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Psychiatric Service Dog Outcomes for Veterans with Posttraumatic Stress Disorder over an 18 month-period: A pilot study

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Abstract

Mental health and rehabilitation professionals are hesitant to recommend the use of a psychiatric service dog (SD) to veterans with posttraumatic stress disorder (PTSD) given the lack of evidence regarding their potential beneficial outcomes over time, and regardless of the many dog training schools. In order to preserve this ecological perspective, the main objective of this study was to evaluate the longitudinal impacts of acquiring a SD on various outcomes: psychiatric symptoms, quality of life, and daily/social functioning of veterans with PTSD. A one-group interrupted time-series study incorporating seven measurement times over an 18-month period was conducted (3 before, 4 after the SD acquisition). Six different standardized questionnaires targeting domains known to be potentially modifiable with a SD were completed. From seven different dog schools, 31 participants started the study, 7 dropped out before having their dog, but 19 completed it. Data was analyzed using a nonparametric test (NparLD) preserving measures of those who dropped out before the end of their follow-ups. The questionnaire scores highlight that SDs largely decreases posttraumatic and depressive symptoms while also improving sleep quality. Veterans also reported an improved quality of life in many aspects, including social integration, particularly in the community, and being more relaxed in public places. All beneficial impacts were maintained-even enhanced-over time. The provision of a SD improves veterans' well-being and community functioning over time in many regards. SD represents an alternative that requires additional attention in the rehabilitation process whenever veterans experience limited beneficial effects from usual care.

Keywords: *Stress related disorder; Assistance dog; Comfort being in public places; Psychosocial impacts*

Introduction

Since the mission in Afghanistan, there has been a dramatic rise in the number of veterans and Canadian Armed Force members who have accessed services provided by Veterans Affairs Canada for posttraumatic stress disorder (PTSD) [1]. Of the 14,111 individuals diagnosed with a psychiatric condition, 70.4% had PTSD, a rise of 350% from March 2004 to March 2011 (n=2,824 vs. 9,928). PTSD is "a mental health problem that some people develop after experiencing or witnessing a life-threatening event" [2]. Among veterans, PTSD mostly results from major accidents, armed combat, terrorism, or sexual assaults during deployment [3]. Symptoms include recurring memories of the trauma (cognitive intrusions), avoidance, alterations in mood and cognition, and anxious hyper-arousal [4]. PTSD affects multiple aspects of people's daily functioning. It is often associated with lower quality of life, social reclusion, poor relationships, long-term depression, suicidal ideation, and sleep perturbations [5]. In many cases, veterans present additional comorbid conditions

(e.g., substance abuse, major depressive disorder, generalized anxiety disorder), as well as significant difficulties in the social and occupational domains [6].

In current clinical practice, most veterans with PTSD receive pharmacotherapy combined with evidence-based psychotherapy, either concurrently or sequentially [7]. However, a significant proportion of people do not seem to respond to these first-line treatments. A report published by the Anxiety Disorders Association of America [8] stated that 39% to 60% of those who received cognitive-behavioural therapy still met the criteria for PTSD 12 months after initiating treatment. Research literature also suggests that some of these treatments are less effective among veterans [6,9], with dropout rates as high as 49.4% [10]. It is therefore no surprise that veterans are increasingly seeking other rehabilitation options for their recovery.

According to the American with Disabilities Act [11], service dogs are animals "that are individually trained to do work or perform tasks for people with disabilities". Unlike emotional support dogs, psychiatric service dogs are recognized legally and are given special rights to accompany their owner in public places to provide assistance and care [12]. They give psychological and emotional support, provide assistance in medical crises, offer security, engage cognitive behaviour skills, and prompt strategies for self-regulation [13,14]. Lessard, Vincent, Gagnon, Belleville, Auger, Lavoie and collaborators [5] have defined three main roles of SDs for veterans with PTSD: acting as a socialization agent, contributing to a feeling of safety, and detecting and intervening when the veteran is anxious, disoriented in time or space, depressed, or aggressive. Despite the great potential of SD, a recent Canadian consultation among 21 stakeholders revealed that there are many flaws concerning their accessibility, their training, and the follow-up procedures [15]. Moreover, the lack of empirical data on their effectiveness for veterans with PTSD makes mental health and rehabilitation professionals hesitant to recommend or prescribe service dogs [5]. Veterans Affairs and other organizations have demonstrated growing interest in this alternative [16,17]. There are still few published, peer-reviewed articles on the matter [18], and there is a major gap in the literature regarding longitudinal follow-up trials. However, qualitative studies have highlighted that, combined with first-line treatments, SDs have beneficial effects on veterans' well-being and social integratio [19-21]. Recent empirical research also suggested that the addition of trained service dogs to usual care leads to significant improvements in PTSD symptomatology for veterans [22-24]. In addition, Whitworth, Scotland-Coogan and Wharton [25] recently completed a controlled pilot study that highlights some immediate beneficial effects (i.e., pre versus post-intervention measures) solely among veterans with PTSD in central Florida who enrolled and completed a 14-week service dog training program (i.e., 15 participants in the intervention group; 15 participants in the waitlist controlled group). In fact, they found that, compared to participants included in the waitlist controlled group, those who were included in the intervention group showed significant improvements on the 136-item Trauma Symptom Inventory-2 [self-disturbance ($p<0.05$), posttraumatic stress ($p<0.05$), and externalization ($p<0.05$); decreases in subscales of depression ($p<0.05$), and anger ($p<0.05$); insecure attachments ($p<0.05$), relational avoidance ($p<0.05$), and rejection sensitivity ($p<0.05$)] as well as on the 36-item World Health Organization–Disability Assessment Schedule 2.0 [getting around ($p<0.05$), getting along with others, and participation in society ($p<0.05$); reflecting their general perceptions of their own disability ($p<0.05$)]. Their results provide evidence supporting the endorsement and implementation of service dog programs as helpful complementary or alternative treatment options for some veterans. Hence, all above-mentioned findings emerging from different studies support the need for further longitudinal, empirical data on the effects and effectiveness of SDs, so that mental health and rehabilitation professionals have strengthened evidence to recommend their use as a complementary treatment.

The main objective of this study was to empirically evaluate the longitudinal impacts of acquiring a SD on psychiatric and depressive symptoms, quality of life, and daily/social functioning of veterans with PTSD. It was hypothesized that stability will be observed in the scores before the acquisition of the SD, followed by a progressive improvement of their condition after having been provided a trained SD. The hypotheses are that SDs will contribute to H1decreasing posttraumatic symptoms, such as cognitive intrusions, avoidance, alterations of mood, and hyper-arousal, H2improving sleep, H3decreasing depressive symptoms, H4improving quality of life, and H5improving social integration in the community and comfort being in public places.

Method

A quasi-experimental research study was conducted to address these hypotheses, incorporating a one-group interrupted time-series analysis in which participants completed standardized assessments before (pre-experimental) and after (experimental) the intervention. The pre-experimental assessment times (equivalent of a comparison/self-controlled group) included veterans that were on a waiting list to be paired with a SD. The experimental assessment times consisted of these same veterans once they had acquired their SD. The intervention (X) is the pairing and training with a SD. A total

of seven observation (O) times were planned to measure participants' responses: three before the intervention and four after. The specific research design was therefore: O-6O-3O0 $_{months}$ XSD O+3O+6O+9O+12 $_{months}$. Ethical approval was obtained from the Research Ethics Committee of Université Laval (2015-118). All veterans who agreed to participate in the study completed a consent form as requested by this Committee.

Participants and Procedures

Participants were recruited through stakeholders' organizations that have relationships with many veterans. A recruitment poster, which indicated 8 dog training schools willing to provide SDs were widely distributed by these organizations, notifying veterans about the opportunity to participate in this research project (September 2015). Veterans who met all selection criteria and found a nearby dog training school communicated with the research coordinator (FD) to express their interest in participating in the study [26].

Inclusion criteria consisted of letter of authorization from a treating mental health or rehabilitation professional to participate in the study, minimum cut-off score of '50' on the Posttraumatic Stress Disorder Checklist for military (PCL-M), aged between 20 and 65 years, must like dogs, must want to use a dog as a coping strategy, must be willing to participate in the pre-experimental group for 6 months as well as in the experimental group for an additional 12 months, and must be willing to accept the dog that the training school chooses for him/her. Exclusion criteria were: Wanting to use the dog as self-protection or as a weapon, being unable to take care of the dog 24/7, bringing his or her own dog to the training school, and presenting a concomitant psychiatric diagnostic (schizophrenia, schizoaffective disorder, bipolar disorder), severe substance use disorder (or remission <6 months), or elevated homicidal or suicidal risk.

Using G*Power v3.1.7, it was estimated that, with 7 observation times among 1 group and a projected medium effect size (f=0.30), the sample size required to get statistically significant results (α=0.05) was 21 for an ANOVA with repeated measures.

The intervention (independent variable) was entirely ecological [27] and the training of the SD and of the dog-veteran dyad was under the responsibility of the schools with no input from the research team, aside for data collection. These schools were located in diverse provinces and states across Canada and the US: British Columbia (n=2), Ontario (n=2), Alberta (n=1), Quebec (n=1), and the State of Kansas (n=1). There have been important disparities regarding schools' selection criteria for selecting and pairing veterans and dogs [27]. For example, SD breeds varied widely across schools: Crossed race dogs, Labrador retrievers, Bernese Mountain dogs, German Shepherds, Golden Retrievers, Chesapeake Bay Retrievers, Great Pyrenes, Labradoodles, and Poodles were provided to veterans.

Data collection took place between November 2015 and September 2018. Once a veteran had been recruited, the research coordinator (FD) sent the questionnaires by e-mail for completion within a one-week deadline. Assessments were self-administered and were expected to require around 45 minutes altogether for the veteran to complete, although this varied based on their energy and ability to focus. FD reviewed answers within 48 hours to verify for missing data and to evaluate if some answers reflected an elevated suicidal risk. A psychologist from the research team (GB) further evaluated risks whenever necessary. Veterans completed every standardized assessment seven times throughout the 18-month period, except for the PIADS, which was only completed twice (6 and 12 months after acquiring the SD). Sociodemographic questions were asked at the first follow-up.

Measures and data Analysis

Six standardized questionnaires were used to evaluate each hypothesis regarding the clinical outcomes of SD used by veterans with PTSD (dependent variables).

The Posttraumatic Stress Disorder Checklist for military (PCL-M) was used to assess H1 (decreasing posttraumatic symptoms). The PCL-M is a 17-item self-report checklist of PTSD symptoms based closely on the DSM-IV criteria. Respondents indicate the extent to which they have been bothered by a particular symptom over the past month, by rating each item from 1 ("not at all") to 5 ("extremely"). The total score ranges from 17 to 85, with higher scores indicating more problems. A cut-off score of 50 has been established as optimal for indicating a probable diagnosis of combat-related PTSD [28]. Internal consistency (Cronbach's α) ranges between 0.94 [29] and 0.97 [28], and test-retest reliability has been reported as 0.96 at 2-3 days [29].

The Pittsburgh Sleep Quality Index (PSQI) was retained to evaluate H2 (improving sleep) with 21 items that assess sleep quality and disturbances over one month for seven components (subjective sleep quality, sleep latency, habitual sleep efficiency, sleep duration, sleep disturbance, use of sleep medication, and daytime dysfunction). Individual items are scored on a 3-point scale and then summed across components, yielding a score range of 0 to 21. Higher scores indicate poorer sleep quality [30]. The PSQI has been proven to have a high degree of internal consistency, with a Cronbach's α of 0.83 [30].

The Beck Depression Inventory (BDI-II) was used to assess H3 (decreasing depressive symptoms) with 21 items; each rated on a scale value of 0 to 3. Higher scores indicate more severe depressive symptoms. According to standardized cut-offs, a total score of 0 to 13 indicates minimal depression; 14 to 19 indicates mild depression; 20 to 28 indicates moderate depression; and 29 to 63 indicates severe depression [31]. High internal consistency estimates were found for the BDI-II (α=0.91 to 0.92) [32].

The Brief World Health Organization Quality of Life questionnaire (WHOQOL-BREF) was used to assess H4 (improving quality of life) with 26 questions, yielding four domain scores: Physical health, Psychological, Social relationships, and Environment. Each item is rated on a 5-point Likert scale in which '1' indicates low, negative perceptions and '5' indicates high, positive perceptions. Higher total scores thus signify a better quality of life [33]. Cronbach's α values for each of the four domain scores range from 0.66 to 0.84, demonstrating good internal consistency [33].

The Life Space Assessment (LSA) was used to partially assess H5 (improving comfort being in public places). The LSA collects information about mobility habits in five successive environments: Within the home, around the home, in the neighbourhood, in town, and outside of town. Respondents are asked if, over the last four weeks, they attained each of the five levels, at what weekly frequency, and whether assistive devices were used or human assistance was needed. From a total of 20 items, five scores are generated. Higher scores indicate a larger life space mobility range. The validity, reliability, and sensitivity to change of the LSA were confirmed with ambulant elderly and wheelchair user populations [34,35].

Finally, the Psychosocial Impact of Assistive Device Scale (PIADS) was used to finalize the assessment of H5 (improving social integration in the community). It measures the impacts of rehabilitative technologies on competence, adaptability, and self-esteem of users [36]. It contains 26 items, each rated on a 7-point Likert scale ranging from -3 ("maximum negative impact") to +3 ("maximum positive impact"), indicating how respondents are affected by their assistive device [37]. The F-PIADS' internal consistency values (Cronbach's α) are very good, estimated between 0.91 and 0.94 for the total score [37].

Data analysis was realised with descriptive statistics for sociodemographic data and the questionnaire scores, sub-scores, and items (total, mean, frequency, median, and standard deviation). Sociodemographic data were compared using Mann-Whitney tests, to evaluate differences between both groups of participants over one year. Afterwards, nonparametric statistics were used to evaluate the significance of the collected clinical data. "Nonparametric Analysis of Longitudinal Data" (nparLD) tests were used to observe changes over repeated measures for the PCL-M, PSQI, BDI-II, WHOQOL-BREF, LSA, and PIADS scores. This statistical approach was selected for its robustness with respect to outliers and small sample sizes, and for its ability to take into account subjects with missing data (e.g. conserving data from participants that only answered some follow-ups) [38]. It does not require distributional assumptions and it is applicable to a variety of data types (continuous, discrete, ordinal, or dichotomous). Wilcoxon tests were used for *post hoc* analyses, which are presented between baseline measures, baseline and experimental measures, and between experimental follow-ups.

Results

Results portrayed the veterans' profile followed by clinical outcomes summarized in figures 1 to 3 and tables 2 and 3. Most of the clinical outcome measures remained relatively stable prior to the allocation of the SD and, thereafter, progressively demonstrated beneficial outcomes over the 1-year follow-up period. Results are presented below according to the research hypotheses. The number of participants reported in each figure is sometimes lower than the actual number of participants, due to the fact that some questionnaires were not filled (there were seven time measurements).

Participants' Profile

Veterans' sociodemographic characteristics at baseline (n=31) and 6 months after acquiring a SD (n=22) are presented in Table 1. These two observation times were specifically selected to show differences between groups before and after SD delivery, at equal time intervals and over exactly one year. As shown in Table 1, statistical tests did not reveal significant differences between groups ($p>0.05$). At the beginning of the study, a large majority of veterans were men (83.9%), between 41 and 50 years of age (35.5%), and their principal occupations were other (51.6%) and family (29%). Most of them were married or in a relationship (80.6%), and only 12.9% lived alone, generally in a house (80.6%). More than 41% of participants already had another dog at home. On average, they had served 19.9 years in the army and had been retired for 8.7 years, after a mean of 5.5 military deployments, mostly in the former Yugoslavia (48.4%). On average participants had been diagnosed with PTSD for 7 years.

	6 months before the service dog (n = 31)		6 months after the service1 dog (n = 22)		Mann-Whitney p-value
	%		%		
Gender					0.846
Men	83.9		81.8		
Women	16.1		18.2		
Age group					0.756
Between 31-40	25.8		22.7		
Between 41-50	35.5		36.4		
Between 51-60	29.0		27.3		
61 or more	9.7		13.6		
Live alone	12.9		18.2		0.809
Other animals at home					0.492
Dog	41.9		40.9		
Cat	35.5		45.5		
	Mean (SD)	Median	Mean (SD)	Median	
Years in army	(8.6) 19.9	20	(8.5) 19.4	18.5	0.935
Years since diagnosed with PTSD[2]	(5.8) 7.0	5	(6.4) 7.3	5	0.949
Years since retirement	(9.1) 8.7	6	(10.1) 9.0	5	0.919
Number of deployments	(9.7) 5.5	3	(3.0) 3.3	3	0.641

Note 1: At 12 months, n = 19, meaning 12 participants dropped out of the study: 7 dropped out before receiving their dog, 2 returned their dog and dropped out, and 3 kept their dog but quit the study. Note 2. PTSD = Posttraumatic Stress Disorder.

Posttraumatic Symptoms and Sleep Quality

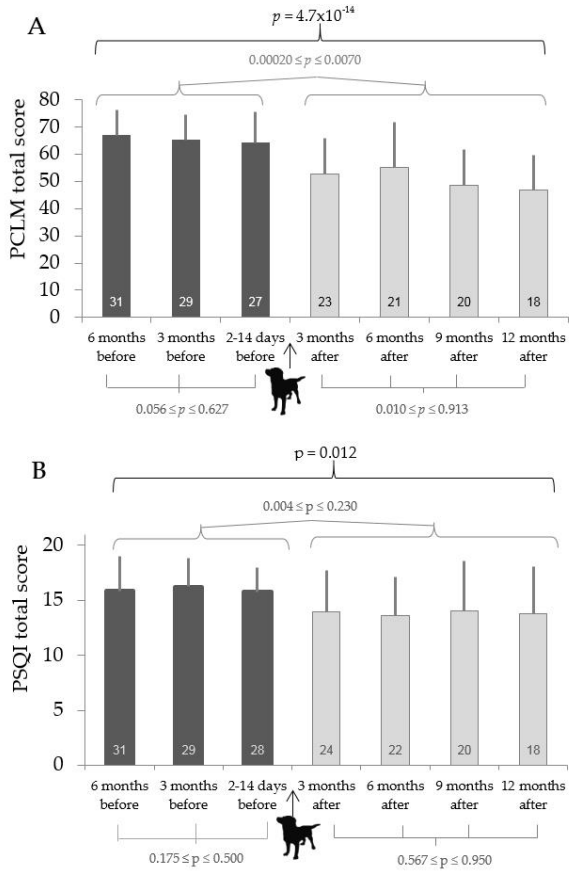

Figure 1: Posttraumatic Symptoms and Sleep quality. A) Total Scores of the PTSD Checklist – Military Version (PCL-M). A higher score indicates more symptoms (17-85). B) Total Scores of the Pittsburgh Sleep Quality Index (PSQI). A higher score indicates lower sleep quality (0-21). Error bars represent standard deviations. Numbers of participants are displayed at the bottom of the figure.

Considering the PCL-M total scores over 18 months displayed in Figure 1, a reduction of 19.9 points was considered to be a clinically meaningful change as mentioned by the U.S. Department of Veterans Affairs [39]. PTSD symptoms are significantly reduced compared to baseline measurements ($0.00020 \leq p \leq 0.0070$). Post hoc tests also revealed a further decrease in total scores after 9 months living with the SD, the scores shifting from 53 (after 3 months) or 55 (after 6 months) to 48.5 ($p=0.010$ and $p=0.014$, respectively). The score after 12 months decreased to 46.9 but was not statistically different from results after 3 and 6 months living with the SD ($p=0.072$ and $p=0.055$). These scores were nevertheless below or around the suggested cut-off of 50 for probable PTSD diagnosis [28]. Sixteen out of the 17 items composing this questionnaire decreased very significantly over time ($p=1.6$ x 10-5 to 6.5 x 10-14). The only statement that did not statistically change was "Trouble remembering important parts of a stressful military experience" ($p=0.57$). On the other hand, the most significant reductions were for the items "Feeling distant or cut off from other people", "Being super alert or watchful on guard", and "Feeling jumpy or easily startled". It is interesting to note that, although veterans remembered their stressful experience with the same ease over time, they could better cope with their reactions to these memories.

As shown in Figure 1, longitudinal scores on the PSQI questionnaire indicated significant change over time ($p=0.012$). Post hoc analyses show a significant decrease of the PSQI between baseline and experimental follow-ups (except when compared to "9 months after") indicating fewer problems and better sleep quality ($0.004 \leq p \leq 0.230$). The scores of the four follow-ups were statistically similar to one another ($p=0.567$ to $p=0.950$).

Statistical analyses of the 7 PSQI sub-scores revealed that there was a significant increase in subjective sleep quality ($p=0.0004$), a reduction of sleep latency ($p=0.0185$), and longer sleep duration ($p=0.0048$). However, there was no change in sleep efficiency ($p=0.068$), the use of sleep medication ($p=0.285$), and daytime dysfunction ($p=0.248$). Finally, although no statistical decrease was measured in overall sleep disturbances ($p=0.199$), veterans were found to experience fewer bad dreams when living with their SD ($p<0.001$).

Depressive Symptoms and Quality of Life

Considering the BDI-II results displayed in Figure 2, the decrease in depressive symptoms was unequivocally significant ($p<0.001$) after veterans had acquired their SD. The scores during follow-ups were fairly stable, with a tendency to decrease over time ("6 months after" compared to "9 months after" ($p=0.015$) and "12 months after" (0.105)).

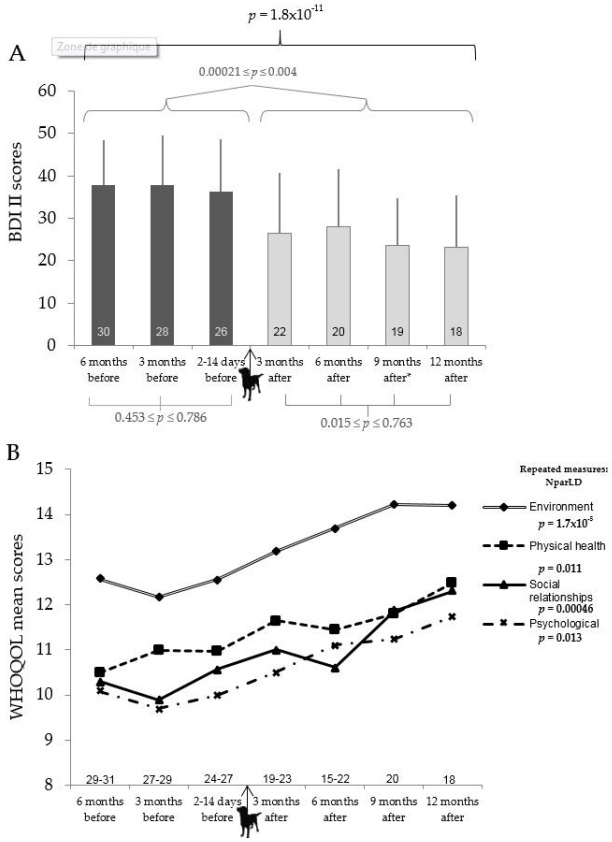

Figure 2: Depressive Symptoms and Quality of life. A) Total Scores of the Beck Depression Inventory (BDI-II). A higher score indicates more depressive symptoms. Error bars represent SD. B) Total Scores of the Brief World Health Organization Quality of Life questionnaire (WHOQOL-BREF). A higher score indicates a higher quality of life. Numbers of participants are displayed at the bottom of the figure.

The WHOQOL-BREF main scores shown in Figure 2 indicated that the acquisition of a SD had major impact on veterans' quality of life, for each of the four domains ($p<0.001$ to $p=0.013$). However, the *post hoc* analyses presented in Table 2 revealed that change patterns were different between domains. There was a significant increase in *the physical activity domain* after only 3 months with the SD. The scores of the *environment domain* began to be statistically different from baseline to the 6-month follow-up. An improvement in *the psychological domain* was observed 9 months after veterans had acquired their SD. For the *social relationships domain*, only the last follow-up score was significantly higher compared to at -6 and -3 months ($p=0.015$ and $p=0.001$). Composed of only three items, additional analyses on this domain revealed that satisfaction about *sexual activities* did not change for participants ($p=0.47$), but satisfaction about *personal relationships* and *social support* clearly increased ($p=0.002$ and $p=0.005$). Two other questions about subjective quality of life and health perception were not part of the 4 domains but clearly showed an increase in the reported quality of life ($p<0.001$), which could be seen after 3 months with the SD but was even more significant after 9 months. Participants' subjective health perception also changed significantly over time ($p<0.001$).

	Wilcoxon Post hoc p-value			
Observation times compared	Physical activity	Psycho-logical	Social relationships	Environment
6 months before x 3 months before	0.090	0.185	0.714	0.079
6 months before x 2-14 days before	0.426	0.582	0.420	0.867
6 months before x 3 months after	0.007	0.121	0.112	0.103
6 months before x 6 months after	0.019	0.068	0.169	0.035
6 months before x 9 months after	0.075	0.050	0.065	0.015
6 months before x 12 months after	0.002	0.012	0.015	0.018
3 months before x 2-14 days before	0.307	0.397	0.333	0.432
3 months before x 3 months after	0.027	0.011	0.058	0.015
3 months before x 6 months after	0.057	0.004	0.182	0.010
3 months before x 9 months after	0.131	0.010	0.019	0.004
3 months before x 12 months after	0.001	0.001	0.001	0.002
2-14 days before x 3 months after	0.005	0.097	0.521	0.045
2-14 days before x 6 months after	0.024	0.053	0.455	0.036
2-14 days before x 9 months after	0.056	0.016	0.102	0.035
3 months before x 12 months after	0.001	0.001	0.071	0.020
3 months after x 6 months after	0.241	0.253	0.835	0.324
3 months after x 9 months after	0.711	0.007	0.160	0.169
3 months after x 12 months after	0.028	0.029	0.291	0.163
6 months after x 9 months after	0.393	0.186	0.139	0.319
6 months after x 12 months after	0.026	0.185	0.055	0.461
9 months after x 12 months after	0.191	0.722	0.875	0.710

Table 2: *Brief World Health Organization Quality of Life Questionnaire (WHOQOL-BREF) Post Hoc Comparisons*

Comfort Being in Public Places and Social Integration in the Community

According to LSA total score displayed in Figure 3, the mobility in the community increased significantly over time for ($p=0.0017$). Baseline measurements were not stable, showing an increase between the first and last baseline measurement ($p=0.037$). *Post hoc* also shows that changes in the LSA total scores only became significant after 6 months with the SD, compared to baseline measures. There was indeed a relatively high variability in the results, which decreased for the last three follow-ups. Furthermore, individual analyses of the five mobility areas showed that only area 3 ("In the neighbourhood") changed significantly over time ($p=0.0003$). The mean score 6 months before SD delivery represented 43% of the maximum score for this area (representing 1-3 times a week in their neighbourhood). This frequency, however, increased to 4-6 times a week at the last follow-up (76% of the area 3 maximum score).

As the PIADS results presented in Table 3, the use of a psychiatric SD had positive psychosocial impacts on veterans after 6 and 12 months. The mean total score at 6 months was 26.3 (SD 14.9), indicating an average of +1 for every item on the scale. The score significantly increased at the last follow-up ($p=0.0061$) to reach 35.6 (SD 13.4), which is almost a mean of +2 per item, signifying that the impacts of SD on daily functioning were maintained or even enhanced over time. Analyses of each sub-score revealed a significant increase in self-esteem, competence, and adaptability ($p=0.034$, $p=0.004$, and 0.046). The highest score at 6 and 12 months was for the item "Feeling safe rather than feeling vulnerable

or insecure" (mean of 2.15 and 2.39), which plays an important part in people's willingness to go into the community. "Happiness" (2.22), "independence" (1.94), and "quality of life" (1.94) also had high scores at 12 months, underlining the positive impact of the SD.

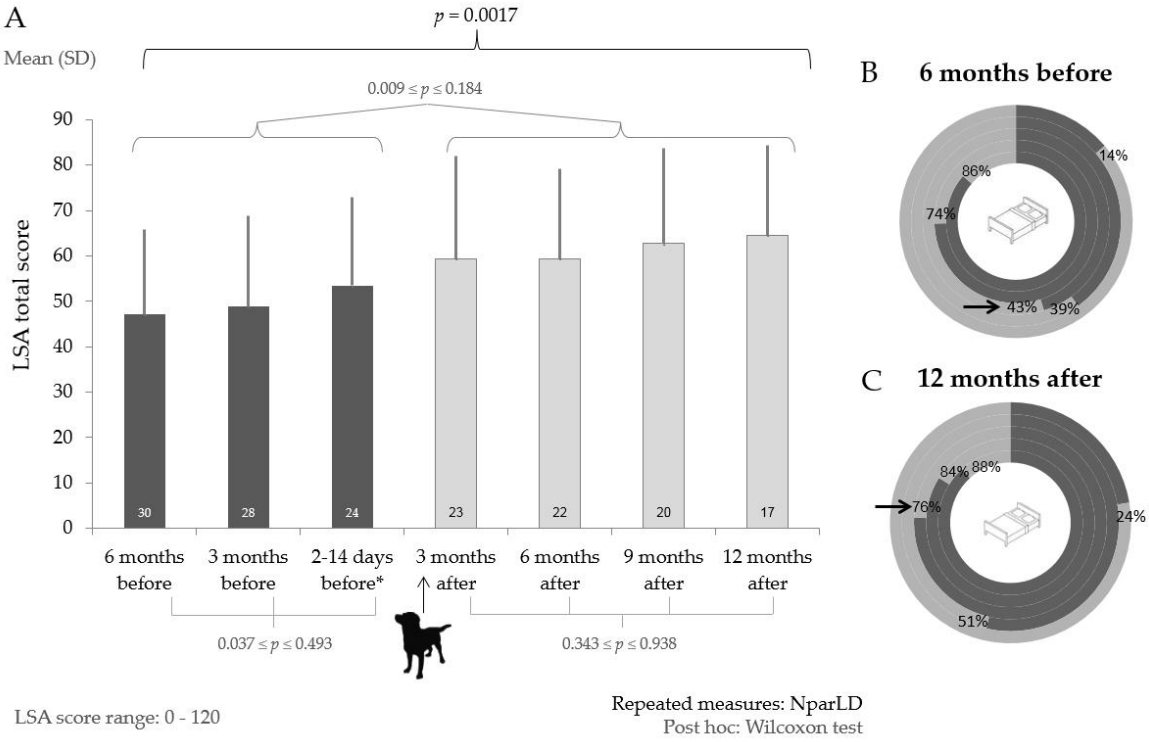

Figure 3: Comfort Being in Public Places. A) Total Scores of the Life Space Assessment (LSA). A higher score indicates a higher level of mobility. Error bars represent standard deviations. Numbers of participants are displayed at the bottom of the figure. The circles at B) the beginning of the study and C) at the end of the study reveal that the veterans are increasingly comfortable about going out in public, increasing their life spaces from within the home (concentric, closed to the bed), around the home, in the neighborhood, in town, and to outside of town.

	Mean (SD)		
Categories and items	6 months after (n = 20)	12 months after (n = 18)	NparLD p-value
Total score /78	26.3 (14.9)	35.6 (13.4)	0.006
Self-Esteem /24	8.4 (4.8)	10.9 (4.9)	0.039
Competence /36	11.7 (6.9)	16.6 (5.8)	0.001
Adaptability /18	6.2 (4.6)	8.1 (4.2)	0.046

Table 3: *Social Integration in the Community with the service dog measured with the Psychosocial Impact of Assistive Devices Scale (PIADS)*

Discussion

The main objective of this study was to evaluate the long-term impacts of acquiring a SD on psychiatric symptoms, quality of life, and daily/social functioning of veterans with PTSD. Overall, the findings indicate that SDs do have positive impacts on all of these aspects.

Hypothesis 1 is confirmed by the PCL-M total scores, showing a major decrease in PTSD-related symptoms after the acquirement of the SD. Moreover, the final mean score (49.96) was below the suggested diagnostic threshold of 50 [28] which indicates a beneficial longitudinal effects on symptoms than what was also observed to some extent by O'Haire & Rodriguez [23]. In their study, they invited veterans with PTSD to complete the PCL-M before the SD (three measurement times: initial application to the service-dog provider, n=60; during the waitlist period, n=66; immediately prior to SD acquisition, n=33) and after the SD was provided (two measurement times: three weeks after the SD, n=35; follow-up once the service dog was in the home, n=74). Their results revealed that the PCL-M scores remained stable before the SD was provided whereas it significantly decreased at both measurement times after the SD was provided while a moderate effect size was also observed. Moreover, they confirmed that the initial PTSD symptom severity was not associated with outcomes on the PCL-M. However, their mean PCL-M scores remained elevated despite a significant beneficial effects 3 weeks after the SD (mean score=47.9±11.7) and, even more so at follow-up once the SD was in

the home (mean score=58.2±13.1). In our study, unlike O'Haire & Rodriguez [23], significant beneficial effects with scores under the diagnostic threshold (≤50) were observed at 9 and 12 months after the allocation of SD. Our results demonstrate for the first time the importance of investigating effects over longer periods of times after veterans have been paired with their SD to allow sufficient time to optimize the potential beneficial effects. Similarly, when investigating service dogs that are provided to individuals with sensorimotor impairments and functional disability, it was found that for the benefit be optimal, an adaptation period of about 6 to 9 months is needed in the natural environment of these individuals [40]. Conversely, Kloep et al. [22] found PCL-M below 35 after 6 months with their trained SD in a sample of 12 veterans. Overall, the decrease that we measured in cognitive intrusions, avoidance, alterations of mood, and hyper-arousal confirms previous observations [21-23]. Moreover, our results have been observed over a longer period than previous studies, with a similar number of participants and standardized procedures.

The results from the PSQI questionnaire also validate our second hypothesis: significant positive effects were observed on veterans' sleep quality after they had acquired their SD. These results are highly relevant since they support the effectiveness of SD on sleep quality, which had never been longitudinally measured in this context. These results also offer a better understanding of the specific aspects of veterans' sleep that are improved by SDs. The global increase in the PSQI scores found aligns perfectly with the outcomes of comprehensive interviews conducted by Yarborough et al. [21], in which participants reported better and longer sleep with fewer nightmares.

BDI-II total scores revealed that depressive symptoms largely decreased, thus confirming hypothesis 3. Throughout the course of the study, depression in veterans went from being classified as "severe" (29-63) to "moderate" (20-28) [31]. These results confirm in a more thorough way the outcomes of the longitudinal study of Kloep *et al*. [22]. They chose a different questionnaire (i.e., QIDS) to evaluate depressive symptoms in veterans, but also observed a significant decrease in scores after only one week and after 6 months with the SD. O'Haire & Rodriguez [23] came to similar results, finding cross-sectional differences in depression between one group of veterans with usual care and the other group who had SD. The SD group had significantly lower scores on the PHQ-9 and on the PROMIS Depression questionnaires.

Our fourth hypothesis is confirmed by participants' results on the WHOQOL-BREF. This assessment revealed that veterans generally had a better quality of life after acquiring their SD, although results varied between domains and individual items. The analyses of sub-sections presented in this paper are of interest, as they offer for the first time in-depth data on the impacts of SD on diversified aspects of veterans' quality of life. For example, the unclear change in the social relationships domain (only the last follow-up score was significantly higher compared to -6 and -3 months) could be explained by the fact that this category contains only three items, making it more sensitive to changes in one item (two out of three items significantly increased; see results section). Previous scientific literature had only presented global tendencies on that matter. In their longitudinal study, Kloep et al. [22] observed a significant increase in veterans' scores on the QOLS questionnaire after 6 months with the SD, which concords with our observations, contrarily of Whitworth, Scotland-Coogan and Wharton [25] that have observed it sooner (14 weeks after SD), O'Haire & Rodriguez [23] reported higher quality of life among veterans with SD compared to the usual-care group on 3 of the 4 questionnaires used. Our study thus specifies which aspects are and are not improved.

Lastly, the results validate our fifth hypothesis, suggesting potentially more comfort being in public places and an improved social integration in the community after 12 months with the SD. The LSA total scores indicate greater mobility for most participants, although baseline measurements were increasing and changes were not immediately significant. This may be due to the preparation needed for the acquisition of the SD (e.g.. school visits). The PIADS total scores also support these findings at 6 and 12 months. Overall, participants felt that their SD had positive psychosocial impacts. The current study was the first to use such standardized questionnaires to evaluate veterans' daily functioning and social integration. Although some authors had already suggested the benefits of SDs in this area [19,21,23], our results provide the first quantitative evidence of their actual effectiveness.

Strengths of the Study

These conclusive findings represent a great step forward in empirical research on SDs for veterans with PTSD, filling some gaps in the literature regarding the longitudinal impacts of SD. This study was the first to collect data on a group of veterans for an 18-month period, with a stable baseline comparison period. Specific items in the three chosen assessments have revealed long-term benefits of SDs that are much more substantial than previous studies about psychiatric symptoms, quality of life, and community functioning of veterans with PTSD symptoms [16,19,22,23]. The specific sub-scores of PIADS and LSA assessments usually used for assistive technology were helpful in revealing other personal benefits of SD. The specific sub-scores of PSQI were also helpful in documenting the quality of sleep over time before and after being paired with a SD.

The internal validity of this study was elevated: Both English and French versions of all questionnaires were standardized, with confirmed validity, reliability, and sensitivity to change. Furthermore, the nparLD approach, chosen for data analyses, strengthened statistical analyses confirming that changes were significant. In fact, at each observation time, the nparLD approach considered all participants while also accounting for dropouts and missing data. Moreover, as supported by Noguchi *et al*. [38], the nonparametric nature of the nparLD approach makes it very robust with smaller sample size because it is not based on assumptions (e.g. normal distribution). For these reasons, the nparLD analysis contributed to the fact that we observed statistical differences despite a smaller sample size than anticipated with G*Power that used a parametric test to estimate the initial sample size needed.

The external validity of this study was also elevated: Three baseline measurements were taken to evaluate the stability of the questionnaire scores before the acquirement of the SD. With this stable 6-month comparison period for almost all assessments, the pre-experimental group can statistically be considered as a control group.

The mandate of the granting organization (i.e., Veterans Affairs Canada) was to evaluate over time the effectiveness of having a specially-trained SD in comparison to not having one. In this context, the self-controlled research design selected in the present study presents numerous advantages. Among those, it makes it more plausible that the observed improvements were due to SDs, and not to natural changes over time alone or heterogeneity between the control and experimental groups. Furthermore, our study's ecological context offers an accurate representation of the variety of dog training schools in North America. Seven schools with various training processes, coming from 4 Canadian provinces and 1 USA state, provided SD to participants [27]. Many of these dogs came from donations of all forms (rescued dogs, community donations, service-dog organizations donations, etc.), and a few came from breeding programs. Trainers had very different backgrounds, as some were highly experienced (>21 years) and others were only beginning their careers in this domain (<5 years). The nature, length, and intensity of the training also varied between institutions, as well as the follow-up procedures, which lasted from 3 to 12 months. Training was conducted in various locations, from ranches to community centers or veterinary hospitals [27].

Limits of the Study and Future Research

The first limit of the study is its sample size; had all participants remained enrolled in the study at +6 months, evidence could have been strengthened or expanded. A second limit relates to the maintenance of the engagement of veterans throughout the course of the study. A total of 12 dropouts occurred (39%), nine from the schools and three from the study. Seven veterans dropped out before receiving their SD (-6 and -3 months), two returned their SDs and dropped out (+3 months), and three kept their SD but quit the study after +6 months (due to the reasons: 'filling research questionnaires was emotionally difficult', and 'health problems'). We had no control over the schools' interventions and could not directly intervene to prevent the dropouts. Finally, we could not restrict or avoid the use of medications, alcohol, and drugs that could have potential interaction effects on the selected outcomes measures.

Future focus-group research should be conducted, comparing dropouts and successful dog-veteran dyads, to identify veterans' characteristics that could attenuate/improve the effectiveness of SDs. This could guide mental health and rehabilitation professionals in their decision as to whether or not to prescribe this option to a veteran with PTSD. It would also contribute to the identification of strategies to prevent dropouts and guide trainers in teaching specific roles and tasks to dyads.

Conclusion

Pairing veterans with PTSD with a well-trained SD is an effective intervention to improve psychiatric symptoms, quality of life, and daily/social functioning. In fact, participants reported long-term positive effects on specific aspects of PTSD symptoms, sleep quality, depressive symptoms, quality of life, and social integration through mobility habits. These findings may encourage mental health and rehabilitation professionals to recommend this intervention. as an adjunct to evidence-based interventions, for veterans who have a suitable profile and are agreeable to this option. Results indicate that SDs help veterans deal with their stressful memories, particularly by reducing hyper-arousal, behavioural avoidance, and depressive feelings. Further empirical research is needed to evaluate SDs' potential after 12 months and implementation of the interventions in SD schools. Mental health and rehabilitation professionals may recommend their use.

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