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ORIGINAL ARTICLE

The effects of service dogs on psychosocial health and wellbeing for individuals with physical disabilities or chronic conditions

Kerri E. Rodriguez[a], Jessica Bibbo[a,b] and Marguerite E. O'Haire[a]

[a]Center for the Human-Animal Bond, Department of Comparative Pathobiology, Purdue University College of Veterinary Medicine, West Lafayette, IN, USA; [b]Center for Research and Education, Benjamin Rose Institute on Aging, Cleveland, OH, USA

ABSTRACT

Purpose: To evaluate the effects of service dogs on psychosocial health and indicators of wellbeing among individuals with physical disabilities or chronic conditions.

Materials and methods: A total of 154 individuals participated in a cross-sectional survey including 97 placed with a mobility or medical service dog and 57 on the waitlist to receive one. Hierarchical regression evaluated the effect of having a service dog on standardized measures of psychosocial health (Pediatric Quality of Life Inventory) as well as anger, companionship, and sleep disturbance (Patient Reported Outcome Measurement Information System). Among those with a service dog, the Monash Dog–Owner Relationship Scale quantified the human–animal bond.

Results: Results indicated that compared to those on the waitlist, individuals with a service dog exhibited significantly better psychosocial health including higher social, emotional, and work/school functioning. There was no significant effect of having a service dog on anger, companionship, or sleep disturbance. Among those with a service dog, emotional closeness, dog–owner interaction, and amount of time since the service dog was placed were weak correlates of outcomes.

Conclusions: Findings suggest that service dogs may have measurable effects on specific aspects of psychosocial health for individuals with physical disabilities or chronic conditions.

➤ **IMPLICATIONS FOR REHABILITATION**

- Health care providers should recognize that in addition to the functional benefits service dogs are trained to provide, they can also provide their handlers with psychosocial benefits from their assistance and companionship.
- Results indicate that having a service dog was related to better emotional functioning, social functioning, and work/school functioning. Areas with no significant relationship with having a service dog included social companionship, sleep, and anger.
- Although findings are from a large and representative sample of mobility and medical service dogs, there may be individual differences in how service dogs affect the psychosocial health of their handlers.

Introduction

For those with physical disabilities or chronic conditions, it is often difficult to maintain functionality during daily activities without a form of aid or assistance. One form of assistance that can improve independence and functionality is a service dog [1–3]. A service dog is defined by the American for Disabilities Act as "any dog that is individually trained to do work or perform tasks for the benefit of an individual with a disability" [4]. In addition to guide dogs for the vision impaired and hearing dogs for the hearing impaired, mobility service dogs can assist those with physical disabilities by performing tasks such as retrieving dropped items, opening doors, or pulling a wheelchair. For individuals who require diabetic or epileptic monitoring, medical service dogs can be trained to provide alert or response for seizures or hypoglycaemic episodes. As the potential roles that service dogs can fulfil have expanded over time, placements of service dogs both in the USA and internationally continue to increase [5].

Beyond the functional physical benefits that a service dog is trained to provide [e.g., 6], there is a growing literature describing the effects of service dogs on psychosocial health and quality of life. Initial studies suggest that a service dog's presence, companionship, and assistance can have measurable effects on their handler's health and wellbeing [7,8]. Specifically, individuals retrospectively report that since receiving a service dog, they require less assistance from others, have more confidence and self-esteem, and are more able to participate in social activities [9–13]. In addition, as individuals with both physical and "invisible" disabilities are often subject to social isolation, low self-esteem, and significant challenges when navigating their social environment [14–16], the effects of a service dog's companionship and social support may be particularly salient for improving positive interpersonal interactions in this population. Observational studies have found that when accompanied by a service dog, individuals in wheelchairs are more likely to be smiled at,

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approached by strangers, and receive positive social interactions than when alone [17–19]. These social facilitation effects are thought to be moderated by the positive implicit social bias caused by the service dog, whereby the dog's presence may increase positive attitude towards an individual with a disability and act as a social lubricant to promote positive social interactions [20–22].

To date, two systematic reviews have described the literature on the effects of service dogs on psychosocial health of individuals with physical disabilities or chronic conditions [7,8]. Existing literature consists of a variety of study designs including longitudinal, retrospective, and cross-sectional studies which largely vary in methodological rigor. The first longitudinal, randomized study on this topic in 1996 found that after only six months with a service dog, individuals with ambulatory disabilities exhibited significant improvements in psychological wellbeing, self-esteem, and community integration [23]. However, the validity of these findings has been controversial as a result of unrealistically large effect sizes and several methodological omissions by the authors [24,25]. Since then, other longitudinal pilot studies have provided promising findings regarding increases in independence, self-esteem, and social functioning after receiving a service dog, but are limited by small sample sizes and the lack of a control group [12,26]. Findings from longitudinal studies with a control group have not been as uniformly positive; a 2008 pre-post study compared eight individuals who received a service dog to 15 on the waitlist at baseline and after six months and found no significant effect of time or having a service dog on standardized measures of mental health and life satisfaction [27].

Most published research on the effects of service dogs has featured retrospective designs, which have been valuable to understand long-term impacts of the dog's assistance and companionship. In one of the largest studies to date on this topic, a majority of 202 individuals with physical disabilities who had a service dog retrospectively reported that since obtaining a service dog they were more confident, needed less assistance from others, and had been more able to participate in social activities [25]. Other retrospective studies found that those with a service dog reported increases in self-esteem, social interactions, and positive affect from their service dog's assistance and companionship [9,10]. However, these studies lack a control group, are limited by the biases of retrospective report, and rely on unstandardized measures.

Several cross-sectional studies have provided promising evidence by using larger sample sizes and standardized outcome measures, but findings have been mixed. For example, a recent large cross-sectional study compared 76 individuals using wheelchairs with a service dog to 76 matched controls and found no significant group differences on standardized measures of loneliness, depression, self-esteem, positive affect, and community integration [28]. Although those with a service dog and those on the waitlist did not statistically differ in outcomes, depression and progressiveness of disease were key moderating variables of outcomes among those with a service dog. A small cross-sectional study found that 10 individuals with a mobility service dog reported higher quality of life on a standardized measure compared to a matched control group [29]. Recently, a 2017 cross-sectional survey also found that 72 individuals with a mobility service dog reported significantly higher quality of life (specifically in the areas of social health, work/school functioning, and independence) than a control group of 24 individuals on the waitlist [30].

In addition to service dogs trained for mobility assistance, a number of recent studies have begun to examine the psychosocial effects of having medical alert dogs such as those who are trained for diabetic individuals or those with seizure disorders [31,32]. In one retrospective study, 36 participants reported that since obtaining a diabetic alert service dog, individuals not only experienced significant decreases in the frequency of hypoglycaemia episodes, but also reported that they were less worried, had greater quality of life, and were more able to participate in physical activities [32]. Similarly, retrospective study of 22 individuals with epilepsy found that all participants reported major to moderate increases in their quality of life (including improvements in interpersonal relationships, self-confidence, and independence) since getting a seizure response service dog [33]. Thus, preliminary studies with this population indicate that the assistance and companionship from a medical alert or response service dog are likely to facilitate similar psychosocial effects to mobility service dogs.

Despite several studies offering promising findings that service dogs may have a significant effect on their handler's psychosocial functioning, the most recent systematic review concluded that the current state of knowledge is "inconclusive and limited" as a result of widespread methodological weaknesses [8]. Specifically, a majority of the existing literature lacks a control/comparison group, is limited by small sample sizes, or has relied on retrospective reports. In addition, many studies have used unstandardized measures with minimal or absent psychometrics resulting in findings that are not generalizable across studies. Another methodological limitation of the current literature is that statistical analyses have often failed to account for important covariates explaining variance in quality of life. Specifically, disability-specific characteristics such as daily functional limitation and progressiveness of the chronic condition can be key variables explaining individual differences in psychosocial outcomes [e.g., 28].

An additional important consideration that most published studies have not accounted for is the confounding variable of having a pet dog in the home. Not only has previous research found that dog ownership can provide significant social support and fulfil many social needs [34], but they may also facilitate community involvement and social interaction [35,36]. For example, a 2012 observational study quantified the social interactions of a confederate in a wheelchair who was alone, with a service dog, or with a pet dog in public. Although the individual received more social interaction when a dog was present, there was no significant difference between the pet dog and service dog conditions, suggesting that pet dogs may have similarly significant effects on social facilitation as service dogs [37]. Therefore, the presence of a pet dog may be an important confounding variable to account for which may explain variance in psychosocial outcomes, especially for those in waitlist control groups.

As applications for service dogs continue to increase [5], there remains a need for replicable, reliable quantification of the effects of this unique human–animal relationship. Our objective in this research was to evaluate the effects of service dogs on psychosocial health and indicators of wellbeing in a population of individuals with physical disabilities or chronic conditions. This study adds to current knowledge by assessing outcomes with standardized measures, controlling for the presence of a pet dog and disability-specific variables, and including a large and representative sample of individuals with a service dog compared to a waitlist control group. We hypothesized that individuals placed with a service dog would exhibit significantly better psychosocial functioning as well as significantly lower anger, higher social

companionship, and lower sleep disturbance when compared to a waitlist control group with no service dog. Among those with a service dog, we also hypothesized that time since placement and the strength of the human–animal bond would be significant positive correlates of outcomes.

Materials and methods

This study was approved by the Purdue University Institutional Review Board (IRB Protocol #1602017187). No interactions occurred with any service dogs, therefore a waiver was obtained from the Purdue University Institutional Animal Care and Use Committee (IACUC).

Participants

Participants were recruited between September and December 2016 from the database of Canine Assistants, an Assistance Dog International (ADI) certified provider of mobility and medical service dogs for a variety of physical conditions and disabilities. Inclusion criteria for study participants included being accepted by the Canine Assistants program, which excludes those with dog allergies, fear of dogs, or family members convicted of violent crime or animal abuse. No exclusions were made based on participants' age, gender, diagnosis, living situation, or presence of a pet dog in the home.

Participants recruited from the waitlist group ($n = 165$) had applied for a service dog, had been approved by the organization, and were currently waiting until their scheduled date to receive a service dog. Participants recruited from the service dog group ($n = 214$) had already been provided a service dog from the provider, and were matched for recruitment based on approximate age (±5 years) and primary diagnosis from participating individuals on the waitlist. Participants who had been paired with their service dog within the past six months of the study's beginning were excluded from the study (based on an estimated adjustment period following service dog placement [7]).

Service dogs were primarily purebred or crosses between Labrador Retrievers, Golden Retrievers and Standard Poodles. All dogs were born, raised, and prepared for placement at Canine Assistants' facilities. Service dogs consisted of mobility service dogs, seizure response dogs, and diabetic alert dogs. Mobility service dogs assisted individuals with physical disabilities by performing such behaviours as turning lights on and off, opening and closing doors, and retrieving dropped objects. Seizure response service dogs are placed with those with epilepsy or seizure conditions to remain next to the individual during a seizure or summon help/retrieve a phone in the event of a seizure (certain seizure response dogs also develop the ability to predict an oncoming seizure in advance, but this was not a task specifically taught by Canine Assistants). Diabetic alert dogs are placed with those with type 1 diabetes to alert to changes in blood sugar, summon help, or retrieve medication.

Procedures

All potential participants were emailed an invitation to participate in the study. A research assistant then called individuals within one to three days to give an overview of the study and obtain informed consent or minor assent. Participants who were either younger than 13 or lacked sufficient verbal skills had a parent or guardian report on their functioning via proxy. All participants were entered into a drawing for one of 20 cash prizes ranging from $25 to $100. The survey, which took approximately 10–20 minutes to complete, could be completed online, over the phone, or on paper through the mail.

Measures

Demographic and medical variables

By participating in the research study, participants consented for the researchers to access their records on file with Canine Assistants. Records included key demographic variables (e.g., the recipient's date of birth and gender) as well as the date of service dog placement or waitlist assignment. Records also included the original application to obtain a service dog, which contained a medical history form filled out by a physician or medical professional verifying the primary diagnosis and progressiveness of condition. Primary diagnoses were categorized into five categories: seizure disorders (e.g., epilepsy, Koolen DeVries syndrome), musculoskeletal disorders (e.g., Duchenne's muscular dystrophy, osteogenesis imperfecta, Charcut–Marie–Tooth disease), neuromuscular disorders (e.g., cerebral palsy, spinal cord injury, spinal muscular atrophy, para/tetra/quadriplegia), developmental or intellectual disorders (e.g., Down syndrome, fetal alcohol syndrome), and a general "other" category (e.g., type 1 diabetes, cystic fibrosis).

The medical history form also contained a section for the physician or medical professional to rate the participant's ability to perform activities of daily living (ADL). The section contained eight items about the extent to which the participant was able to physically and mentally function (e.g., "Is the patient able to control physical or motor movement sufficient to sustain ADL?", "Is the patient capable of perception and memory to the degree necessary to sustain ADL?"). Responses were yes (2), minimally (1), and no (0). An ADL Capability score was then calculated by averaging responses (of forms which had at least 5/8 items completed), such that a score of 0 indicated the individual was fully dependent on a caregiver to sustain ADL and a score of 2 indicated the individual was fully independent and capable to sustain ADL.

Pediatric Quality of Life Inventory (PedsQL)

Psychosocial health was measured via the PedsQL 4.0 Generic Core Scales [38]. The measure asked how often the individual had problems with an item in the past month on a scale of 0 (never) to 4 (almost always). The subscales of Emotional Functioning (four items), Social Functioning (three items), and Work/School Functioning (three items) contributed to an Overall Psychosocial Health summary score. For each subscale, scores were linearly transformed to a 0–100 scale, so that higher scores indicated better functioning [38].

The PedsQL Generic Core Scales were age-specific, such that each participant was automatically directed to an age-appropriate form (either self-report or proxy) based on the reported age of the service dog recipient [39]. The three age-specific forms were: Adult (ages >18), teenage (ages 13–18), and children (ages 4–12). Each version was identical except for slight variations in wording. For example, the Social Functioning subscale asked how often in the past month the individual has had a problem with "Other X teasing me", "Other X not wanting to be my friend", and "Getting along with other X" in which X could be "children" (ages 4–12), "teens" (ages 13–18), or "adults" (ages 18+). Similarly, the Work/School Functioning subscale asked how often in the past month the individual has had a problem with "Keeping up with X" in which X could be "schoolwork" (child/teen forms), or "work or studies" (adult form).

Table 1. Demographic and medical characteristics of the sample.

Variable	Waitlist (n = 57)	Service dog (n = 97)	Total (N = 154)	t	χ^2	p
	Group			Group difference		
Age, years, M ± SD	22.70 ± 20.50	28.44 ± 14.92	26.32 ± 17.35	1.847		0.068
ADL capability, M ± SD[a]	1.26 ± 0.45	1.41 ± 0.26	1.35 ± 0.35	2.367		0.020
Male, n (%)	36 (63%)	46 (47%)	82 (53%)		3.571	0.059
Has a pet dog, n (%)	37 (65%)	44 (45%)	81 (53%)		5.504	0.019
Progressive disability, n (%)	32 (56%)	40 (41%)	72 (47%)		3.203	0.073
Survey type, n (%)					19.828	<0.001
Self-report	26 (46%)	78 (80%)	104 (68%)			
Proxy	31 (54%)	19 (20%)	50 (32%)			
Primary diagnosis, n (%)					8.936	0.063
Seizure	15 (26%)	25 (26%)	40 (26%)			
Musculoskeletal	15 (26%)	18 (19%)	33 (22%)			
Neuromuscular	20 (35%)	50 (52%)	70 (46%)			
Developmental/intellectual	2 (4%)	2 (2%)	4 (3%)			
Diabetes	5 (9%)	1 (1%)	6 (4%)			
Unknown	0 (0%)	1 (1%)	1 (0%)			

n: partial sample size; N: full sample size; M: mean; SD: standard deviation; ADL: activities of daily living on a scale of 0–2, with higher scores indicating a higher capability to sustain ADL.
[a]ADL capability was missing for n = 6 participants with a service dog.

Cronbach's α indicated high reliability for all subscales (Overall Psychosocial Health Cronbach's α = 0.79, Emotional Functioning α = 0.80, Social Functioning α = 0.74, Work/School Functioning α = 0.73).

Patient Reported Outcomes Measurement Information System (PROMIS)

Additional outcomes were measured with the PROMIS, a system of reliable patient-reported outcomes developed by the National Institutes of Health [40]. Three PROMIS short forms (SF) were used: Anger (SF-5a), Companionship (SF-4a), and Sleep Disturbance (SF-4a). Similar to the PedsQL, PROMIS measures could be worded for either proxy of self-report. The anger short-form consisted of five Likert-style questions that measured the degree to which the participant agreed with statements regarding their irritability and anger in the past seven days (e.g., "In the past seven days, I felt like I was ready to explode"). The companionship short-form consisted of four Likert-style questions that measured the participant's level of general social companionship (e.g., "Do you have someone with whom to have fun?"). Finally, the sleep disturbance short-form consisted of four Likert-style questions that measured the recipient's sleep quality and intensity of sleep disturbance over the past seven days (e.g., "In the past seven days, my sleep was refreshing"). For all PROMIS measures, a higher score indicates more of the domain being measured. Cronbach's α for all three PROMIS measures indicated high reliability (Companionship α = 0.92, Anger α = 0.90, and Sleep Disturbance α = 0.85).

Monash Dog Owner Relationship Scale (MDORS)

Those with a service dog completed the MDORS, a 28-item standardized and validated measure of the human–animal bond [41]. The MDORS contains three subscales: Emotional Closeness, Dog–Owner Interaction, and Perceived Costs. Only the two subscales of Emotional Closeness and Dog–Owner Interaction were used for this study, with α = 0.82 and α = 0.65, respectively. For each Emotional Closeness question, participants were asked to rate on a Likert scale the degree to which they agreed with a series of statements about their relationship with their dog (e.g., "My dog helps me get through tough times", "My dog gives me a reason to get up in the morning"). For each Dog–Owner Interaction question, participants were asked to rate on a Likert scale the frequency in which they engaged in a series of activities with their dog (e.g., "How often do you hug your dog?", "How often do you play games with your dog?"). Higher scores on both subscales indicated more of the construct being measured (i.e., greater emotional closeness or more frequent daily interaction).

Statistical analysis

Demographic and medical characteristics of the two groups were compared with independent t-tests or chi-squared tests as appropriate. A series of hierarchical multiple linear regressions predicted each outcome with two sets of independent variables. Set 1 included the demographic variables of age, gender, the recipient's ADL capability, and disease progressiveness. Set 2 included the primary predictor of interest, having a service dog or being on the waitlist, as well as whether the recipient had a pet dog living with them or not.

To examine the potential effect of the human–animal bond, bivariate correlations were calculated for those with a service dog between the MDORS human–animal bond subscales and all outcome variables and continuous demographic variables. In addition to the MDORS, the length of time that had elapsed since the service dog was placed (in years, as a continuous variable) was also included in the bivariate correlations.

Results

Total response rate was 46%; 65% of participants completed the survey online, 30% via phone, and 5% on paper. Demographic and medical characteristics of the sample are displayed in Table 1. A total of 154 surveys were completed, including n = 97 from those with a service dog and n = 57 from those on the waitlist. The sample consisted of a wide range of ages (M = 26.32 ± 17.35 years, range of 4–72 years), with those on the waitlist slightly younger on average (t = 1.847, p = 0.068). Those on the waitlist also exhibited less capability to sustain ADLs than those with a service dog (t = 2.367, p = 0.020). Surveys included both self-report (68%) and parent proxy (32%), with the waitlist having significantly more proxy surveys (54%) than the service dog group (19%; χ^2 = 19.828, p < 0.001) because of the higher distribution of younger children. While there were trending group differences, those with a service dog and on the waitlist did not significantly differ in sex, primary diagnosis category, or the progressiveness of disability or condition (all p's > 0.059). However, those on the

Table 2. Descriptive statistics of psychosocial outcomes across group.

Measure	Waitlist (n = 57)			Service dog (n = 97)			Instrument range
	M ± SD	Min	Max	M ± SD	Min	Max	
PedsQL Overall Psychosocial Health	59.11 ± 16.29	16.67	90	72.42 ± 14.38	32.50	97.50	0–100
PedsQL Work/School Functioning	46.81 ± 26.50	0	100	64.47 ± 23.11	0	100	0–100
PedsQL Emotional Functioning	58.13 ± 22.35	12.50	100	69.85 ± 17.98	37.50	100	0–100
PedsQL Social Functioning	72.14 ± 19.39	25	100	82.60 ± 19.23	16.67	100	0–100
PROMIS Anger	51.06 ± 10.90	32.90	79.60	49.46 ± 9.03	31.50	72.60	29–85
PROMIS Companionship	49.19 ± 7.62	25.20	63.10	51.59 ± 8.77	29.50	63.10	25.20–63.10
PROMIS Sleep Disturbance	53.18 ± 3.21	43.80	63.80	52.77 ± 3.78	41.10	61.70	32–73.30

M: mean; SD: standard deviation; Min: minimum value; Max: maximum value; PedsQL: Pediatric Quality of Life Inventory; PROMIS: Patient-Reported Outcomes Measurement Information System.

waitlist were more likely to be currently living with a pet dog at the time of surveying than those with a service dog ($\chi^2 = 5.504$, $p = 0.019$).

Descriptive information on psychosocial variables by group is displayed in Table 2, while Table 3 displays the statistical output from the regression models. Demographic and disability-specific variables alone including age, sex, ADL capability, and disease progressiveness significantly explained variance observed in overall psychosocial health ($R^2 = 0.12$, $p = 0.002$), work/school functioning ($R^2 = 0.17$, $p < 0.001$), and social functioning ($R^2 = 0.18$, $p < 0.001$). Base models predicting emotional functioning, anger, companionship, and sleep disturbance were not significant (all R^2's < 0.05, p's > 0.128). Both age ($\beta = 0.24$, $p = 0.012$) and sex ($\beta = 0.28$ $p = 0.003$) were significant predictors of overall psychosocial health, with older age and males associated with better psychosocial health. Older age was also associated with higher social functioning ($\beta = 0.31$, $p = 0.001$), while being male was associated with higher work/school functioning ($\beta = 0.33$, $p < 0.001$) and less anger ($\beta = -0.24$, $p = 0.009$). ADL capability was a significant predictor of social functioning, such that less impairment was associated with better social functioning. There were no significant relationships between any demographic or disability variables and emotional functioning, companionship, or sleep disturbance.

After the addition of the service dog and pet dog variables to the models, final models explaining overall psychosocial health and work/school, emotional, and social functioning subscales were significant with R^2 values between 0.16 and 0.28. However, final models predicting anger, companionship, and sleep disturbance remained not significant (all R^2's < 0.07, p's > 0.132). Results indicated that having a service dog was a significant predictor of overall psychosocial health ($\beta = 0.36$, $p < 0.001$) as well as its three subscales of work/school functioning ($\beta = 0.33$, $p < 0.001$), emotional functioning ($\beta = 0.27$, $p = 0.002$), and social functioning ($\beta = 0.20$, $p = 0.016$). Specifically, there was a 0.36 standard deviation increase in overall psychosocial health among those with a service dog compared to those on the waitlist while holding all other predictors constant. However, having a service dog was not significantly associated with anger, companionship, or sleep disturbance (all p's > 0.098).

Having a pet dog was associated with lower emotional functioning ($\beta = -0.22$, $p = 0.010$). Specifically, while controlling for the presence of a service dog, those with a pet dog had a 0.22 standard deviation lower emotional functioning score than those without a pet dog in the home. There was no significant effect of having a pet dog on work/school functioning, social functioning, anger, companionship, or sleep disturbance (all p's > 0.109).

For those with a service dog, scores were high on both human–animal bond scales (Emotional Closeness subscale: $M = 4.31$, SD = 0.58; Dog–Owner Interaction subscale: $M = 4.14$, SD = 0.61, on a scale from 1 to 5). Table 4 displays the relationships between the outcome variables and human–animal bond variables among those with a service dog. There were no significant correlations between Emotional Closeness and any outcome or demographic variable (all r's < 0.16). There was a moderate negative correlation between the level of Dog–Owner Interaction and the participant's work/school functioning ($r = -0.30$, $p = 0.004$), in which less dog-owner interaction was associated with better work/school functioning. There was a small positive correlation with time since service dog placement and overall psychosocial health ($r = 0.23$, $p < 0.05$).

Discussion

The results of this study suggest that having a service dog for mobility or medical assistance was significantly associated with psychosocial health in a large and diverse sample of individuals with disabilities or chronic conditions. Specifically, after controlling for demographics, having a pet dog, and disability-specific variables such as ADL capability and progressiveness, having a service dog was significantly associated with higher overall psychosocial health including higher emotional, social, and work/school functioning, supporting our main hypothesis. However, having a service dog was not significantly related to wellbeing measures of anger, companionship, or sleep disturbance. Among those with a service dog, the human–animal bond and time since being placed with a service dog were only weak correlates of outcomes, refuting our secondary hypothesis. The findings of the study demonstrate the distinctive role that a service dog may have on the lives of individuals with a disability or chronic condition.

Findings demonstrated a significant relationship between having a service dog and better overall psychosocial health among individuals with physical disabilities or chronic conditions. This result is in line with other cross-sectional studies that have found significant associations between having a service dog and standardized measures of health-related quality of life [29,30]. However, results are in contrast with Collins et al.'s study that found no significant group differences on standardized measures of loneliness, depression, self-esteem, positive affect, and community integration [28]. While different measures were used across studies, it is possible that the PedsQL subscales may have captured a more precise level of age-appropriate functioning that may be more susceptible to observing group differences from a service dog's companionship and assistance. In addition, as the sample from Collins et al. was older on average ($M = 44.4 \pm 12.1$ years compared to $M = 26.3 \pm 17.4$ years in this study) and did not include individuals with chronic conditions such as epilepsy, the discrepancy in findings may be a result of the populations studied. Further research and replication is needed to determine the extent to which these variations or mediating factors may influence outcomes.

Table 3. Hierarchical linear regressions summarizing the effect of a service dog on primary outcomes.

Variable	PedsQL overall psychosocial health		PedsQL work/school functioning		PedsQL emotional functioning		PedsQL social functioning		PROMIS anger		PROMIS companionship		PROMIS sleep disturbance	
	β	p	β	p	β	p	β	p	β	p	β	p	β	p
Age	0.24	0.012	0.18	0.052	0.08	0.429	0.31	0.001	-0.08	0.425	0.05	0.652	0.16	0.103
Sex	0.28	0.003	0.33	<0.001	0.16	0.098	0.15	0.096	-0.24	0.009	0.11	0.212	0.07	0.440
ADL capability	0.12	0.181	0.16	0.070	-0.07	0.477	0.21	0.016	0.04	0.672	0.15	0.118	-0.14	0.130
Progressive	0.06	0.480	0.14	0.082	-0.04	0.621	0.05	0.505	0.04	0.636	0.01	0.890	0.00	0.972
Model 1 R^2	0.12	0.002	0.17	<0.001	0.03	0.494	0.18	<0.001	0.05	0.128	0.03	0.324	0.03	0.446
Age	0.20	0.025	0.16	0.082	0.03	0.767	0.31	0.001	-0.06	0.577	0.04	0.721	0.15	0.142
Sex	0.29	0.001	0.35	<0.001	0.16	0.083	0.17	0.055	-0.24	0.010	0.12	0.179	0.05	0.563
ADL capability	0.06	0.458	0.11	0.201	-0.10	0.280	0.17	0.057	0.04	0.654	0.12	0.211	-0.11	0.240
Progressive	0.09	0.226	0.18	0.020	-0.03	0.696	0.08	0.299	0.04	0.635	0.03	0.701	-0.02	0.800
Service dog	0.36	<0.001	0.33	<0.001	0.27	0.002	0.20	0.016	-0.09	0.320	0.15	0.098	-0.10	0.279
Pet dog	-0.13	0.109	-0.05	0.531	-0.22	0.010	0.04	0.639	0.10	0.276	-0.02	0.840	-0.13	0.120
Model 2 R^2	0.27	<0.001	0.28	<0.001	0.16	0.001	0.22	<0.001	0.07	0.132	0.05	0.258	0.05	0.346

PedsQL: Pediatric Quality of Life Inventory; PROMIS: Patient-Reported Outcomes Measurement Information System; β: standardized regression coefficient; R^2: variance explained; ADL: activities of daily living.
Note: Disease progressiveness (1 = yes, 0 = no); service dog (1 = yes, 0 = no); pet dog (1 = yes, 0 = no); sex (1 = male, 0 = female).

Of the psychosocial functioning subscales studied, the presence of a service dog had the largest impact on work/school functioning. This finding is supported by studies which have found that the presence of a dog can increase social interaction and engagement in classrooms [42,43] and in the workplace [44,45]. In addition, an early observational study found that children in wheelchairs with service dogs received more social acknowledgment by peers at school than children in wheelchairs without a service dog [18]. Therefore, our results support previous research in this domain and provide justification for further research on the integration of service dogs into schools or the workplace [2].

Our results did not indicate a relationship between having a service dog and standardized measures of anger, companionship, or sleep disturbance. Of these, the most surprising finding is the lack of a significant association between having a service dog and companionship. The PROMIS companionship measure was developed to measure human companionship, but was broadly worded (e.g., "Do you have someone to have fun with?") such that some participants may have interpreted the "someone" to be their service dog, while others may have interpreted the questions as referring to human interactions. In regards to human companionship, while there is published evidence of the social facilitation effects of service dogs [e.g., 13,18], it may be that the social benefits experienced in work, school, or in the public from having a service dog are short-term in nature compared to the deeper social interaction involved in companionship. Regarding canine companionship, those with a service dog exhibited near-ceiling MDORS Emotional Closeness scores, indicating that companionship was indeed received from the relationship with their dog. Further research will need to explore the constructs of social companionship that are the most susceptible to changes from being placed with a service dog in order to understand the underlying mechanisms of socio-emotional improvement in this population.

Having a service dog did not significantly impact sleep disturbance. To our knowledge, no other quantitative studies on service dog partnerships have directly examined sleep as an outcome variable. Our null findings may be due to the fact that sleep problems are common with many of the disabilities in our sample (e.g., cerebral palsy [46], muscular dystrophy [47], and epilepsy [48]). While it is possible that the sleep disturbance measure may not have been precise enough to capture the effects that a service dog may have on night time functioning, sleep may be too inflexible or complex of a construct in this population to be significantly affected by a service dog.

Among those with a service dog, results indicated a strong human–animal bond among our sample. This mirrors findings from several qualitative studies that cite the human–animal bond as a central theme when describing the service dog relationship [e.g., 9,49,50]. However, among those with a service dog, the degree of emotional closeness with the service dog was not a significant correlate of outcomes which did not support our hypothesis. This was likely due to a ceiling effect, whereby participants were highly bonded with their service dogs with little variance. In regards to dog–owner interactions, we found that individuals with higher work/school functioning tended to interact less with their service dog on a daily basis. This may be a function of the fact that those who need more assistance are likely utilizing their service dog more frequently than those who may have less impairment and/or are thriving at work or school. To our knowledge, no other studies have examined the relationship between the human–animal bond among those with service dogs and psychosocial outcomes using standardized measures. However, a 2017

Table 4. Bivariate Pearson's *r* correlations between human–animal bond variables and outcome variables among $n = 97$ participants with a service dog.

Variable	Emotional closeness (MDORS)	Dog–owner interaction (MDORS)	Time since service dog placement
Age	0.14	0.07	0.21**
ADL capability[a]	0.16	0.19	0.08
PedsQL overall psychosocial health	0.00	−0.16	0.23*
PedsQL work/school functioning	−0.16	−0.30**	0.19
PedsQL emotional functioning	0.05	0.01	0.16
PedsQL social functioning	0.07	−0.11	0.16
PROMIS anger	0.01	0.10	−0.12
PROMIS companionship	0.03	0.10	0.05
PROMIS sleep disturbance	0.06	−0.08	0.20

MDORS: Monash Dog Owner Relationship Scale; ADL: activities of daily living; PedsQL: Pediatric Quality of Life Inventory; PROMIS: Patient-Reported Outcomes Measurement Information System.
*$p < 0.05$.
**$p < 0.01$.

study surveying 73 service dog owners in the U.K. did find a significant positive relationship between participants' quality of life and their level of anxious attachment towards the service dog [51]. While our study did not measure attachment styles, findings from this study and ours indicate that relationship-specific variables may have measurable effects on outcomes in service dog owners.

Although not one of our primary aims of the study, we found a relationship between having a pet dog and lower emotional functioning after controlling for the presence of a service dog in the home. While several studies have described a positive relationship between pet ownership and measures of human health and wellbeing [e.g., 34], studies have also noted significant associations between pet ownership and negative outcomes such as depression [52,53]. Our findings should not be interpreted as definitive for several reasons: groups were not matched for or equal in distribution of pet ownership, the sub-group of pet owners was a relatively small sample size, and there are likely many explanatory variables contributing to pet ownership that were not included in the study. More research is necessary to determine how having a pet dog may fit into the lives of individuals with disabilities or chronic conditions with rigorous and replicable research methodology [54].

Lastly, as hypothesized, we did find a significant positive correlation with time since being placed with the service dog and overall psychosocial health. However, time did not significantly relate to any subscales of the PedsQL including work/school functioning, emotional functioning, or social functioning. A similar range of service dog placement times was observed in Collins et al.'s study ($M = 3.1$ years, range of 0–13.1 years), however, no significant relationships were observed between time since placement and depression, positive affect, loneliness, self-esteem, or community participation among 76 participants with a service dog [28]. Due to these mixed findings, future research is necessary to determine the extent that time with a service dog influences outcomes, as well as the potential individual differences that may moderate the relationship.

This study contributes to the disparate literature assessing the effects of mobility or medical service dogs on quality of life and psychosocial health and highlights the need for more rigorous, replicable research on this topic using standardized measures. A specific important finding from this study is that demographic and disability-specific variables such as ADL are critical to include as covariates in future studies aiming to determine the impact of service dogs on quality of life. Further, future studies should be careful to also assess and include the presence of a pet dog in the home to avoid the exclusion of a possibly confounding variable impacting psychosocial health. Future research will also

benefit from exploring the potential mechanisms of action underlying the relationship between a service dog and an individual with a disability or chronic condition, as well as potential moderating individual differences in either human or canine variables that may contribute to outcomes.

Limitations

This study has several limitations. Due to the cross-sectional design, we cannot infer causation between variables. The treatment group was not randomized, so results may have been partially due to changes over time rather than the placement of a service dog. We also lack longitudinal information on individual differences regarding the temporal pattern of change after receiving a service dog, which likely varies with individual and environmental factors. Further research will benefit from employing longitudinal designs to explore patterns of change across individuals as the relationship with the service dog develops.

Another limitation of the research is that the results are based on self-report, which may be subject to expectancy biases [55]. We also relied on proxy reports for children in a substantial portion of our data, which could have introduced bias by underestimating quality of life [56]. In addition, we also relied on a medical professional to assess functioning and ADL capability, which could have biased results. Future research will benefit from assessing disability-related impairment with a more objective and/or sensitive measure to fully capture the individual differences in physical and mental functioning across the population of service dog recipients.

Finally, results should be interpreted in caution as our population may not be fully representative of the disabled population; our recruitment pool had already applied for and/or received a service dog, thus were amenable to service dog ownership. However, the focus of this study was to quantify the psychosocial effects among those would receive service dogs as a realistic representation of the population and to preserve ecological validity.

Conclusions

In this study, the provision of a medical or mobility service dog was associated with better psychosocial health among a large, heterogeneous sample of individuals with disabilities and chronic conditions. Specifically, having a service dog was significantly associated with higher social, emotional, and work/school functioning, but was not significantly associated with anger, companionship, or sleep disturbance. These effects were independent of variation due to age, sex, disability impairment and progressiveness, and having a pet dog in the home. Overall, the results of

this study suggest that in addition to the functional benefits of a service dog such as mobility assistance, medical alert, and seizure response, their placement may also afford measurable psychosocial benefits to the daily lives of individuals with physical disabilities or chronic conditions.

Disclosure statement

No potential conflict of interest was reported by the authors.

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