SDQ score or the emotional difficulties, conduct problems, hyperactivity, or peer problems sub-scales based on pre-schoolers’ frequency of playing with the family dog per week.

## DISCUSSION

This study investigated the relationship between dog ownership and pre-school children’s social–emotional development. We found that pre-school children with a family dog were less likely to have conduct problems, peer problems, and had a lower overall difficulties score than children from non-dog-owning families, after adjusting for socio-demographic factors and child screen and sleep time. Children from dog-owning families also had higher levels of

prosocial behaviors compared with children from non-dog-owning families. These results support the findings of other studies, which have reported better self-esteem, improved empathy towards peers,<sup>21,22,26</sup> and higher levels of personal responsibility and autonomy<sup>21</sup> in children with pets compared to those without.

Importantly, this appears to be the first study to investigate the relationship between social–emotional development and dog ownership in a young age group of 2–5 year olds. Existing studies have observed these relationships in children 8 years and older showing that the positive influence of pets on child development was greatest during preadolescence.<sup>21</sup> One study to date has reported that adult social competency and positive self-concept may be related to childhood animal ownership when it occurs prior to 6 years of age or after 12 years of age;<sup>35</sup> however, these results relied on retrospective recall, and have not since been replicated. Our findings highlight the potential positive impact of family dog ownership on children’s

**Table 4.** Association between active play with dog and pre-schooler social-emotional development.

	SDQ total score	Emotional difficulties	Conduct problems	Hyperactivity	Peer problems	Prosocial behaviors
	OR <sup>a</sup> (95% CI)					
Active play with family dog $\geq 3$ times/week <sup>b</sup>	1.09 (0.67, 1.77)	0.86 (0.53, 1.38)	1.18 (0.73, 1.91)	1.15 (0.73, 1.83)	1.57 (0.89, 2.77)	1.74* (1.16, 2.59)
Adjustment variables						
Boy	1.41 (0.93, 2.12)	0.92 (0.61, 1.39)	1.35 (0.90, 2.01)	1.53* (1.04, 2.25)	1.05 (0.68, 1.62)	0.62* (0.43, 0.89)
Age	0.73* (0.54, 0.99)	0.92 (0.68, 1.25)	0.97 (0.73, 1.30)	0.78 (0.59, 1.03)	0.65* (0.47, 0.91)	1.52* (1.17, 1.98)
Screen time (h/week)	1.02* (1.03, 1.05)	1.01 (0.99, 1.03)	1.02 (0.99, 1.04)	1.02* (1.01, 1.05)	1.03* (1.01, 1.05)	0.99 (0.97, 1.01)
Sleep time (h/24 h)	0.98 (0.90, 1.06)	1.00 (0.92, 1.09)	1.01 (0.93, 1.10)	0.96 (0.89, 1.03)	0.94 (0.87, 1.03)	0.98 (0.91, 1.06)
Parent education						
University or postgraduate	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Trade/diploma	1.02 (0.64, 1.62)	0.89 (0.56, 1.42)	1.61* (1.03, 2.53)	1.15 (0.74, 1.77)	0.97 (0.58, 1.60)	1.34 (0.89, 2.02)
Year 12 or lower	1.41 (0.84, 2.37)	0.79 (0.44, 1.40)	1.99* (1.19, 3.32)	1.55 (0.95, 2.53)	1.24 (0.70, 2.19)	0.92 (0.57, 1.46)

\* $P < 0.05$ ; reference category is "active play with family dog  $< 3$  times/week." Model adjusted for: child age, sex, sleep and screen time, and parent education.

<sup>a</sup>Odds ratio of having an above-average score for a SDQ sub-scale ("above average" represents poorer development, except for prosocial behaviors, where "above average" represents better development).

<sup>b</sup>Reference category is "active play with family dog  $< 3$  times/week."

social-emotional development at a young age, reflecting the age that children are mobile and able to physically interact with the family dog.

The SDQ total difficulties score was significantly lower for children from dog-owning families compared with those children who did not have a family dog. A review paper reported mixed evidence for enhanced social and behavioral outcomes related to pet ownership.<sup>14</sup> However, this review included only three papers focused on pre-school children with only one quantitatively examining social development.<sup>14</sup> This study investigated child-pet attachment and the quality of the home environment on the social development of 3–6 year olds ( $n = 86$ ), showing that children with stronger parent-reported pet attachment had better social competence and empathy.<sup>14</sup> These findings are consistent with our own; however, our study did not measure pet attachment and instead measured dog ownership specifically, showing that the mere presence of a family dog was associated with better social-emotional development in pre-school children. Future studies should examine the impact of different types of pets and the level of attachment children have to their pets on social-emotional development as well as other domains of child development and behavior.

We found no association between dog ownership and the emotional difficulties or hyperactivity sub-scales. To date, no studies have examined these relationships in young children; however, in a study of 8–12-year-old children, higher levels of attachment to the family dog was associated with lower levels of teariness or weepiness at 12 months follow-up.<sup>36</sup> These findings require confirming in younger children.

We hypothesized that playing and walking with the family dog may be an important mechanism through which dog ownership can facilitate improved child developmental outcomes. After adjusting for socio-demographic factors, screen and sleep time, pre-schoolers from dog-owning families who walked with the family dog once a week or more had significantly lower total difficulties scores and better prosocial behavior scores compared with pre-schoolers who walked with the family dog less than once a week. Pre-schoolers who played with the family dog three or more times per week also had significantly higher levels of prosocial behaviors compared with those who reported playing with the family dog less than three times per week. These results highlight that even a small to moderate commitment to involving pre-schoolers in time spent walking with the family dog may

provide important social and emotional benefits for young children. While there are some studies showing that dog ownership is associated with physical activity and/or social-emotional benefits in older children and adolescents,<sup>14,25</sup> there are very few studies that have identified if these relationships exist in younger pre-school-aged children. Importantly, our findings showed that playing and walking with the family dog had the largest effect on the prosocial behavior sub-scale, which is not included in the total SDQ score.

Child-pet attachment has been identified as being important for promoting social and emotional well-being in early childhood.<sup>25</sup> Young children may spend more time with the family dog than older children since they are not yet at full-time school; thus, it is possible that this contributes to stronger attachments to the family dog and better social-emotional functioning.<sup>25</sup> The child-dog attachment strength was not measured in the current study; however, this may be reflected in the amount of time children spend walking and playing with their dog. For example, we observed that children who played with their dog a minimum of three times per week or walked with their dog at least once per week had better social-emotional development. In addition, as reported in adults, it may be that children experience similar "vicarious pleasure" and happiness when interacting with the dog through physical activity,<sup>37</sup> and this promotes better prosocial behavior. Importantly, our study appears to be the first to show the potential social-emotional developmental benefits of family dog walking and dog play in children under 5 years of age. Future studies should further investigate the mechanisms through which dog ownership, child-dog attachment, playing, and walking with the family dog facilitate improved developmental outcomes in young children and determine the causal relationships between dog ownership, family dog walking, and playing with the dog on different domains of early child development.

#### Limitations

This study was a secondary data analysis and was limited by the aims and questions as set out in the original PLAYCE study. This study was also limited by its cross-sectional design and thus was not able to determine the casual relationships between dog ownership, family dog walking, playing with a dog and social-emotional development in young children or unpack further the mechanisms through which dog ownership facilitates better social-emotional outcomes. For example, dog ownership

and dog play/walking may reflect a general characteristic of higher functioning families who can provide more nurturing environments for their children. In addition, it may be that young children with good social-emotional development happen to have dogs and play/walk them more, rather than dog ownership and dog play/walking causing young children to develop social-emotional skills better than children who do not have a dog. Moreover, a number of variables were not collected in this study, which may have been important adjustment variables to consider in models. For example, there is some evidence that children from single-parent households are more attached to their dog.<sup>38</sup>

Future studies should include other measures of family structure as well as parent-dog and child-dog attachment levels. While this study collected information about the frequency of dog play and family dog walking, future studies may consider the duration of dog-child related activities across different behavior settings (at home, parks, family, and friends) so as to gain insight into the types of environments that better support positive child-dog interactions and developmental outcomes. Future research should investigate further the role of dog- and non-dog-facilitated physical activity and its impact on young children's social and emotional development.

#### Public health implications

Overall, our findings suggest that the benefits from owning a pet (dog) may commence early in childhood. We found that pre-schoolers from dog-owning families had less peer problems and conduct problems and higher prosocial behaviors than children from non-dog-owning families. In the dog-owning group, pre-schoolers who walked with their dog at least once a week or played with their dog at least three times a week had significantly higher prosocial behaviors than those who did not. Pre-schoolers who walked with their family dog at least one day per week also had significantly lower total difficulties. Further research on the different developmental benefits of other pets in early childhood is warranted as well as longitudinal studies to confirm the casual relationships between different types of pet ownership and early child development and the mechanisms through which pets may facilitate positive child developmental outcomes.

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#### AUTHOR CONTRIBUTIONS

H.E.C. designed the study and oversaw acquisition of the data. E.J.W., L.L., and H.E.C. analyzed the data. E.J.W. and H.E.C. drafted the article. All authors interpreted the data and provided feedback on drafts of the paper, approved the submitted version, and have agreed both to be personally accountable for their own contributions and to ensure that questions related to the accuracy or integrity of any part of the work, even ones in which the author was not personally involved, are appropriately investigated, resolved, and the resolution documented in the literature.

#### ADDITIONAL INFORMATION

**Competing interests:** The authors declare no competing interests.

**Patient consent:** Written informed consent was obtained from all participants in the PLAYCE Study. Consent conformed with the University of Western Australia Human

Research Ethics Committee approval (RA/4/7417) for this project and the Australian Government's National Statement on Ethical Conduct of Human Research 2007 (updated 2018).

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