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Review

Animal-assisted interventions for elderly patients affected by dementia or psychiatric disorders: A review

V. Bernabei [a,*,1], D. De Ronchi [a,1], T. La Ferla [b], F. Moretti [a,1], L. Tonelli [a,b,1], B. Ferrari [a,1], M. Forlani [a,1], A.R. Atti [a,1]

[a] Department of Biomedical and Neuromotor Sciences, Viale C. Pepoli 5, 40123 Bologna, Italy
[b] Department of Clinical and Experimental Medicine, Section of Psychiatry, University of Perugia, Perugia, Italy

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ABSTRACT

Objective: The aim of this literature review was to assess the effects of Animal-Assisted Interventions (AAI) on elderly patients with dementia or various psychiatric disorders.
Methods: We conducted a comprehensive literature search using the online PubMed network of the US National Library of Medicine & National Institutes of Health, Embase, PsycINFO, with the purpose of investigating AAI effects on cognitive functions, mood, and behaviour.
Results: A total of 18 articles on dementia and 5 on psychiatric disorders were included in the present review. AAI were found to have positive influences on demented patients by reducing degree of agitation and by improving degree and quality of social interaction. Few studies have assessed the effects of AAI on mood, and even fewer have assessed its consequences on cognitive functions. The results that are available indicate a positive effect on communication and coping ability, but none on cognitive performance. A substitute pet robot yielded encouraging results, but its use requires further investigation. The few studies conducted for elderly patients presenting a variety of psychiatric diagnoses produced controversial findings.
Conclusions: In spite of the encouraging results of AAI, much more research examining the issue of optimal AAI duration, frequency of sessions, and suitable target group is needed.
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1. Introduction

Domestic animals were found to increase patient self-control, play an “emotional mediator” role, and serve as “social facilitator” and “catalyst” for social interaction (Wilson and Netting, 1983). These observational data were further confirmed by experimental studies showing higher neurochemical levels associated with attention-seeking behaviours during positive human–animal interaction (Odendaal, 2000).

The purposeful use of animals as an aid in treating mental and physical health disorders dates back to 1792. Animal-assisted interventions (AAI) include animal-assisted activities (AAA), animal-assisted therapy (AAT), and service animal programs (SAP) (Muñoz Lasa et al., 2011). Given the lack of agreement on the terminology (Kruger and Serpell, 2006), in the present article we adopt the broadest concept of AAI as the result of teamwork involving various types of expertise (Khan and Farrag, 2000; Banks et al., 2008; Williams and Jenkins, 2008). AAI have several important applications (Ballarini, 2003) in activities conducted with single individuals or groups and with either real animals or robotic pets. The most frequently employed animals in this approach are dogs, given their training potential and typically social nature (Jofre, 2005).

Not only do animals keep people company (Ryder, 1985), but they also enhance their health status (McNicholas et al., 2005; Edwards and Beck, 2002; Halm, 2008), provide sensory stimulation and emotional support, and a sense of physical and psychological well-being thereby (Jofre, 2005).

More recent research in the field has investigated the healthy effects of animals on people suffering from psychological distress or somatic diseases, including both sub-acute and chronic disorders (Stasi et al., 2004). For example, a case–control study examining 30 adult out patients with mild to moderate depression showed a greater reduction in depressive symptoms in the group exposed

* Corresponding author. Tel.: +39 328 8123650.
E-mail addresses: virginia.bernabei@studio.unibo.it (V. Bernabei), diana.deronchi@unibo.it (D. De Ronchi), teresalaferla@gmail.com (T. La Ferla), francesca.moretti@studio.unibo.it (F. Moretti), letizia.tonelli@studio.unibo.it (L. Tonelli), barbara.ferrari4@unibo.it (B. Ferrari), martina.forlani@studio.unibo.it (M. Forlani), annarita.atti@unibo.it (A.R. Atti).
[1] Tel.: +39 051 524100. http://www.dibinem.unibo.it/it.

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to AAI, as compared to the control group (Antonioli and Reveley, 2005). AAI positively impact patients' degree and quality of socialization and can produce a variety of psychological benefits (Rossetti and King, 2010). It has also been found to be useful in the rehabilitation of schizophrenic patients living in institutional settings (Kovacs et al., 2004). Moreover, AAI may have a useful role in psychiatric and medical procedures that are anxiety-inducing or have negative socially perceived connotations, such as Electro-Convulsive Therapy (Barker et al., 2003).

Older persons are frequently burdened by high co-morbidity and poly-pharmacological treatment, and are more likely to experience severe disability and/or institutionalization, which may lead to a poorer quality of life. In elderly individuals receiving assistance in long-term care settings, AAI increase verbal interactions and socialization (Fick, 1993) and alleviate participants' feeling of loneliness (Calvert, 1989; Banks et al., 2008). Indeed, treatments based on affective-emotional motivation and psychological stimulation are particularly suitable for individuals suffering the co-occurrence of cognitive disturbances, mood disorders, anxiety, and psychotic symptoms in later life.

AAI present no specific age limits but the most of the available data refer to children/adolescents or adults. Conversely, the amount of data on elderly, especially with mental disorders, is scant. Furthermore, the available literature review on AAI are not systematic (Rossetti and King, 2010; Cozza et al., 1994), refer to children/young persons (Barker and Wolen, 2008; Friedmann and Son, 2009; Cirulli et al., 2011; Endenburg and van Lith, 2011; Muñoz Lasa et al., 2011), are not up-dated (Natoli, 1997; Dossey, 1997) or have narrow inclusion/exclusion criteria (Shibata and Wada, 2011; Filan and Llewellyn-Jones, 2006).

The purpose of the present work was to review the current literature concerning the beneficial and (if any) harmful effects of AAI in elderly patients affected by Dementia or Psychiatric Disorders.

2. Methods

2.1. Search strategy and selection criteria

The US National Library of Medicine National Institute of Health (www.pubmed.org), Embase, PsycINFO, were resourced to identify original publications describing the effects of AAI in the elderly with Dementia or Psychiatric Diseases. Since there is no full agreement in literature on the more appropriate terminology to define the therapeutic use of animals, we included the following search terms: *"Animal Assisted Interventions"/"Animal Assisted Activities"/"Animal Assisted Therapy"/"Pet-Therapy"*. The search further included *"elderly" [MeSH] AND "dementia"/"Alzheimer disease"/"cognitive impairment"/"cognitively impaired"/"mental disease"/"psychiatric disease"/"geriatric psychiatric patients"/"psychiatric elderly person"*. The search was supplemented by additional relevant papers identified through a manual search of the reference lists in all the retrieved articles. The following limits were established: English language, 65 years and over, human being, published between January 1st, 1995 and February 1st, 2012. The choice of 1995 is related to the International Conference entitled "Animals, Health and quality of life" announcing the principles for Animal Assisted Therapy (Geneve in 1995).

3. Results

The search retrieved 56 original articles and three reviews (selection procedure shown in Fig. 1). We excluded 47 articles, because they were not relevant to our purpose (reports on uncontrolled and/or informal observations, studies on inpatients without mental diseases or descriptive articles; see Fig. 1).

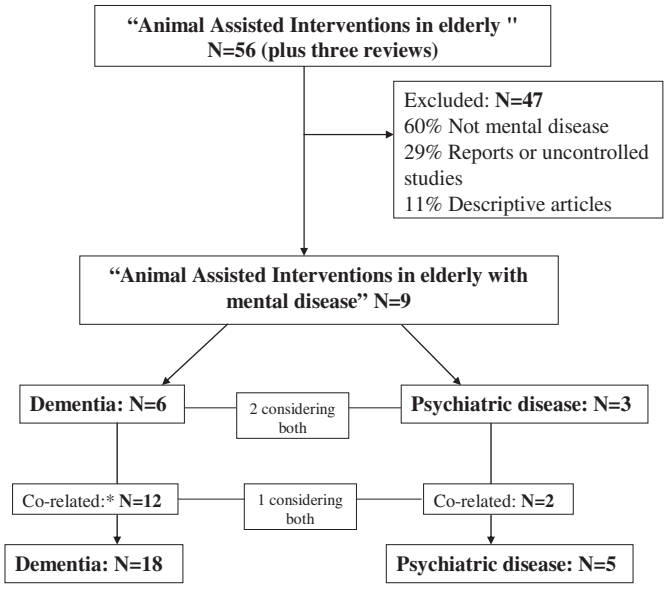


Fig. 1. Description of the selection procedure. *Co-related: additional relevant papers identified through a manual search of the reference lists in all the retrieved articles.

We found 9 articles examining AAI effects in elderly patients with mental diseases. Out of 9 articles, 6 studies were conducted with patients presenting Dementia, 3 on persons with Psychiatric Diseases, and 2 articles considered a miscellaneous group of patients. We used the reference list for all the selected articles to further retrieve 12 original articles on Dementia and 2 on Psychiatric Diseases (one study considered both). Upon conclusion of the selection procedures, we obtained a total of 18 articles on Dementia and 5 on Psychiatric Disorders (See Tables 1–3, for a detailed study description). The main results of the studies listed in the tables are divided according to outcomes (cognitive functions, depressive symptoms, behaviour, and others).

3.1. Animal assisted interventions in elderly with dementia

Out of 18 articles retrieved, 5 were case–control studies (Walsh et al., 1995; Zisselman et al., 1996; Kanamori et al., 2001; Edwards and Beck, 2002; Moretti et al., 2010) (Table 1) and 13 studies used a repeated measures design (Marx et al., 2010; Batson et al., 1998; Churchill et al., 1999; Greer et al., 2001; Kanamori et al., 2002; McCabe et al., 2002; Richeson, 2003; Libin and Cohen-Mansfield, 2004; Naoyasu et al., 2004; Tamura et al., 2004; Sellers, 2005; Kawamura et al., 2007; Mossello et al., 2011) (Table 2). Five studies with robot or toy-pets as an animal substitutes are listed separately in Table 3 (Kanamori et al., 2002; Libin and Cohen-Mansfield, 2004; Tamura et al., 2004; Wada et al., 2004; Wada et al., 2005).

In the following paragraphs we provide results on the effects of AAI on Behavioural and Psychological Symptoms of Dementia (BPSD), on depressive symptoms and on Cognitive Functions among patients with Dementia.

3.1.1. Effects of AAI on BPSD among patients with dementia

AAI effects on BPSD were investigated in 10 studies. Three out of 10, had a case–control design (Walsh et al., 1995; Zisselman et al., 1996; Kanamori et al., 2001), but only 2 reported statistical comparison details.

Walsh et al. (1995) compared 7 elderly patients to a similar control group (six with Dementia and one with Schizophrenia) and found no significant differences in scores on either the London Psycho-Geriatric Rating Scale (LPRS) (Hersch et al., 1978), or on the

Table 1
Effects of AAI on demented persons: case/control studies.

(Author, year) Country Study duration Setting	*N*, (women%), mean age (±SD[a]/range), *N* measurement diagnosis: criteria (if reported)	Method measurement	Results			
			Cognitive function	Depressive symptoms	BPSD	Other effects
(Walsh et al., 1995) Australia 12 weeks Psychiatric hospital	7 (women 40%), 7 Case/7 control 6 dementia, 1 schizophrenia	LPRS[a] and BCABS[a] before and after 12-weeks. Dog visit for 3 h twice per week	–	–	No difference in LPRS or on BCABS were found after the 12-week experimental period	Lower noise level and more social interaction (short-term only) during dog visits, owing to fewer loud or aggressive outbursts ($p = 0.001$)
(Zisselman et al., 1996) USA 1 week Wills Eye Hospital Geriatric Psychiatry Unit	58 divided in case/control, blind. Different psychiatric disease included dementia	AAI and an exercise control group for 1 h a day for 5 days. MOSES[a] before and after intervention	No significant differences in MOSES scores between or within groups	–	AAI group showed a tendency towards less irritable behaviour after treatment	Improved irritable behaviour scores for both groups
(Kanamori et al., 2001) Japan 12 weeks Psychiatric Hospital	27(women 78%), case: 79.43 (±6.06 years); control: 83.4 (±7.22 years). 7 Case/20 control. Case: 5 AD[a], 2 VD[a] Control: 7 AD, 13 VD. DSM-IV, MMSE[a]	Six biweekly sessions AAI. Normal activities in the control group. MMSE, N-ADL[a], Behave-AD[a], CgA[a]	No MMSE and N-ADL score differences before and after intervention	–	Behave-AD decrease, especially for aggressiveness ($p = 0.045$), anxieties ($p = 0.004$), and caregiver burden ($p = 0.047$)	No N-ADL score differences before/after intervention. CgA (mental stress index), showed a decreasing tendency in the AAI group
(Edwards and Beck, 2002) USA 6 and 16 weeks Nursing homes	65 (women 58%), 80.1 years, 45 Case/17 control AD	Treatment group had fish tank in dining area. Control had picture for two weeks; two weeks washout, then fish tank introduced to dining area	–	–	–	Increase in nutritional intake (21.1%; $p < 0.001$) in body weight (1.65 lbs; $p < 0.001$) in the AAI group
(Moretti et al., 2010) Italy 6 weeks Nursing home	21, (95.2%), 84.7 (±9.9 years), 9 case/11 control Dementia (47.6%), psychotic disorders (33.3%), depression (19.0%): ICD-10	AAI for 90 min, once a week for 6 weeks. Control group not allowed to interact with dogs. MMSE, 15-items GDS[a] and quality of life questionnaire before and after intervention	Mean improvement in MMSE (4.5 scores, $p = 0.06$ for cases; 2 scores, $p = 0.0941$ for controls)	GDS improvement in both groups (within group comparison, $p = 0.013$; between group comparison, $p = 0.070$)	–	Positive effect on self-perceived quality of life in 5 pet group participants and 2 control group participants

[a] SD: Standard Deviation; LPRS: London Psycho-Geriatric Rating Scale (Hersch et al., 1978); BCABS: Brighton Clinic Adaptive Behaviour Scale (Wood and Britton, 1985); MOSES: the Multidimensional Observation Scale for Elderly Subjects (Helmes et al., 1987); AD: Alzheimer's disease; VD: vascular dementia; MMSE: Mini Mental State Examination (Folstein et al., 1975); N-ADL: Nishimura's Activities of Daily Living (Yamashita et al., 1988); BEHAVE-D: Behavioural Pathology in Alzheimer's Disease (Reisberg et al., 1987); CgA: Salivary Chromogranin A (Kanamori et al., 2001); 15 items-GDS: 15 items Geriatric depression scale (Sheikh and Yesavage, 1986).

Table 2
Effects of AAI on demented persons: repeated measures design.

(Author, year) Country Study duration Setting	*N*, (women%), mean age (±SD/range), *N* measurement diagnosis: criteria (if reported)	Method measurement	Results			
			Cognitive function	Depressive symptoms	BPSD	Other effects
(Batson et al., 1998) USA Observation during intervention Special resident care	22, 77.9 (62–96 years), 2 measurements Severe dementia: AD	Visiting dog. BDRS[a], Social behaviours, BP[a], HR[a], Skin temperature	–	–	–	Increased duration and frequency of social behaviour during AAI; improvement unrelated to severity of dementia
(Churchill et al., 1999) USA Observation during intervention 3 SCUs[a]	28, (women 25%), 83.8 (±6.8 years), 2 measurement AD: BDBRS[a] 22.2 (3–37), agitated behaviour in the evening	Two 30-min session of researcher alone or researcher + dog. ABMI[a], social behaviours (touch, leans, smiles, verbalization, looks)	–	–	Group exposed to the dog: decreased in agitated/aggressive compared to the group not exposed. *p*-values n.r.[a]	Duration and frequency of social behaviour significantly increased in the presence of a dog
(Greer et al., 2001) USA Observation during intervention Nursing home	6 women, 3 measurements Moderate dementia: MMSE, FAST[a]	3 Measurements: without stimuli, 2 toy cats, 2 live cats. Number of words, MIU[a], videotape recording	–	–	–	Live cat: greater number of total words, MIU and initiations
(McCabe et al., 2002) USA 4 weeks SCU	22 (women 68%), 83.7 (68–96 years), 2 measurements AD	NHBPS[b] (days and evenings) 1 week before and 4 weeks after AAI	–	–	Day shift: fewer problem across the 4 weeks ($p < 0.05$). Evening shift: no significant results	–
(Richeson, 2003) USA 5 weeks Two nursing homes	15 (women 93%), 86.8 (63–99 years), 3 measurements Dementia: MMSE (0–15); MMSE mean score: 3.9; 26% with depression	AAI for three weeks. CMAI[b] and Animal-Assisted Intervention Flow Sheet pre-test, post-test 3 week, 2 weeks washout after the end	–	–	Decrease in agitated behaviour in week 3 vs. week one ($p = 0.001$). Increase in agitated behaviour after the study conclusion ($p = 0.001$)	Increase in social interaction in week 5 compared to week 1 ($p = 0.009$)
(Naoyasu et al., 2004) Japan 4 days Nursing home	8 women, 84.8 (±7.0 years), 2 measurements 4 AD, 4 VD: DSM-IV, NINCDS-ADRDA[b], NINCDS-AIREN[b]	Two dogs for 1 h over 4 consecutive days. Apathy/irritability scale[b], GDS[b], PSMS[b] and MMSE before and after AAI	Non significant change in MMSE before/after: (20.5 ± 6.3)/(19.5 ± 7.4). Non significant change in GDS before/after: (12.5 ± 7.8)/(13.4 ± 3.8)	Apathy scale before/after (19.4 ± 3.7)/ (14.0 ± 3.5) $p < 0.05$	No significant change in irritability scale before (7.5 ± 3.8) and after (7.0 ± 3.1)	No significant change in PSMS before (5.2 ± 2.1) and after (5.0 ± 2.1)
(Sellers, 2005) USA Observation during intervention Residential care	4, (79–95years) 2 measurements Moderate to severe dementia: MMSE	Visiting dog ABMI, SBOC[b]	–	–	Reduced of agitated behaviour during AAI; increase observed social behaviour (*p* value n.r.)	–
(Kawamura et al., 2007) Japan 12-month Nursing home	10 (women 90%), 85 (75–95years) Data collected four times in 1 year. 6 VD; 4 senile dementia	Visiting dog two time at month in 2-h session. GBSS-J14[b] and MENFIS[b]	GBSS. First 6 months: improve spatial orientation ($p = 0.047$); last 6 months: decrease wakefulness, impaired concentration, impaired thinking in abstractions ($p < 0.05$). MENFIS: improve cognitive functions, motivational functions during the first 6 months, decrease during the final 6 months	GBSS: first 6 months decrease emotional liability ($p = 0.046$) MENFIS. First 6 months: improve emotional functions then decrease during the final 6. Over the 12-month period: improve emotional functions and expression ($p = 0.047$), stability of emotional expression ($p = 0.047$)	–	Over 12-month: decrease in eating ($p = 0.038$)

(*continued on next page*)

Table 2 (*continued*)

(Author, year) Country Study duration Setting	*N*, (women%), mean age (±SD/range), *N* measurement diagnosis: criteria (if reported)	Method measurement	Results			
			Cognitive function	Depressive symptoms	BPSD	Other effects
(Marx et al., 2010) USA Observation during 2 session activities Two nursing homes	56 (women 79%), 87 (61–101 years), measurement in different conditions Dementia: DSM-IV, NINCDS-ADRDA	Assessed degree of engagement with dog-related stimuli (real dog, robotic dog, puppy video dog and dog-colouring activity) via OME[b]; verbal responses	–	–	–	Highest engagement duration with the puppy video (160.5″), followed by the real dog (120.2″); prevalence for the large (154.9″, $p = 0.009$) in confront to the medium dog (133.6″, $p = 0.041$) and the small one (75.2″). Lowest for the dog-colouring activity (96.7″). Highest number of spoken comments with the AAI vs. observations without stimuli especially with the real dogs
(Mossello et al., 2011) Italy 8 weeks Alzheimer Day Care Centre	10, (40%) 79 (±6/69–85 years), 3 measurement AD: NINCDS-ADRDA; MMSE	3 Measurement: 2 weeks' pre-intervention; 3 weeks' control activity (CA) and 3 weeks' AAI for 100 min 3 times/week. SIB[b]; ADL; CMAI; NPI; CSDD[b]; OERS[b], ABMI; MoBOF[b]	Cognition was unchanged across the study	Declines in CSDD not significant	NPI unchanged across the study Declines in CMAI not significant NPI anxiety item decreased in AAI comparison to CA (AAI: 1.5 ± 2.7/CA: 3.1 ± 2.3; $p = 0.04$)	OERS "sadness" decreased ($p = 0.002$); "pleasure" ($p = 0.016$), "general alertness" ($p = 0.003$) increased during AAI vs. CA. Observed sadness remained lower after 3 h ($p = 0.002$). Motor activity increased significantly during AAI

[a] BDRS: Bourke Dementia Rating Scale (Haycox, 1984); BP: blood pressure; HR: heart rate; SCUs: Special Care Units; BDBRS: Bourke dementia Behavioural Rating Scale (Haycox, 1984); ABMI: Agitated Behaviours Mapping Instrument (Cohen-Mansfield, 1996); n.r.: not reported; FAST: Functional Assessment Tool for Alzheimer's Type Dementia (Reisberg et al., 1985); MIU: Meaningful Information Units.

[b] NHBPS: Nursing Home Behaviour Problem Scale (Ray et al., 1992); CMAI: Cohen-Mansfield Agitation Inventory (Cohen-Mansfield, 1996); NINCDS-ADRDA: National Institute of Neurological and Communicative Disorders and Stroke-Alzheimer's Disease and Related Disorders Association (Mc Khann et al., 1984); NINCDS-AIREN: National Institute of Neurological Disorders and Stroke and Association International pour la Recherché et l'Enseignement en Neurosciences (Romàn et al., 1993); Apathy Scale, Irritability Scale (Burns et al., 1990); GDS: Geriatric depression scale (Yesavage et al., 1982–1983); PSMS: Physical self-maintenance Scale (Lawton and Brody, 1969); SBOC: Social Behaviour Observation Checklist (Kongable et al., 1989); GBSS-J 14: Gottfries–Brâne–Steen-Score (Gottfries et al., 1982), Japanese Version (Homma et al., 1991); MENFIS: Mental Function Impairment Scale (Homma et al., 1991); OME: Observational Measurement of Engagement (Cohen-Mansfield et al., 2009); SIB: Severe Impairment Battery (Saxton et al., 1990); NPI: Neuropsychiatric Inventory (Cummings et al., 1994); CSDD: Cornell Scale for Depression in Dementia (Alexopoulos et al., 1988); OERS: Observed Emotion Rating Scale (Lawton et al., 1996); MoBOF: Motor Behaviour Observation Form (Mossello et al., 2011).

Table 3
Effects of robot pet substitute among demented subjects: repeated measures design.

(Author, year) Country Study duration Setting	*N*, (Women%), mean age (±SD/range), *N* measurement diagnosis: criteria (if reported)	Method measurement	Results			
			Cognitive function	Depressive symptoms	BPSD	Other effects
(Kanamori et al., 2002) Japan 20 session activities Out patients	3 (women 66%), (68–84 years), 2 measurements Different chronic conditions	Comparison between 1st and 20th sessions with pet-type robot. SI[a], AOK [a], SF-36 survey[a], CgA	–	SI: statistically improved. AOK: 3.33 (1st), 1.00 (20th). *p*-value n.r. CgA: statistically decrease	–	Speech emotional words: statistically improved. SF-36 survey statistically higher (20th vs.1st)
(Libin and Cohen-Mansfield, 2004), USA Observation during intervention Nursing home	9 women, (83–98 years) 2 measurements Moderate-severe dementia: GDS (1–7) of 5.4	Benefits of a robotic cat vs. a plush toy cat. ABMI, LMBS[a] pleasure, interest, sadness, anxiety and anger; engagement (duration, attitude, attention, intensity)	Robotic cat: cognitive function related to duration of engagement ($p = 0.05$). Plush cat: cognitive function related to intensity of manipulation ($p = 0.03$) attention to stimulus ($p = 0.05$)	Robotic cat: increase in pleasure and interest ($p = 0.007$ and $p = 0.028$). Plush cat: no increase ($p = 0.111$ and $p = 0.052$)	Plush cats: lower agitation ($p = 0.036$ physical, $p = 0.046$ overall). Robotic cat: no effect on agitation ($p = 0.078$ overall)	–
(Tamura et al., 2004), Japan Less than 1 week Nursing home	13 (92%women), 84 years, 2 measurements Severe dementia: mean GBS[b] = 66 ± 21.8	4 groups of 3 participants with AIBO[b] and battery toy dog. M1:4 days, first toy dog, then AIBO. M2: 3 days, AIBO, in plush clothes on day 2. Reactions to AIBO and toy	–	–	–	M1: 985 vs. 608 reaction toy vs. AIBO. M2: no effect if AIBO in plush clothes. Most interest on first day. Increased communication patients-AIBO but higher for toy dog
(Wada et al., 2004) Japan Sixth week Day service centre	23 (women 100%), (73–93 years), 2 measurements 8 participants affected by dementia: HDS-R[b]	Paro[b] was given to elderly participants three days/week for five weeks (20 min each) Face scale[b], POMS[b]	–	Face scale before interaction: from 5.3 to 3.0. After interaction: 3.0 for 5 weeks. After removal Paro: higher than the score after interaction. POMS changes in the 2nd, 3rd, 4th, and 5th weeks ($p < 0.05$). The 6th week score (Paro withheld) lower than the post-interaction scores	–	17-KS-S[b] values and ratios of 17-KS-S/17-OHCS[b] increased after introduction of Paro. Robot Assisted Intervention improved the patients' ability to recover from stress
(Wada et al., 2005) One year Health service facility for the aged	12 (women 100%), (77–98 years), 2 measurements, dementia (HDS-R)	Two days per week for durations of approx. 1 h each Face scale GDS before and after the intervention	–	Face scale: statistically significant difference (Wilcoxon's test: $p < 0.05$); non significant results at the GDS	–	–

[a] SI: Satisfaction Index (Burch, 2000); AOK loneliness scale (Ando et al., 2000); SF-36: Japanese version of MOSES 36-Item (Fukuhara et al., 1998); LMBS: Lawton's Modified Behaviours Stream (Lawton et al., 1996).
[b] GBS: Gottfries–Brâne–Steen score (Gottfries et al., 1982); AIBO: dog robot; HDR-S: Hasegawa's dementia scale (Imai and Hasegawa, 1994); Paro: Dog robot (Shibata et al., 2001); Face Scale (Lorish and Maisiak, 1986); POMS: Profile of Mood States (McNair et al., 1992); 17-KS-S: 17-Ketosteroid sulfates values; 17-KS-S/17-OHCS (17-hydroxycorticosteroids) ratios.

Brighton Clinic Adaptive Behaviour Scale (BCABS) (Wood and Britton, 1985) after 12-weeks. Notably, these researchers observed a reduction in blood pressure and heart rate ($p = 0.021$) and lower patient noise levels during dog visits, due to a decrease in loud or aggressive outbursts ($p = 0.001$).

One study (Kanamori et al., 2001) observed the impact of intervention with either a dog or a cat, on 7 participants: 5 with Alzheimer Disease (AD) and 2 with Vascular Dementia (VD). AAI were conducted for a total of six bi-weekly sessions. The control group consisted of 20 elderly participants (7 AD, 13 VD). A significant decrease in specific subscales measuring aggressiveness ($p = 0.045$), anxieties ($p = 0.004$), and care giving burden ($p = 0.047$) was observed.

Lastly, the study by Zisselman et al. (1996) found that 58 demented inpatients of a Psychiatry Unit receiving a pet intervention tended to have less irritable post-treatment behaviour than shown by the control group. A non-specificity of effect, however, was observed in women with Dementia receiving either AAI or exercise intervention: both groups showed improved irritable behaviour post-intervention scores.

Two out of six studies (Churchill et al., 1999; McCabe et al., 2002; Richeson, 2003; Libin and Cohen-Mansfield, 2004; Naoyasu et al., 2004; Sellers, 2005; Mossello et al., 2011) using a repeated measures design to evaluate pre and post AAI changes, did not report either data or statistical measures.

The studies by McCabe et al. (2002) and Richeson (2003) conducted with 22 and 15 participants, respectively, showed a statistically significant improvement on BPSD after the intervention. Conversely, Naoyasu et al. (2004) found no significant irritability scale differences for 8 out of 27 patients. In the study by Mossello et al. (2011) ten patients of an Alzheimer Day Care Centre aged 69–85 years participated in a repeated measures study which included: two weeks' pre-intervention, three weeks' control activity with plush dogs (CA), and three weeks' AAI. The author assessed, at baseline and after each period, cognitive function using the Severe Impairment Battery (SIB) (Saxton et al., 1990), mood with the Cornell Scale for Depression in Dementia (CSDD) (Alexopoulos et al., 1988), BPSD with the Neuropsychiatric Inventory (NPI) (Cummings et al., 1994) and agitation with the Cohen-Mansfield Agitation Inventory (CMAI) (Cohen-Mansfield, 1996). Observed Emotion Rating Scale (OERS) (Lawton et al., 1996) for emotional status and a checklist for motor activity were completed across the study periods, both during intervention sessions and after 3 h. The author found a positive and significant results in anxiety (NPI items) in AAI comparison to CA (AAI: 1.5 ± 2.7/CA: 3.1 ± 2.3; $p = 0.04$), while the decline in CMAI was not significant.

3.1.2. Effects of AAI on depressive symptoms among patients with dementia

Six studies (Kanamori et al., 2002; Libin and Cohen-Mansfield, 2004; Naoyasu et al., 2004; Moretti et al., 2010; Mossello et al., 2011) evaluated the efficacy of AAI on depressive symptoms.

In Moretti et al.'s study (2010), the 15-item Geriatric Depression Scale (GDS) (Sheikh and Yesavage, 1986) were administrated before and after AAI. GDS improvement was observed in both the pet- and control groups. The between-group comparison showed a tendency towards a positive AAI effect ($p = 0.070$), and the within-group comparison showed a significant reduction in depressive symptoms ($p = 0.013$). Conversely Naoyasu et al. (2004) failed to demonstrate significant changes in the GDS before (12.5 ± 7.8) and after (13.4 ± 3.8) AAI, but observed a significant reduction pre/post-intervention in apathy scale (19.4 ± 3.7/14.0 ± 3.5; $p < 0.05$).

Kawamura et al. (2007) evaluated the effect of a dog on 10 demented residents over a 12-month period and observed a decrease in emotional liability ($p = 0.046$) in the first 6 months. During the same period, emotional functions also improved although they decreased during the final 6 months of the study. Mosello et al. (2011) also found no significant results at CSDD.

3.1.3. Effects of AAI on cognitive functions among patients with dementia

A total of seven studies (Zisselman et al., 1996; Kanamori et al., 2001; Kanamori et al., 2002; Libin and Cohen-Mansfield, 2004; Naoyasu et al., 2004; Moretti et al., 2010; Mossello et al., 2011) investigated the effect of AAI on the cognitive functions of participants with Dementia, but reported inconclusive results.

Zisselman et al. (1996) used the Multidimensional Observation Scale for Elderly Subjects (MOSES) (Helmes et al., 1987) to evaluate cases and controls before and after AAI (1 week of interventions), but found no significant pre/past AAI score differences, either between or within groups.

Four studies used a simple screening test such as the MMSE (Mini Mental State Examination) to evaluate cognitive functions: Kanamori et al. (2001) showed a non-significant increase in MMSE (and Activities of Daily Living, ADL) before and after AAI. Moretti et al. (2010) found an improvement in both the pet and control groups with marginally significant between group differences ($p = 0.060$) whereas the studies by Naoyasu et al. (2004) and Mosello et al. (2011) did not yield this type of difference.

The study by Kawamura et al. (2007) showed improvement in spatial orientation, concentration, and abstract thinking, together with a decrease in wakefulness ($p < 0.05$). Motivational functions, however, increased during the first 6 months and decreased during the last 6 months.

3.2. Animal assisted interventions with robots used as a substitute pet

Robot therapy is based on a new form of pet application and is currently attracting the attention of many researchers and psychologists. Artificial animals (i.e., robotic pets) can at times serve as a better alternative, due to insufficient resources available to care for a real pet, allergic responses to pets, hygiene reasons, or other to difficulties (Jofre, 2005). The preliminary study on dog robot used in the treatment of BPSD paves the way to interesting perspectives on the potential of robots as a non pharmacological therapeutic aid in dementia care (Marti et al., 2006).

The studies described in Table 3 yielded encouraging results for substitute pet robot use. Kanamori et al. (2002) reported 3 cases of elderly people with different chronic diseases who were administered 20 sessions of activity with a pet-type robot. Loneliness, as measured by specific scales, decreased from the first session to the 20th session (p value not reported), and role function and satisfaction improved after treatment. Furthermore, salivary cromogranine A, a measure of stress, decreased significantly.

Wada et al. (2004) evaluated 23 women, aged 73–93 years, 8 of whom were affected by dementia (Hasegawa's dementia scale; HDS-R). A Pet robot named "Paro" was given to the elderly people three days per week for five weeks, for approximately 20 min. Face scale scores were used to assess mood state before, during, and after AAI. After the interaction with the Pet robot, the participants' mood improved, and the progress lasted for five weeks post AAI, but failed on the 6th week. Changes on the Profile of Mood States (POMS) (McNair et al., 1992) were observed in the second, third, fourth, and fifth weeks ($p < 0.05$). Moreover, the sixth week score, when Paro application was withheld, was lower than the post-interaction scores. The participants' 17-Ketosteroid Sulfates (17-KS-S) values and the ratio 17-KS-S/17-OHCS (17-hydroxycorticosteroids)

increased after introduction of the pet substitute. The authors therefore consider that robot-assisted activity improved the elderly patients' ability to recover from stress.

In another study, the same researchers observed positive results with 12 elderly women affected by dementia (HDS-R). A statistically significant difference (Wilcoxon's test: $p < 0.05$) was observed for the Face scale, whereas non significant results were found for the GDS (Wada et al., 2005).

The study by Libin and Cohen-Mansfield (2004) compared the benefits of 10-min sessions with either a robotic or plush cat among nine persons with age-related cognitive decline and AD.

The authors used specific scales to demonstrate a lower level of agitation ($p = 0.036$ physical, $p = 0.046$ overall) with the plush cats only. Conversely, interaction with the robot increased patient pleasure and interest ($p = 0.007$ and $p = 0.028$), but these measures were no longer significant once the plush cat was employed ($p = 0.111$ and $p = 0.052$). Furthermore, people with higher cognitive functioning tended to spend more time with the robotic cat ($p = 0.05$) and tended to manipulate the plush cat more intensely ($p = 0.03$).

Severely demented elderly people living in a geriatric home were entertained with a pet robot or alternatively, with a battery powered toy dog. Patients' reactions were closely observed and frequency-counted. An increase in patient-pet robot communication was observed, although a higher effect was measured for the toy dog (Tamura et al., 2004).

Lastly, Wada et al.'s (2004) preliminary experiments showed the high potential of robot therapy to improve brain activity in patients suffering from dementia.

3.3. Animal assisted interventions in elderly with psychiatric diseases

Our review found that only 5 studies actually examined older people with Psychiatric Diseases and that 4 of these were case–control studies (Walsh et al., 1995; Zisselman et al., 1996; Barak et al., 2001; Moretti et al., 2010) (Table 4); the other was a repeated measures design study (Hall and Malpus, 2000) (Table 5).

3.3.1. Effects of AAI on behaviour among persons with different psychiatric diseases

AAI effects on behaviour were investigated in 3 studies (Walsh et al., 1995; Zisselman et al., 1996; Barak et al., 2001). Walsh et al. (1995) which found no LPRS or BCABS differences before and after AAI, and Zisselman et al. (1996) who observed a tendency towards less irritable behaviour after AAI (but also after exercise).

Barak et al.'s study (2001) compared the effect of weekly AAI sessions administered to ten elderly schizophrenic patients and ten matched controls. Social adaptive functioning improved significantly in the AAI group, as compared to the control group over 6 months and was maintained until the end of the study.

3.3.2. Effects of AAI on mood among person with different psychiatric diseases

Moretti et al. (2010) demonstrated a GDS score improvement before and after AAI (see Table 4) in a study examining an elderly sample including 11 participants affected by Psychiatric Diseases.

3.3.3. Effects of AAI on the cognitive functioning of persons with different psychiatric diseases

Three case–control studies (Zisselman et al., 1996; Barak et al., 2001; Moretti et al., 2010) investigated cognitive functioning. Moretti et al. (2010), showed a tendency towards improvement in mean MMSE scores, which was twofold higher in the pet-group than in the control group. The other two studies (Zisselman et al., 1996; Barak et al., 2001) conversely found no post AAI differences (see Table 4).

3.4. Other effects

Other AAI effects deserve a comment. The RCT by Edwards and Beck (2002) investigating the nutritional status of participants undergoing AAI (fish aquariums) found an increase in nutritional intake over 6-weeks and in body-weight ($p < 0.01$) over 16-weeks. This finding was replicated by a longitudinal study (Kawamura et al., 2007) demonstrating a facilitating AAI effect on eating behaviours during the 12-month follow up period ($p = 0.038$).

Social interactions increased positively in five studies (Walsh et al., 1995; Batson et al., 1998; Barak et al., 2001; Greer et al., 2001; Richeson, 2003). At the OERS, Mossello et al. (2011) found a decrease in "sadness" ($p = 0.002$) and an increase in "pleasure" ($p = 0.016$) and "general alertness" ($p = 0.003$) during AAI compared with CA. Finally motor activity increased significantly during AAI.

An Italian study demonstrated a positive, although not statistically significant, effect on self-perceived quality of life in 5 out of 9 participants in the pet group and in 2 out of 11 in the control group (Moretti et al., 2010). Nine out of ten persons reported that the animals had a calming effect. Moreover, Kanamori et al. (2002), showed a reduction in one stress measure (salivary cromogranine A) in the AAI group, as compared to controls.

Participant perception of AAI was investigated in two studies only. In the study by Barker et al. (2003), 71% of the participants claimed they would have like to participate in another AAI session. In the study by Moretti et al. (2010) AAI, estimated by a satisfaction questionnaire, were reported to be enjoyable and interesting. All participants recommended the same experience for other elderly people, and 80% of them would have liked to continue the pet experience.

4. Discussion

Most of the studies examined found AAI to be effective on patients with Dementia, although evidence supporting the use of AAI in elderly affected by Psychiatric Disorders was less clear.

With regards to patients with Dementia seven of the ten studies investigating the effects of AAI on BPSD demonstrated favourable results. AAI effects on Mood Disorders were investigated by six studies, four of which showed positive results. Null AAI cognition effects were observed. Positive results on other outcomes were found in 12 out of 13 studies.

The studies examining patients with mental illness yielded contrasting results, especially research examining mood and behaviour. Conversely, all studies considering quality and/or degree of social interaction as outcomes showed positive AAI effects. In psychiatric patients, as well as in patients with Dementia, AAI showed many valuable "other effects".

One limit to the present review, however, pertains to the large differences in study design of the selected papers, type of intervention, and duration, which made comparison between studies particularly difficult.

In some studies, AAI sessions were very well structured, whereas other studies presented poorly organized frameworks for patient–animal contact. Generally, AAI sessions heterogeneity pertained to the variables of duration, session frequency, type of activities, and type and number of animals used.

The fact that the assessment scales and matching procedures used also differed, presented a further source of bias (Zisselman et al., 1996; Kanamori et al., 2001; McCabe et al., 2002; Richeson, 2003; Libin and Cohen-Mansfield, 2004). Another complication in the results comparison was due to researchers subjectively

Table 4
Effects of AAI on persons with psychiatric disease: case/control studies.

(Author, year) Country Length of studies Setting	*N*, (Women%), mean age (±SD/range), *N* measurement Diagnosis: criteria (if reported)	Method measurement	Results			
			Cognitive function	Depressive symptoms	Behaviour	Other effects
(Walsh et al., 1995) Australia 12 weeks Psychiatric hospital	7 (women 40%), 7 Case/7 control. 6 dementia, 1 schizophrenia	LPRS[a], BCABS[a] before and after 12-weeks. Dog visit for 3 h twice per week. Blood pressure, heart rate and noise measured	–	–	No difference in LPRS[a] or on BCABS[a] were found after the 12-week experimental period	Lower noise level, more social interactions (not long-lasting): decrease in aggressive outbursts ($p = 0.001$)
(Zisselman et al., 1996) USA 1 week Wills Eye Hospital Geriatric Psychiatry Unit	58 divided in Case/control, blind. Different psychiatric disease included dementia	AAI group vs. exercise control group for 1 h a day for 5 consecutive days. MOSES[a] before and after	No significant differences in MOSES[a] scores, between or within groups	–	Pet-Therapy group showed tendency towards less irritable behaviour after treatment	–
(Barak et al., 2001) Israel 48 weeks Mental Health Centre	20 (women 70%), 79.1 (±6.7years) 10 Case/10 control, Schizophrenia: DSM-IV according with SCID-Hebrew Version[a]	AAI in weekly 4-h sessions. Control group read/discussed. SAFE[a] (impulse control, instrumental and self-care, social-function): baseline, after 24 weeks, until the end (48 weeks)	SAFE total score significant improve in AAI vs. control; already at 24 weeks ($p < 0.003$) and until the end ($p < 0.001$). Instrumental and self-care improved in both groups (not significant)	–	Impulse control does not change in either group	Social functioning improved in AAI group ($p < 0.001$)
(Moretti et al., 2010) Italy Six weeks Nursing home	21, (95.2%), 84.7 (±9.9 years), 9 case/11 control Dementia (47.6%), psychotic disorders (33.3%), depression (19.0%): ICD-10	AAI for 90 min, once a week for 6 weeks. Control group was not allowed to interact with dogs. At time 0, MMSE, 15 items-GDS, quality-of-life questionnaire to all participants, than after intervention. Satisfaction questionnaire to pet group	MMSE improvement from Time 0 to Time 1 in case (mean increase 4.5 scores, $p = 0.06$). MMSE control-group scores increased by two points ($p = 0.0941$)	GDS improvement for both groups. Pet group decreased from 5.9 ± 4.7 to 2.7 ± 3.1 (within group comparison: $p = 0.013$; the between group comparison showed improvement tendency ($p = 0.070$)	–	Positive effect on self-perceived quality of life in 5 pet group participants and 2 control group participants

[a] LPRS: London Psycho-Geriatric Rating Scale (Hersch et al., 1978); BCABS: Brighton Clinic Adaptive Behaviour Scale (Wood and Britton, 1985); MOSES: the Multidimensional Observation Scale for Elderly Subjects (Helmes et al., 1987); SCID-Hebrew Version: Structured Clinical Interview for schizophrenia Hebrew Version (Hadassa University team, 1995); SAFE: Social Adaptive Functioning evaluation (Harvey et al., 1997).

Table 5
Effects of AAI on persons with psychiatric disease: repeated measures design.

(Author, year) Country Length of studies Setting	*N*, (Women%), mean age (±SD/range), *N* measurement Diagnosis: criteria (if reported)	Method measurement	Results			
			Cognitive function	Depressive symptoms	Behaviour	Other effects
(Hall and Malpus, 2000) 20 weeks Nursing home	5 (women 100%), over 65 years. 4 measurements, no blind Psychiatric patients institutionalized for over 40 years, diagnosis not reported	A: 2 sessions with the observer at weekly intervals. B: dog owner present for further 2 weeks. C: dog introduced for 14 weeks. D: dog and handler removed. Verbal and non-verbal social behaviours	Increase in verbal and non-verbal social behaviour during dog visit. Small increase with introduction of the dog handler, which was markedly greater during the dog visit phase	–	–	–

evaluating participants' quality and frequency of social interaction (Hall and Malpus, 2000).

An important issue is whether AAI effects persist and, if so, to what extent. For example, Richeson (2003) found that the positive effect on agitated behaviour disappeared after discontinuation of AAI. Walsh et al. (1995) noted that the observed increase in frequency and quality of social interaction did not remain over time. Three studies showed longer-term effects (Kanamori et al., 2001; Kanamori et al., 2002; McCabe et al., 2002), although the degree to which they persisted beyond the study duration is not clear.

Barker et al. (2003) evaluated the immediate effects of AAI. Hall and Malpus (2000) and Barak et al. (2001) conducted longer-term AAI (14 weeks and 12 months respectively). In particular, Hall and Malpus (2000) noticed that, after approximately six visits, the residents became more familiar with the dog and showed a greater number of responses, especially in terms of non-verbal behaviour (smiling, touching). Barak et al. (2001) found that improvement was already significant after 6 months and persisted until the end of the study.

In agreement with Filan and Llewellyn-Jones's review (2006), we also conclude that the duration of AAI impact is unclear, and the most cost-effective duration and optimal AAI sessions frequency remain to be established.

The studies based on robot substitutes yielded positive results. These studies suggest the possibility of using robot substitutes for patients with Dementia, but further studies are required to better define the technique. Shibata et al. (2001) suggest that robot therapy has the same effects on people as animal therapy and are currently conducting an experiment in a dementia care centre in Denmark. Preliminary results obtained from the 7-month clinical trial showed positive effects on elderly patients' mental health, but a larger patient sample and control group were necessary to scientifically verify the study's effects.

It must be noted that any positive AAI effects observed can be confounded by several factors. Firstly, quality and frequency of interactions with the human therapist may modulate the effects of AAI (Churchill et al., 1999; Hall and Malpus, 2000). Secondly, frequency, quality, and duration of interaction can be influenced by staff reaction to the dog (Perkins et al., 2008). Unfortunately, only one study specified information about previous positive patient interaction with animals (Barker et al., 2003). Lastly, the presentation of both live and toy cats can be a confounding factor (Greer et al., 2001), and only one study had randomized the order of presentation.

The studies were frequently limited by small sample size (Kanamori et al., 2001; Tribet et al., 2008) which can, of course, reduce statistical power for detecting statistically significant associations. In addition to sample size, lack of homogeneity in the study samples also confounded the results.

Despite the above described difficulties in comparing AAI procedures (in terms of duration, frequency of intervention, assessment scales, sample size and homogeneity, and duration), the following positive influences emerged in studies carried out among demented patients: calming of agitated behaviour and positive effects on quality of social interaction and mood disturbances, although no effect was observed for cognitive performance.

The potential of AAI on social interaction was also evident among psychiatric patients, whereas the role of AAI on behaviour and mood warrants further investigation, as the current evidence is insufficient and contradictory. Hence, the issues of optimal AAI duration and frequency and what the most suitable target group might be, will require future research.

Contributors

V. Bernabei conceptualized this analysis and wrote the paper; A.R. Atti, F. Moretti and D. DeRonchi assisted with conceptualization of the work and writing the paper; and B. Ferrari, M. Forlani, T. La Ferla and L. Tonelli assisted with writing the paper.

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