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

V. Bernabei\textsuperscript{a,b,1}, D. De Ronchi\textsuperscript{a,1}, T. La Ferla\textsuperscript{b}, F. Moretti\textsuperscript{a,1}, L. Tonelli\textsuperscript{a,b,1}, B. Ferrari\textsuperscript{a,1}, M. Forlani\textsuperscript{a,1}, A.R. Atti\textsuperscript{a,1}

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

\textsuperscript{1}Corresponding author. Tel.: +39 328 8123650.
E-mail addresses: virginia.bernabei@studio.unibo.it (V. Bernabei), diana.deronchi@unibo.it (D. De Ronchi), teresa.laferla@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).

\section{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 behaviors 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-directed therapy (ATT), 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 to dog assisted therapy (AADT) compared to sham AADT, indicating a possible effect of animal intervention on depressive symptoms (Stasi et al., 2004). In the present review, we will focus on AAI studies involving dogs and other domesticated animals. The few studies conducted for elderly patients presenting a variety of psychiatric diagnoses produced controversial findings.

The purpose of this literature review was to assess the effects of Animal-Assisted Interventions (AAI) on elderly patients with dementia or various psychiatric disorders.

\section*{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.

\section*{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.

© 2013 Elsevier Ltd. All rights reserved.

\textit{Article info}

Article history:
Received 30 May 2012
Received in revised form 6 December 2012
Accepted 27 December 2012

Keywords:
Pet therapy
Animal assisted interventions
Elderly
Dementia
Alzheimer disease
Mental health
Psychiatry
Rehabilitation

\textit{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.

© 2013 Elsevier Ltd. All rights reserved.
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).

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; Naojasi et al., 2004; Tamura et al., 2004; Sellers, 2005; Kawamura et al., 2007; Moshell 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>
<thead>
<tr>
<th>(Author, year)</th>
<th>Country</th>
<th>Study duration</th>
<th>Setting</th>
<th>N, (women%), mean age (±SD)</th>
<th>Measurement diagnosis; criteria (if reported)</th>
<th>Method measurement</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Walsh et al., 1995)</td>
<td>Australia</td>
<td>12 weeks</td>
<td>Psychiatric hospital</td>
<td>7 (women 40%), 6 Case/7 control</td>
<td>7 dementia, 1 schizophrenia</td>
<td>LPRS(^a) and BCABS(^b) before and after 12-weeks. Dog visit for 3 h twice per week</td>
<td>No difference in LPRS or on BCABS were found after the 12-week experimental period</td>
</tr>
<tr>
<td>(Zisselman et al., 1996)</td>
<td>USA</td>
<td>1 week</td>
<td>Wills Eye Hospital</td>
<td>58 divided in case/control, blind. Different psychiatric disease included dementia</td>
<td></td>
<td>AAI and an exercise control group for 1 h a day for 5 days. MOSES(^a) before and after intervention</td>
<td>No significant differences in MOSES scores between or within groups</td>
</tr>
<tr>
<td>(Kanamori et al., 2001)</td>
<td>Japan</td>
<td>12 weeks</td>
<td>Psychiatric Hospital</td>
<td>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)</td>
<td></td>
<td>Six biweekly sessions AAI. Normal activities in the control group. MMSE, N-ADL(^a), Behave-AD(^a), CgA(^a)</td>
<td>No MMSE and N-ADL score differences before and after intervention</td>
</tr>
<tr>
<td>(Edwards and Beck, 2002)</td>
<td>USA</td>
<td>6 and 16 weeks</td>
<td>Nursing homes</td>
<td>65 (women 58%), 80.1 years, 45 Case/17 control AD</td>
<td></td>
<td>Treatment group had fish tank in dining area. Control had picture for two weeks; two weeks washout, then fish tank introduced to dining area</td>
<td>–</td>
</tr>
<tr>
<td>(Moretti et al., 2010)</td>
<td>Italy</td>
<td>6 weeks</td>
<td>Nursing home</td>
<td>21, (95.2%), 84.7 (±9.9 years), 9 case/11 control</td>
<td>Dementia (47.6%), psychotic disorders (33.3%), depression (19.0%); ICD-10</td>
<td>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</td>
<td>Mean improvement in MMSE (4.5 scores, p = 0.06 for cases; 2 scores, p = 0.0941 for controls)</td>
</tr>
</tbody>
</table>

\(^a\) 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.

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

(continued on next page)
<table>
<thead>
<tr>
<th>Author, year</th>
<th>Country</th>
<th>Study duration</th>
<th>Setting</th>
<th>N, (women%), mean age (±SD/range), N measurement diagnosis: criteria (if reported)</th>
<th>Method measurement</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marx et al., 2010</td>
<td>USA</td>
<td>Observation during 2 session activities</td>
<td>Two nursing homes</td>
<td>56 (women 79%), 87 (61–101 years), measurement in different conditions Dementia: DSM-IV, NINCDS-ADRDA</td>
<td>Assessed degree of engagement with dog-related stimuli (real dog, robotic dog, puppy video dog and dog-colouring activity) via OME; verbal responses</td>
<td>Cognitive function: Declines in CSDD not significant; Depressive symptoms: NPI unchanged across the study; BPSD: declines in CMAI not significant; Other effects: NPI anxiety item decreased in AAI comparison to CA (AAI: 1.5 ± 2.7/CA: 3.1 ± 2.3; p = 0.04); Motor activity increased significantly during AAI.</td>
</tr>
<tr>
<td>Mossello et al., 2011</td>
<td>Italy</td>
<td>8 weeks</td>
<td>Alzheimer Day Care Centre</td>
<td>10, (40%) 79 (±6/69–85 years), 3 measurement</td>
<td>3 Measurement: 2 weeks' pre-intervention; 3 weeks' control activity (CA) and 3 weeks' AAI for 100 min 3 times/week. SIB; ADL; CMAI; NPI; CDDP; OERS; ABMI; MoBOF³</td>
<td>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); Motor activity remained lower after 3 h (p = 0.002). 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.</td>
</tr>
</tbody>
</table>

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 Recherche et l’Enseignement en Neurosciences (Roman 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-14: Gottfries–Bräne–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.

<table>
<thead>
<tr>
<th>(Author, year)</th>
<th>Country</th>
<th>Study duration Setting</th>
<th>N, (Women%), mean age (±SD/range), N measurement diagnosis: criteria (if reported)</th>
<th>Method measurement</th>
<th>Results</th>
<th>Depressive symptoms</th>
<th>BPSD</th>
<th>Other effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Kanamori et al., 2002)</td>
<td>Japan</td>
<td>20 session activities Out patients</td>
<td>3 (women 66%), (68–84 years), 2 measurements</td>
<td>Comparison between 1st and 20th sessions with pet-type robot. SF⁴, AOK⁵, SF-36 survey⁴, CgA</td>
<td>SI: statistically improved. AOK: 3.33 (1st), 1.00 (20th). p-value n.r. CgA: statistically decrease</td>
<td></td>
<td></td>
<td>Speech emotional words: statistically improved, SF-36 survey statistically higher (20th vs. 1st)</td>
</tr>
<tr>
<td>(Libin and Cohen-Mansfield, 2004), USA</td>
<td>Observation during intervention Nursing home</td>
<td>9 women, (83–98 years), 2 measurements</td>
<td>Benefits of a robotic cat vs. a plush toy cat. ABMI, LMBS⁴ pleasure, interest, sadness, anxiety and anger; engagement (duration, attitude, attention, intensity)</td>
<td>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)</td>
<td>Robot cat: increase in pleasure and interest (p = 0.007 and p = 0.028). Plush cat: no increase (p = 0.111 and p = 0.052)</td>
<td></td>
<td></td>
<td>Plush cats: lower agitation (p = 0.036 physical, p = 0.046 overall). Robot cat: no effect on agitation (p = 0.078 overall)</td>
</tr>
<tr>
<td>(Tamura et al., 2004), Japan</td>
<td>Less than 1 week Nursing home</td>
<td>13 (92%women), 84 years, 2 measurements</td>
<td>4 groups of 3 participants with AIBO⁵ 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 dog. Paro was given to elderly participants three days/week for five weeks (20 min each)</td>
<td>Face scale⁶, POMS⁶</td>
<td></td>
<td></td>
<td></td>
<td>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</td>
</tr>
<tr>
<td>(Wada et al., 2004), Japan</td>
<td>Sixth week Day service centre</td>
<td>23 (women 100%), (73–93 years), 2 measurements</td>
<td>Paro was given to elderly participants three days/week for five weeks (20 min each)</td>
<td>Face scale⁶, POMS⁶</td>
<td>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 &lt; 0.05). The 6th week score (Paro withheld) lower than the post-interaction scores</td>
<td></td>
<td></td>
<td>17-KS-S² values and ratios of 17-KS-S/17-OHCS³ increased after introduction of Paro. Robot Assisted Intervention improved the patients’ ability to recover from stress</td>
</tr>
<tr>
<td>(Wada et al., 2005) One year</td>
<td>Health service facility for the aged</td>
<td>12 (women 100%), (77–98 years), 2 measurements, dementia (HDS-R)</td>
<td>Two days per week for durations of approx. 1 h each</td>
<td>Face scale before and after intervention</td>
<td>Face scale: statistically significant difference (Wilcoxon’s test: p &lt; 0.05); non significant results at the GDS</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

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–Bråne–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; Moretti 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), and agitation with the Cohen-Mansfield Agitation Inventory (CMAI) (Cohen-Mansfield, 1996), Observed Emotion Rating Scale (BERS) (Lawton et al., 1996) for emotional status and a checklist for motor activity were included: two weeks’ pre-intervention, three weeks 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 ± 7.8) AAI, but observed a significant reduction pre/post-intervention in apathy scale (19.4 ± 7.7/14.0 ± 5.3; $p < 0.05$).

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 (Activities of Daily Living, ADL) before and after AAI. Moretti et al. (2010) found an improvement in both the pet and control group 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. Participants’ 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.

<table>
<thead>
<tr>
<th>(Author, year)</th>
<th>Country</th>
<th>Length of studies</th>
<th>Setting</th>
<th>N (Women%), mean age (±SD)/range</th>
<th>Diagnosis: criteria (if reported)</th>
<th>Method measurement</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Walsh et al., 1995)</td>
<td>Australia</td>
<td>12 weeks</td>
<td>Psychiatric hospital</td>
<td>7 (women 40%), 7 Case/7 control, 6 dementia, 1 schizophrenia</td>
<td>N measurement</td>
<td>LPRS(^a), BCABS(^a) before and after 12-weeks. Dog visit for 3 h twice per week. Blood pressure, heart rate and noise measured</td>
<td>Cognitive function – Depressive symptoms – Behaviour – Other effects</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>No difference in LPRS(^a) or on BCABS(^a) were found after the 12-week experimental period</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lower noise level, more social interactions (not long-lasting): decrease in aggressive outbursts (p = 0.001)</td>
</tr>
<tr>
<td>(Zisselman et al., 1996)</td>
<td>USA</td>
<td>1 week</td>
<td>Wills Eye Hospital Geriatric Psychiatry Unit</td>
<td>58 divided in Case/control, blind. Different psychiatric disease included dementia</td>
<td></td>
<td>AAI group vs. exercise control group for 1 h a day for 5 consecutive days. MOSES(^a) before and after</td>
<td>Cognitive function – Depressive symptoms – Behaviour – Other effects</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>No significant differences in MOSES(^a) scores, between or within groups</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Pet-Therapy group showed tendency towards less irritable behaviour after treatment</td>
</tr>
<tr>
<td>(Barak et al., 2001)</td>
<td>Israel</td>
<td>48 weeks</td>
<td>Mental Health Centre</td>
<td>20 (women 70%), 79.1 (±6.7 years), 10 Case/10 control, Schizophrenia: DSM-IV according with SCID-Hebrew Version(^a)</td>
<td></td>
<td>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)</td>
<td>Cognitive function – Depressive symptoms – Behaviour – Other effects</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SAFE total score significant improve in AAI vs. control; already at 24 weeks (p &lt; 0.003) and until the end (p &lt; 0.001). Instrumental and self-care improved in both groups (not significant)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Impulse control does not change in either group</td>
</tr>
<tr>
<td>(Moretti et al., 2010)</td>
<td>Italy</td>
<td>Six weeks</td>
<td>Nursing home</td>
<td>21, (95.2%), 84.7 (±9.9 years), 5 case/11 control. Dementia (47.6%), psychotic disorders (33.3%), depression (19.0%): ICD-10</td>
<td></td>
<td>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</td>
<td>Cognitive function – Depressive symptoms – Behaviour – Other effects</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>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)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>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)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Positive effect on self-perceived quality of life in 5 pet group participants and 2 control group participants</td>
</tr>
</tbody>
</table>

\(^a\) 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).
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 agitation 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 confusing 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.

**Funding source**

None.

**Conflict of interest**

None.

**Acknowledgement**

We are grateful to all colleagues of the Institute of psychiatry in Bologna “P. Ortonello”.

**References**


Wada K, Shibata T, Saito T, Tanie K. Effects of robot-assisted activity for elderly people and nurses at a day service center. Proceedings of the Institute of Electrical and Electronics Engineers 2004;92(11).