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Paws and Effect: Canine Companionship and Outcomes in the Chronic Health Condition Hypermobility Ehlers-Danlos Syndrome

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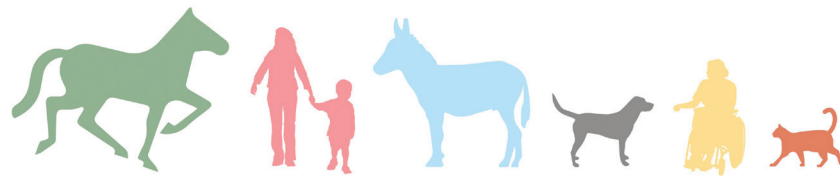
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Paws and Effect: Canine Companionship and Outcomes in the Chronic Health Condition Hypermobile Ehlers-Danlos Syndrome

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Keywords: hypermobile Ehlers-Danlos syndrome, dogs, canine companions, health and well-being

Abstract Emerging research suggests canine companions may support the management of health conditions, yet evidence within complex, long-term conditions like hypermobile Ehlers-Danlos Syndrome (hEDS) remains limited. hEDS is a multifaceted condition often associated with social withdrawal. Thus, the current research provided a high-powered investigation into whether the nonjudgmental support of canine companions could improve health and well-being outcomes for individuals with hEDS. An online survey of 401 participants was utilized to compare differences in health and well-being among individuals with hEDS who have a canine companion to those who do not. Results revealed that participants with canine companions experienced fewer difficulties in daily activities related to emotional issues, with some less robust evidence suggesting improvements in physical health and loneliness. However, most outcomes showed no significant differences between those with and without canine companions. Further analysis generally indicated better outcomes among individuals whose dogs exhibited fewer behavioral issues, highlighting the role of dog behavior in shaping outcomes. Moreover, participants who spent all their time with their dog reported worse outcomes, potentially reflecting the effects of severe symptomatology and limited mobility. These findings highlight the complex interplay between canine companionship and health. While canine companionship may offer specific benefits, particularly emotional support, it is not universally beneficial and may depend on nuanced factors such as dog behavior, the quality of the human-dog bond, and guardian expectations. Future research should explore these dynamics longitudinally and include broader considerations of dog-related and individual factors in both those with and without chronic health conditions.

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Introduction

Animal companionship is reportedly associated with an array of benefits for humans, with growing interest in the health-related factors associated with the human-animal bond (Walsh, 2009; Webel & Higgins, 2012). A greater sense of connectedness, improved physical health outcomes and better emotional well-being have all been associated with animal companionship (González-Ramírez et al., 2018; Silva et al., 2021; Spitznagel et al., 2017; Thiele et al., 2023). Additionally, evidence suggests that animal companionship can be beneficial for both managing and recovering from health conditions (Webel & Higgins, 2012). While much of this literature focuses predominantly upon animal-assisted programs or service animals (Rodriguez, Bibbo, et al., 2020; Rodriguez, Greer, et al., 2020), there is a growing body of research investigating canine companionship more generally. This research suggests that canine companionship is associated with increased physical activity (Christian et al., 2018; Dall et al., 2017; Westgarth et al., 2014), improved mental health and well-being (Liu et al., 2019; Oliva & Johnston, 2021), and greater connectedness in the general population (Antonacopoulos & Pychyl, 2014; Knight & Edwards, 2008; Westgarth et al., 2017), as well as among those diagnosed with physical health conditions (e.g., HIV, Kabel et al., 2015; diabetes, Peel et al., 2010; arthritis, Thiele et al., 2023), and those living with intellectual (Bould et al., 2018), mental health, or psychiatric conditions (Stern et al., 2013). These benefits have been attributed to increased physical activity (Christian et al., 2018; Peel et al., 2010), physiological improvements such as lowered heart rate, blood pressure, and cortisol levels (Hughes et al., 2020), stress-reduction due to petting and the associated oxytocin release (Teo et al., 2022), a greater sense of nonjudgmental support (Kabel et al., 2015), and improved sleep quality (Brown et al., 2018; Ogechi et al., 2016).

However, evidence for the potential benefits of animal companionship has been contradictory, with some studies reporting no association between animal companionship and health outcomes, mixed, or even negative outcomes (see Herzog, 2011; Scoresby

et al., 2021 for critical reviews). For example, Antonacopoulos and Pychyl (2014) found that high attachment to pets predicted higher scores on loneliness and depression, and increased symptoms of depression have been found in older people with dogs (Parslow et al., 2005; Sharpley et al., 2020).

It is important to note that the variation in study participants, often based on small convenience samples, complicates comparisons and reduces the statistical power to control for the mediating and moderating factors in the human–animal relationship (Utz, 2014). Moreover, such studies rarely try to account for the array of human-related and animal-related factors that make up this complex relationship.

Key factors influencing the relationship between animal companionship and human health and well-being outcomes include human sociodemographic factors (Apostol et al., 2013), personality (Eckardt Erlanger & Tsytsarev, 2012; Herzog & Mathews, 1997), and attachment style and quality (Antonacopoulos & Pychyl, 2014; Azanpa et al., 2019; Lass-Hennemann et al., 2022). However, there are other factors that are likely to be influential that have received little research to date, particularly around the animal characteristics (Stephens-Lewis & Schenke, 2023). For example, the personality, behavior, and needs of the animal are all likely to be important determining factors. Understanding these complexities is integral given the emerging focus on the effects of animal companionship on human health conditions.

Given the unique characteristics of canine companionship, which often involve increased human-initiated exercise and shared activities compared to other companion animals such as cats, birds, or reptiles (Utz, 2014), these benefits are understandable. However, the specific interactions between the human–canine bond and associated health and well-being outcomes remain unclear, particularly for those living with chronic health conditions.

This is an important area for further research because chronic health conditions may reduce engagement in the typical shared activities associated with canine companionship, a key expectation of such companionship (Stephens-Lewis & Schenke, 2023). For example, individuals with Ehlers-Danlos

syndrome (EDS) - a group of inherited disorders affecting connective tissue - often have a range of physical symptomology (such as urogynecology, cardiovascular, and gastrointestinal complaints) that can reduce their ability to leave the proximity of their house or venture to places without public facilities (Baeza-Velasco et al., 2021; Kciuk et al., 2023; Rashed et al., 2022; Roma et al., 2018). Thus, they may be less able to participate in the desired shared activities with their canine companion (or may not be able to participate as much as they would like to), which could have ramifications not only for the human-dog bond but also the health and well-being benefits often seen in those with canine companions. Additionally, there is a high association between EDS and psychiatric co-morbidities (Pasquini et al., 2014) including anxiety, depression (Bulbena et al., 2017), and suicide risk (Baeza-Velasco et al., 2022). This complex range of symptomology, chronic pain, and frequent subluxations/dislocations, combined with the knock-on implications to one's daily functioning (De Baets et al., 2022) and social and work life (Bennett et al., 2019; De Baets et al., 2021; Murray et al., 2013), can significantly impact an individual's quality of life (Orenius et al., 2022). Furthermore, the interplay between condition complications, lack of effective treatment, and secondary social impact can result in those diagnosed with the condition becoming withdrawn and isolated (Palomo-Toucedo et al., 2020), further exacerbating their health and well-being. This may limit the potential benefits of canine companionship on health and well-being, as the obstacles faced by this population might be too significant to overcome solely through the presence of a canine companion.

However, there is emerging evidence that emotional well-being, pain, and social functioning can be improved by strategies to reduce psychological distress and anxiety such as cognitive-behavioral therapy, mindfulness practices, and regular physical exercise (Baeza-Velasco et al., 2019). Canine companionship could contribute to these strategies by increasing physical activity levels, providing companionship, and reducing stress. Additionally, dogs can play a social facilitation role (e.g., encouraging

social interactions and reducing feelings of loneliness). This could be particularly beneficial for individuals with EDS to reduce their social withdrawal and help them to manage the chronic pain and psychological challenges associated with the condition. To our knowledge, the current research provides the first high-powered investigation into the health and well-being effects of canine companionship within the hypermobile type of Ehlers-Danlos syndrome (hEDS; the only one of the 14 subtypes of EDS without a known molecular basis; Malfait et al., 2017), which accounts for approximately 80% of cases (Tinkle et al., 2017). Here, participants with hEDS were surveyed as to whether they had a canine companion alongside a range of standardized and reliably measured physical, psychological, and social outcomes. It was hypothesized that those with canine companions would have a higher quality of life, better physical health and functioning, better social functioning, better well-being, lower pain (and a better ability to manage their pain), lower anxiety, and lower depression than those without canine companions when controlling for the covariate of whether the participant was experiencing a flare-up in their condition or not.

Method

Participants

Prospective power analyses assuming a medium effect size with an alpha level of .05 suggested a minimum of 134 participants for .8 power (Cohen, 1992). Participants were recruited from social media sites, the EDS society website, and the RIC:HER Alliance (consisting of health professionals and experts by experience). Initially 415 eligible participants completed the online survey, but 14 participants who reported living with a registered assistance dog were excluded from analyses because including them as a separate group would have greatly reduced statistical power, and it would have been a confound to include them within the canine companion condition given the specific role their dog plays in supporting their day-to-day life. Therefore, the final sample

Table 1. Participant Living Situations and Roles in Dog Care

Living Situation	Number of Participants	Role in Dog Care	Number of Participants
Living with a dog	297	Primary caregiver	189
		Secondary caregiver	76
		Cohabitor with the dog	29
		Not involved in care	2
		Did not specify	1
Not living with a dog	104		

consisted of 401 participants (*mean age* = 38.4, *SD* = 12.0; 375 female, 10 male, 12 nonbinary, 2 transgender, 2 other), most of whom resided in England (195) or the UK more widely (104). For a detailed description of the participant characteristics see Foster et al., 2024. Table 1 provides the breakdown of how many participants lived with dogs and their role for caring for the dog. Ethical clearance was gained from the University of Gloucestershire ethics panel.

Design, Materials, and Procedure

This research forms part of a broader online survey examining the health and well-being of individuals with hEDS with and without canine companions (for a comprehensive overview of the methodology see Foster et al., 2024), which took approximately 30 minutes to complete. The survey provided a detailed information sheet such that participants could provide informed consent before answering questions around demographic information, hEDS characteristics, and a variety of health and well-being outcomes:

- The RAND 36-item Health Survey (Version 1.0 - SF-36 -; Hays et al., 1993) measured health-related quality of life within the last 4 weeks (a lower score represents a less favorable health state).
- The Warwick-Edinburgh Mental Wellbeing Scale (WEMWS; Tennant et al., 2007)

measured subjective well-being within the last 2 weeks (a lower score denotes lower levels of mental well-being).

- The Physical Health Questionnaire (PHQ) measured physical health within the last 2 weeks (a lower score denotes higher levels of physical health).
- The Generalised Anxiety Disorder-7 (GAD7; Spitzer et al., 2006) measured generalized anxiety within the last 2 weeks (a lower score denotes less severe levels of anxiety).
- The Chronic Pain Acceptance Questionnaire-8 (CPAQ-8; Fish et al., 2010) measured acceptance of chronic pain (a lower score represents lower levels of willingness to experience pain, engage in activities despite pain, and display more avoidance or control of pain).
- The UCLA-3 loneliness scale (Hughes et al., 2004) measured loneliness in relation to their life as it is now (a lower score denotes feeling less loneliness).
- The Perceived Social Support-Friends (PSS-Fr) and Perceived Social Support-Family (PSS-Fa) scales (Procidano & Heller, 1983) measured perceived support from friends and family respectively (a lower score denotes lower perceived support).

Those who reported living with a canine companion completed further measures regarding their companionship:

- The Lexington Attachment to Pets Scale (LAPS; Johnson et al., 1992) assessed how emotionally attached guardians feel to their canine companion across 23 questions such as “My pet makes me happy” and “I feel that my pet is part of my family.” A higher score indicates a higher attachment to one’s pet. It is one of the most widely used measures of its kind (Wilson & Netting, 2012) with good reliability (Johnson et al., 1992). The Cronbach’s alpha for the current sample was .91.
- The Canine Behavioral Assessment & Research Questionnaire (C-BARQ; Hsu & Serpell, 2003) assessed dog behavioral issues across 7 broad subscales: excitability, aggression, fear and anxiety, separation-related behavior, attachment and attention-seeking, obedience and training, and miscellaneous behavior. Questions asked participants to rate their dog’s response to specific events/environments on a 5-point Likert scale measuring either the severity of their reaction (0 = no signs, 4 = severe signs) or its frequency (0 = never, 4 = always). Higher scores reflect less desirable behavior, apart from 2 questions regarding trainability (which were reverse scored). Cronbach’s alpha for the current sample was .89.
- Participants were also asked whether they perceived their dog to have any behavioral concerns (with the responses “yes” or “no”), and how much time they spent with their dog (with the responses “I spend little time with the dog,” “I spend some time with the dog,” “I spend most of the day with the dog,” and “I’m always with the dog”).

For this paper, we focus on comparing those who reported living with canine companions and those that did not for each health and well-being outcome. Therefore, for the primary hypotheses a cross-sectional design was employed with three factors: Companionship (dog, no dog), Behavioral Issues (no dog, dog with behavioral issues, dog with no behavioral issues), and Time (no dog, spends little time with the dog, spends some of the time with the dog, spends

most of the time with the dog, always with the dog). However, there were only 3 participants who only spent a little time with the dog, so they were removed from the relevant analyses given the lack of statistical power to analyze their data. The dependent variables were perceived quality of life, pain, general health, health change compared with a year ago, physical health and functioning, social functioning, subjective well-being, anxiety, depression, loneliness, and perceived support from friends and family.

Results

Due to the linear combination of variables (e.g., dog companionship and behavioral issues), a factorial ANOVA was not suitable for the dataset. Instead, one-way ANOVAs were conducted separately for each health and well-being outcome. Welch’s test was used throughout for its robustness to unequal sample sizes. Despite the imbalance in group sizes, the large sample ensured sufficient statistical power, confirmed through an a priori power analysis in G*Power (Faul et al., 2007).

A mean imputation for each participant was used for missing data within all measures except the SF-36, which had specific instructions to ignore missing data. This missing data represented only a small proportion of the total dataset: 6 questions for anxiety, 9 for pain, 2 for loneliness, 11 for well-being, 5 each for perceived support from friends and family, and 41 for physical health.

Homogeneity of variance assumptions were met for all variables except general health in some conditions. Nonparametric tests and analyses on non-mean imputed and outlier-adjusted data were conducted but reported only when interpretations differed. All reported *p* values are two-tailed.

Participants who did not respond to any questions on the questionnaire were excluded from the analyses: 12 from the CPAQ, 2 from the SF-36 questions around difficulties in daily activities related to emotional issues such as anxiety and depression, and 1 and 2 from the perceived social support from friends and family questionnaires, respectively.

Canine Companionship

First, independent measurements *t* tests were conducted to establish whether there were differences in the outcome variables based on whether participants had a canine companion or not. Additional analyses included whether participants were experiencing a flare-up of their hEDS as a covariate (only reported if they altered the interpretation).

Participants with canine companions reported fewer difficulties in daily activities related to emotional issues ($M = 36.6$, $SD = 37.8$) compared to those without canine companions ($M = 26.2$, $SD = 35.8$), $t[186.82] = 2.50$, $p = 0.013$, Cohen's $d = 0.28$, 95% $CI [-18.60, -2.19]$. Additionally, while more improvements in health compared to a year ago were initially found for those with canine companions ($M = 41.7$, $SD = 26.4$) compared to those without ($M = 35.6$, $SD = 25.0$), $t(188.77) = 2.10$, $p = .04$, $d = .23$, 95% $CI [-11.80, -0.38]$, this result did not stand up to nonparametric testing ($p = .052$) or the removal of outliers ($p = .174$).

No significant differences were observed for the other outcomes (see Supplementary Materials Table 1), except that the covariate Flare-Up explained some variance in physical health ($p = .041$, though not for the non-imputed data; $p = .346$) and health-related quality of life ($p = .041$ for the non-imputed data). Additionally, including the covariate resulted in near-significant increases in loneliness for those without (compared to with) a canine companion ($p = .055$, $\eta^2 = .010$, although for the non-imputed data this effect was less borderline; $p = .091$).

Behavioral Issues

Next, independent measurements one-way ANOVAs were conducted to identify differences in the outcome variables for those that did not have a canine companion, and those that had a canine companion with or without participant-reported behavioral concerns. As before, the same analysis was conducted with the Flare-Up covariate, which was only reported if the interpretation changed.

Again, the only robust effect demonstrated differences in difficulties in daily activities related to

emotional issues for those with canine companions with ($M = 30.6$, $SD = 33.5$) and without behavioral issues ($M = 39.3$, $SD = 39.1$), and those that did not have canine companions ($M = 26.2$, $SD = 35.8$), $F(2, 184.59) = 4.79$, $p = .009$, $\eta^2 = .02$. Tukey post hoc tests revealed that those reporting no behavioral issues in their canine companion had fewer difficulties in daily activities related to emotional issues than those without a canine companion ($p = .010$). No significant differences were observed for the other outcomes (see Supplementary Materials Table 2), except that the covariate Flare-Up explained some variance in health-related quality of life ($p = .056$).

While 217 participants reported no behavioral concerns (compared to 75 that reported behavioral concerns, 5 did not respond to this question), the data from the CBARQ suggests that most dogs did display negatively perceived behaviors. There were fewer negative behaviors reported for those who did not report explicit behavioral concerns ($M = 45.1$, $SD = 15.4$) than for those that did ($M = 69.4$, $SD = 20.3$), $t [105.751] = 9.46$, $p < .001$, Cohen's $d = 1.35$, 95% $CI [-29.371, -19.195]$. This difference was reflected across all CBARQ subscales (see Supplementary Materials Table 3).

As the CBARQ data suggest that most dogs were displaying at least some negative behaviors, regressions were conducted to assess whether higher incidences of negative canine behaviors were negatively associated with health and well-being using the Enter method. These were supported by robust regression analyses of iterated reweighted least squares using Huber weights and bisquare weighting (using the "Mass" - Venables, & Ripley, 2002 - and "Foreign" - R Core Team, 2023 - r packages). The same analyses were also conducted based on the non-imputed data.

Results revealed that dog behavior was significantly associated with several health and well-being outcomes (see Supplementary Materials Table 4). Specifically, higher incidences of behavioral issues were predictive of greater anxiety, depressive symptoms, loneliness, and difficulties in daily activities related to emotional issues, as well as poorer social functioning. These relationships, while statistically significant, accounted for a small proportion

of variance (R^2 ranged from .015 to .031), indicating small effect sizes. Conversely, dog behavior was not significantly predictive of pain, energy/fatigue, or perceived social support. General health and well-being were not initially significantly predicted by dog behavior; however, after removing outliers, these relationships became significant ($p = .004$ for general health and $p = .048$ for well-being). Additionally, conducting robust regression yielded a significant relationship between dog behavior and general health ($p = .026$). These findings suggest that while negative dog behavior may modestly impact certain aspects of psychological and social functioning, it is not strongly associated with physical health, pain management, or perceived social support.

Attachment to the Dog

To assess whether behavioral issues influence attachment to the dog, a linear regression with the CBARQ as the predictor and LAPS as the criterion variable was conducted. While the overall CBARQ scores were not predictive of attachment to the dog ($F = .859$, $p = .355$), a follow-up regression where each of the CBARQ subscales was included as a predictor variable was significant, $F(7, 285) = 8.06$, $p = .001$ ($R^2 = .165$, Adjusted $R^2 = .145$ —see Supplementary Materials Table 5). Excitability, Fear/Anxiety, Attachment, Obedience, and Aggression were all significant predictors of attachment (with aggression having the strongest negative association). The Separation-related behavior and Miscellaneous subscales were not significant predictors. There were minor variations in coefficients for Excitability and Fear/Anxiety when non-imputed data and outlier adjustments were applied, suggesting some caution needed in their interpretation. These results highlight the nuanced role of behavioral traits in shaping dog-guardian attachment.

Time Spent with the Dog

Finally, independent measurements one-way ANOVAs were conducted to investigate the influence of the amount of time spent with the canine

companion on the outcome variables. As before, the Flare-Up covariate was analyzed and reported if it changed the interpretation.

There were several robust findings across the outcome variables, mostly driven by differences between those that were always with their dog having worse outcomes compared to those that spent most of the day with their dog (see Supplementary Materials Tables 6, 7, and 8). Physical functioning, general health, pain, energy levels and fatigue, and difficulties in daily activities related to emotional issues were worse for participants who spent all their time with their dog compared to those who spent most or some of the day with their dog. Borderline significant results were observed for comparisons of current health compared to health one year ago and well-being. In these cases, differences were not robust when accounting for data adjustments or outliers. No statistically significant differences were found for social functioning, health-related quality of life, generalized anxiety, loneliness, or perceived social support from family or friends. These results suggest nuanced relationships between time spent with the dog and various aspects of physical and mental health, with indications that excessive time may be related to poorer outcomes in some domains.

Discussion

The current research provided the first high-powered investigation, to our knowledge, into whether canine companionship improves quality of life, well-being, physical health and functioning, and social functioning, and reduces loneliness, anxiety, and depression within a hEDS population. The findings revealed one robust result: Those with canine companions reported fewer difficulties in daily activities related to emotional issues compared to those without canine companions. There was also some less robust evidence that physical health, health compared to a year ago, and loneliness may also be better in those with canine companions. These findings provide tentative support for the hypothesis that canine companionship offers certain health and well-being benefits.

However, most outcomes showed no significant differences between those with and without canine companions, challenging the broader hypothesis.

Given the complex relationship between animal companionship and human health and well-being benefits (Utz, 2014), further analyses explored whether the presence of explicit behavioral concerns in dogs influenced the findings. Again, the only robust finding was that those with dogs without behavioral issues reported fewer difficulties in daily activities related to emotional issues than those without a dog. There was also some less robust evidence for improvements in health compared to a year ago and loneliness. However, being forced to label their dog as having behavioral concerns or not is not necessarily representative of the spectrum of perceived negative behaviors that a dog may display. Indeed, people may (consciously or unconsciously) be unwilling to overtly label their dog as displaying concerning behaviors. As such, we also conducted regression analyses on the actual canine behaviors reported by the participants, which revealed that higher incidences of negative dog behaviors were associated with worse anxiety, social functioning, emotional difficulties, loneliness, physical health, and general well-being. Taken together, this highlights the importance of considering dog-related information such as their behavior when considering the overall effect of having a companion dog. Indeed, evidence suggests that perceived dog behavioral issues can impair the formation and maintenance of the human–dog bond (Salman et al., 2000; Wells & Hepper, 2000), potentially affecting human health and well-being (Barcelos et al., 2023). The current data further supported this as participants reported more attachment to dogs displaying fewer negative behaviors.

The role of guardian expectations, while beyond the scope of the current study, also warrants further investigation (Stephens-Lewis & Schenke, 2023) and may explain the mixed findings within the field. Unrealistic expectations about dog behavior can negatively impact the human–dog bond, especially if behaviors considered normal but undesirable (e.g., digging or barking) are viewed negatively

(Stephens-Lewis & Schenke, 2023). This can lead to disappointment or resentment when the dog is not able to behave as hoped within a challenging environment. Thus, it is important for practitioners and researchers to consider the role educational initiatives could play in shaping realistic expectations and improving the management of perceived behavioral issues.

An unexpected but noteworthy finding was that participants who spent all of their time with their dog reported worse health and well-being outcomes. This pattern likely reflects the challenges faced by individuals who are housebound due to severe symptomatology. Limited mobility may reduce opportunities for shared activities with their dog, an important component of the human–dog relationship (Stephens-Lewis & Schenke, 2023), and may contribute to worse physical and psychological outcomes. This highlights the need for further research into how guardian expectations, both for themselves and their dogs, influence these outcomes, as well as the implications for dog rehoming practices to ensure optimal matches.

It is important to note the wide standard deviations and confidence intervals observed in the data, which suggest substantial variability within the sample. This reflects the heterogeneity inherent in hEDS as a condition (De Wandele et al., 2013) and the variety of comorbidities within the current sample (see Foster et al., 2024). The heterogeneity of the sample (and, indeed, the heterogeneity of hEDS more widely) is important because it means that the variation within the group could mask any potential effects or differences that might be present. This diversity in the sample can lead to increased variability in the data, making it harder to detect significant relationships or differences with the given sample. Therefore, future research should aim to account for, and minimize, such heterogeneity, possibly by stratifying the sample or using more targeted inclusion criteria. While we demonstrated that whether the individuals were having a flare-up in their condition can be influential, it was beyond the scope of the current research to consider the specific symptomatology and comorbidities of the participants, which may

also help to explain this heterogeneity (especially when the symptomology results in the individual being house bound). Therefore, further exploration of participants' symptomatology, including flare-ups and co-morbid conditions, could provide deeper insights into these findings.

Preliminary analyses in the current study suggest that dogs displaying more negative behaviors can impair health and well-being outcomes. However, more extensive research is needed to explore additional dog-related factors that may be influential such as age, health status, and other companion animals in the household.

One particularly important area for future research is the supportive roles that companion dogs can offer their human guardians. Previous studies highlight the potential for dogs to reduce loneliness (Oliva & Johnston, 2021), alleviate isolation (Liu et al., 2019), and provide emotional and instrumental support and a sense of meaning (all without "judgment") in those with chronic conditions (Carr et al., 2018; Siegel, 2011). Indeed, our recent research (Stephens-Lewis & Schenke, 2023) suggested that guardians more generally expect both emotional and instrumental support, particularly in relation to support with daily tasks. This is likely to be heightened within guardians with chronic health conditions such as those with hEDS, whereby dogs may offer physical and psychological support, providing a sense of purpose and acceptance without judgment. However, our findings indicate that simply having a dog does not guarantee improved health and well-being; rather, the relationship is nuanced, influenced by factors such as the guardian's expectations and dog behavior. This is important for researchers and practitioners to consider carefully to inform education of what can fairly be expected from a canine companion, as well as how to manage expectations when one's dog does not behave as expected (or wanted).

The belief that animals (and especially companion dogs) can offer support that most humans cannot in that they do not "judge" their human guardian (Carr et al., 2018; Stephens-Lewis et al., 2024) is likely to be particularly important to those

with chronic health conditions. This is especially relevant for those with "invisible" conditions who may feel particularly judged. Indeed, individuals with hEDS often have a protracted diagnostic journey, which has typically involved accusations of hypochondria, disbelief, medical gaslighting, and suggestions that symptoms are all in the mind (Bennett et al., 2021; Palomo-Toucedo et al., 2020). They also often face significant psychological challenges, including anxiety, depression, and feelings of judgment due to the "invisible" nature of their condition (Bennett et al., 2021; Palomo-Toucedo et al., 2020). Therefore, the nonjudgmental companionship offered by dogs may hold particular value for this population. However, unrealistic expectations about the dog's role or guilt over perceived shortcomings as a guardian, such as being unable to walk or play with the dog, can negatively impact the relationship and overall well-being (Merkouri et al., 2022; Westgarth et al., 2019). Additionally, limitations on functioning can have significant consequences for employment and lifestyle for those with hEDS (De Baets et al., 2021, 2022). Pain, fear of injury, and complications from eating disorders can have an impact on social activity and engagement (Bennett et al., 2019, 2021; Guadagnoli & Taft, 2020; Schmidt et al., 2015), often triggering a cycle of withdrawal and isolation (Palomo-Toucedo et al., 2020). Thus, even though canine companions may improve outcomes to some extent, it is a lot to ask to overcome very poor health and well-being.

While this study was well-powered and utilized standardized, validated measures (with good reliability—see Foster et al., 2024), several limitations must be acknowledged. The self-reported nature of the data may introduce social desirability bias, despite efforts to mitigate this through anonymity. Survey fatigue, exacerbated by the long survey length and participants' fatigue levels, may also have influenced responses, especially toward the end of the survey. We tried to reduce this by allowing participants to pause and come back to the survey later. However, this could be an issue if the participant started the survey while in a flare-up and finished while in a lull in their symptoms (or vice versa),

although this is unlikely given the time frame for which the survey was open. Additionally, the study primarily included female participants (375 out of 401), reflecting the gender distribution of hEDS more widely, but limiting generalizability. Finally, the cross-sectional design precludes causal conclusions. Longitudinal studies are needed to better understand the impact of canine companionship over time, including assessments before acquiring a dog and subsequent changes in health and well-being, considering significant life events that could be affecting the results in the short term. For example, we did not consider the age of the dog (yet a puppy is typically much more demanding to look after) or whether the dog suffered from a health condition. We also did not ask about other companion animals within the household, which could explain the lack of differences between groups if those without a dog had another companion animal.

Despite these limitations, the current research has provided a valuable foundation for further research into the nuanced interplay between canine companionship and human health and well-being within chronic health conditions such as hEDS (as well as in the general population). The research highlights the importance of considering individual and dog-related factors, particularly within the context of chronic health conditions such as hEDS. It is hoped that this study will stimulate further research and contribute to a deeper understanding of the factors driving the mixed findings often reported in this field.

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Supplementary Materials

Table 1. The *t*-test findings for the non-statistically significant analyses comparing those that did and did not have a canine companion

Dependent Variable	<i>t</i> Value	<i>df</i>	<i>p</i> Value	Cohen's <i>d</i>	95% CI
General Anxiety Levels	0.42	193.01	0.677	0.05	[-1.06, 1.63]
Physical Functioning	0.68	173.9	0.498	0.08	[-7.04, 3.59]
Energy/Fatigue	0.03	194.22	0.977	0.003	[-3.34, 3.24]
Social Functioning	0.48	189.02	0.633	0.05	[-5.58, 3.40]
Pain (RAND-36)	0.32	175.85	0.75	0.04	[-5.30, 3.81]
General Health	0.85	159.02	0.398	0.10	[-2.26, 5.66]
Subjective Well-Being	0.62	185.72	0.537	0.07	[-2.63, 1.37]
Perceived Social Support (Friends)	0.003	191.15	0.998	0.0003	[-1.24, 1.24]
Perceived Social Support (Family)	0.66	185.6	0.507	0.07	[-1.93, 0.96]

Table 2. Findings for the non-statistically significant analyses comparing those without a dog and those with a dog with and without perceived behavioral concerns

Dependent Variable	<i>F</i> -Value	<i>df</i>	<i>p</i> -Value	η^2
Generalized Anxiety Levels	0.73	2, 181.96	0.48	0.004
Physical Functioning	0.39	2, 180.67	0.68	0.002
Energy/Fatigue	0.27	2, 179.16	0.77	0.001
Social Functioning	0.23	2, 180.37	0.80	0.001
General Health	0.28	2, 169.93	0.75 *	0.001
Health Change	2.49	2, 184.35	0.086	0.01
Pain (RAND-36)	0.21	2, 180.65	0.81	0.001
Pain (CPAQ-8)	0.16	2, 177.67	0.855	0.0008
Subjective Well-Being	0.22	2, 178.6	0.870	0.001
Perceived Social Support (Friends)	0.22	2, 181.99	0.80	0.001
Perceived Social Support (Family)	0.61	2, 175.51	0.55	0.003
Loneliness	1.81	2, 179.49	0.166	0.008

*.218 when 10 outliers removed

Table 3. Statistical outcomes of *t*-tests comparing CBARQ subscales based on perceived behavioral issues in dogs

CBARQ Subscale	Dog Behavioral Issues Reported			Max. Subscale Score	<i>t</i> -Test Result
	No	Yes	Yes		
Excitability	4.5 (SD = 2.0, Min. = 0, Max. = 8.0)	5.8 (SD = 1.8, Min. = 0, Max. = 8.0)	8	8	$t(147.5) = 5.10, p < .001^*, d = 0.66$
Aggression	5.2 (SD = 4.5, Min. = 0, Max. = 18.0)	12.6 (SD = 7.9, Min. = 0, Max. = 37.8)	40	40	$t(91.3) = 7.70, p < .001^*, d = 1.15$
Fear and anxiety	9.1 (SD = 6.2, Min. = 0, Max. = 30.0)	15.8 (SD = 7.5, Min. = 0, Max. = 33.0)	36	36	$t(111.2) = 6.95, p < .001^*, d = 0.98$
Separation-related behavior	2.8 (SD = 2.8, Min. = 0, Max. = 12.0)	4.8 (SD = 3.7, Min. = 0, Max. = 12.0)	12	12	$t(105.7) = 4.37, p < .001^*, d = 0.62$
Attachment and attention-seeking	6.3 (SD = 1.7, Min. = 0, Max. = 8.0)	6.5 (SD = 1.5, Min. = 2, Max. = 8.0)	8	8	$t(143.3) = 0.91, p = 0.362, d = 0.12$
Obedience and training	3.8 (SD = 2.3, Min. = 0, Max. = 11.0)	4.9 (SD = 2.1, Min. = 0, Max. = 12.0)	12	12	$t(138.2) = 3.49, p < .001^*, d = 0.46$
Miscellaneous	13.4 (SD = 7.1, Min. = 0, Max. = 43.0)	19.0 (SD = 7.4, Min. = 0, Max. = 34.0)	52	52	$t(124.0) = 5.67, p < .001^*, d = 0.77$

**p* < .05

Table 4. Regression outcomes with the CBARQ as the predictor variable

Criterion Variable	Overall Regression Model	R ²	Standardized Coefficient	Unstandardized Coefficient
Anxiety (GAD-7)	$F(1, 291) = 9.34, p = .002^*$	.031	0.176	.056
Pain (CPAQ-8)	$F(1, 291) = .63, p = .625$	.001	-.029	-.014
Pain (SF-36)	$F(1, 291) = 1.73, p = .189$	.006	-.077	-.076
Physical Functioning	$F(1, 291) = 3.01, p = .081$	.010	-.102	-.121
Social Functioning	$F(1, 291) = 5.27, p = .022^*$	.018	-.133	-.139
Role Limitations (Emotional Health)	$F(1, 291) = 4.47, p = .035^*$	.015	-.123	-.233
Energy/Fatigue	$F(1, 291) = 1.57, p = .211$	.005	-.073	-.058
General Health	$F(1, 291) = 2.00, p = .159$ (.004 when outliers removed, .026 robust regression with and without outliers)	.007	-.083	-.065
Health Change	$F(1, 291) = .54, p = .462$	.002	-.045	-.058
Loneliness	$F(1, 291) = 6.06, p = .014^*$	.020	.143	.014
Well-Being	$F(1, 291) = 2.52, p = .114$ (.048 when outliers removed)	.009	-.093	-.042
PHQ	$F(1, 291) = 8.46, p = .004^*$	.028	-.168	-.114
Perceived Social Support (Friends)	$F(1, 291) = .03, p = .865$	.00	.010	.003
Perceived Social Support (Family)	$F(1, 291) = .47, p = .495$	.002	-.040	-.013

* $p < .05$ **Table 5.** Multiple regression outcome when each subscale of the CBARQ was a predictor for attachment

Predictor	Unstandardized coefficient	Standardized coefficient	t	p
Excitability	0.550	0.129	2.265	0.024* (.171 non-imputed & outliers removed)
Aggression	-0.357	-0.261	-3.943	< .001*
Fear/Anxiety	0.213	0.173	2.696	0.007* (.099 outliers removed & .115 non-imputed & outliers removed)
Separation	0.268	0.097	1.545	0.123
Attachment	0.956	0.181	3.109	0.002*
Obedience	-0.633	-0.165	-2.856	0.005*
Miscellaneous	-0.117	-0.101	-1.479	0.140

* $p < .05$

Table 6. ANOVA outcomes based on the factor time spent with the dog

Dependent Variable	F (df)	p	η ²	Post-Hoc Tukey Results
Physical Functioning	5.86 (3, 138.88)	< .001*	0.04	Always with dog < Most (p = .004), Some (p = .009)
Daily Activities (Emotional Issues)	3.47 (3, 135.89)	0.018*	0.027	No dog > Some (p = .010)
Energy/Fatigue	3.06 (3, 133.87)	0.031*	0.023	Always with dog < Most (p = .015)
Pain (SF-36 Scale)	6.70 (3, 140.32)	< .001*	0.047	Always with dog > Most (p < .001), Some (p = .005)
Pain (CPAQ-8 Scale)	6.43 (3, 123.78)	< .001*	0.053	Always with dog > Most (p < .001), Some (p = .004)
General Health	11.11 (3, 136.53)	< .001*	0.051	Always with dog < Most (p < .001), Some (p = .017)
Current Health vs. One Year Ago	2.64 (3, 136.42)	.052 (.123 with outliers removed)	0.02	No dog < Most (p = .056);
Well-Being	2.65 (3, 137.59)	.051 (.183 for non-imputed data)	0.02	Always with dog < Most (p = .034);
Social Functioning	2.05 (3, 134.77)	0.11	0.016	N/A
Health-Related Quality of Life	1.70 (3, 140.17)	0.169	0.013	N/A
Generalized Anxiety	1.03 (3, 136.38)	0.381	0.008	N/A
Loneliness	1.94 (3, 137.42)	0.127	0.014	N/A
Perceived Social Support (Family)	2.05 (3, 134.77)	0.11	0.016	N/A
Perceived Social Support (Friends)	0.07 (3, 142.17)	0.975	< .001	N/A

*p < .05

Table 7. The means (with standard deviations in brackets) for each health and well-being outcome where the ANOVA revealed statistically significant differences based on the amount of time spent with the dog on a typical day

Time with Dog	Physical Functioning	Role Limitations	Energy/Fatigue	Pain (RAND-36)	Pain (CPAQ-8)	General Health	Health Change	Subjective Well-Being
Always	28.4 (20.8)	34.4 (38.7)	16.0 (14.8)	25.6 (19.4)	18.8 (9.8)	14.7 (10.8)	37.4 (25.5)	36.9 (8.7)
Most of the day	38.6 (24.4)	35.8 (36.8)	21.8 (15.1)	34.4 (19.3)	23.7 (8.3)	23.7 (17.0)	43.9 (26.3)	40.1 (9.2)
Some of the day	42.7 (23.0)	48.7 (39.0)	20.4 (17.9)	37.2 (17.5)	24.9 (9.0)	23.9 (16.4)	42.6 (27.6)	39.4 (9.1)
No dog	33.7 (24.6)	26.2 (35.8)	19.6 (14.3)	30.4 (20.4)	21.8 (8.9)	22.5 (18.2)	35.6 (25.0)	38.3 (8.8)

Table 8. The means (with standard deviations in parentheses) for each health and well-being outcome where the ANOVA revealed no statistically significant differences based on the amount of time spent with the dog on a typical day

Time with Dog	Social Functioning	PHQ	UCLA	GAD-7	PSS-FR	PSS-FA
Always	47.0 (21.3)	46.3 (14.1)	7.0 (1.9)	11.5 (6.6)	9.9 (5.7)	10.6 (6.7)
Most of the day	53.4 (19.7)	49.4 (13.4)	6.6 (2.0)	10.4 (6.2)	10.2 (6.1)	11.3 (6.5)
Some of the day	52.5 (22.1)	51.4 (12.2)	6.8 (2.0)	9.8 (6.4)	10.1 (5.1)	9.6 (6.8)
No dog	50.0 (19.7)	49.2 (13.9)	7.1 (1.8)	11.0 (5.9)	10.1 (5.4)	10.3 (6.4)