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ORIGINAL ARTICLE

# Therapeutic effects of dog visits in nursing homes for the elderly

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## Abstract

**Background:** Previous studies have suggested that visiting dogs can have positive effects on elderly people in nursing homes. We wanted to study the effects of biweekly dog visits on sleep patterns and the psychiatric well-being of elderly people.

**Methods:** A total of 100 residents (median age: 85.5 years; [79; 90]) from four nursing homes were randomly assigned to receive biweekly visits for 6 weeks from a person accompanied by either a dog, a robot seal (PARO), or a soft toy cat. Sleep patterns were measured using actigraphy technology before, during (the third and sixth week), and after the series of visits. The participants were weighed and scored on the Geriatric Depression Scale, the Gottfries-Bråne-Steen Scale, and the Mini-Mental State Examination before and after the visit period.

**Results:** We found that sleep duration (min) increased in the third week when visitors were accompanied by a dog rather than the robot seal or soft toy cat (dog: 610 ± 127 min; seal: 498 ± 146 min; cat: 540 ± 163 min; $F_{2,37} = 4.99$; $P = 0.01$). No effects were found in the sixth week or after the visit period had ended. We found that visit type had no effect on weight ($F_{2,88} = 0.13$; $P > 0.05$), body mass index ($F_{2,86} = 0.33$; $P > 0.05$), Geriatric Depression Scale ($F_{2,82} = 0.85$; $P > 0.05$), Gottfries-Bråne-Steen Scale ($F_{2,90} = 0.41$; $P > 0.05$), or Mini-Mental State Examination ($F_{2,91} = 0.35$; $P > 0.05$). Furthermore, we found a decrease in the Geriatric Depression Scale during the experimental period ($S = -420$; $P < 0.05$), whereas cognitive impairment worsened as shown by a decrease in Mini-Mental State Examination score ($S = -483$; $P < 0.05$) and an increase in the Gottfries-Bråne-Steen Scale ($t = 2.06$; $P < 0.05$).

**Conclusion:** Visit type did not affect the long-term mental state of the participants. The causal relationship between sleep duration and dog-accompanied visits remains to be explored.

## INTRODUCTION

It has become generally accepted and even standard practice in some countries to make animals available for interaction with the institutionalized elderly population. Animals are brought into nursing homes to create a homely atmosphere, for entertainment, as social catalysts, or for therapeutic purposes. One of the most common examples is dog visits offered by volunteers. A widely held view of staff, relatives, and the public is that dog visits in nursing homes are beneficial for the residents, but more documentation of potential effects is needed in order to target future initiatives and develop new and better interventions.

The nursing home population could be expected to benefit from this type of intervention as they are in risk of being isolated due to impaired cognitive abilities and reduced communicative skills. It has been suggested that social interaction with an animal, as compared to a human being, is easier for people with cognitive impairment, because the interaction is more direct and relies more on body language than verbal communication.[1] Furthermore, this form of contact is less demanding for the elderly compared to human contact. Finally, since this group of people is less likely to have physical contact with others, contact to a dog may potentially satisfy a need for tactile stimulation.

One way to evaluate the effects of dog visits in nursing homes is to assess the mental well-being of the residents by scoring them on psychiatric scales for, for example, depression and cognitive function. A decrease in depressive symptoms after visits with dogs has been demonstrated,[2,3] but the majority of studies have found that dog visits do not affect depressive symptoms after either group or individual session.[4–6]

To our knowledge, no studies have found that dog visits have significantly positive effects on cognitive performance in nursing home residents. However, Moretti *et al*. reported a strong positive tendency in a small study comparing demented nursing home residents, mainly women, who attended group sessions with dogs to a control group who did not attend the sessions.[7] Two other studies comparing group sessions with a dog or cat to a control group found no effects on impairment level.[5,8] Bernabei *et al*. reviewed the effects of animal-assisted therapy (AAT) in elderly patients and concluded that, at present, no results indicate that AAT affects cognitive performance.[9] Virues-Ortega *et al*. summed up the effects of AAT on the psychological status of nursing home residents in a meta-analysis and found ATT had only a small effect.[10] It may be somewhat overly optimistic to expect an effect on cognitive performance or dementia itself. However, even if AAT affects only dementia-associated complications such as anxiety, sleep disturbances, and lack of appetite, the implications would be important.

It has been shown that the circadian rhythm changes and sleep quality worsens with increasing age and increased cognitive impairment.[11–13] This may partly be due to deterioration of the suprachiasmatic nucleus in the hypothalamus, which is in charge of maintaining the circadian rhythm.[14] Sleep in older people has been found to be more fragmented and with a shorter duration of sleep periods compared to young people, and these changes are even more pronounced in persons suffering from cognitive impairment such as Alzheimer's disease.[15,16]

Sleep quality is an objective measure of well-being, but until now, sleep measures have not been used as an effect goal in studies on the effects of therapy animals. However, some studies have found that other non-pharmacological interventions positively affect circadian rhythm and sleep parameters.[17–19]

Another potential effect goal could be nutritional state. Beck and Damkjær found that a body mass index (BMI) above 29 was associated with a higher quality of life, despite the increased prevalence of obesity-related diseases.[20] A study of the nutritional state of elderly people (65+) found that more than half of the study population had a decreased nutritional state, measured as a BMI below 20.[21]

The pathways of effects of dog visits could be through reciprocal verbal and tactile interactions during the actual visit. Therefore, studying visits with different levels of animal feedback could be a way to disentangle possible causal pathways of an eventual effect of animal contact.

The aim of the present study was to measure the effects of biweekly visits from a person accompanied by a dog. The effects of dog visits were compared to similar visits by the same person bringing either a robot seal (PARO®, Intelligent Systems Co, Ltd., Toyama, Japan), with a limited capacity of giving feedback, or an immobile/motionless soft toy cat. We then measured the possible effects of these interventions on changes in weight/BMI, sleep quality, depression symptoms, and cognitive functioning level.

This study was part of a larger study of the acute and long-term effects of biweekly dog visits.

## METHODS

### Participants

A total of 124 nursing home residents from four nursing homes in Denmark were enrolled in the study. The four institutions have residents from a broad spectrum of the elderly population, but with a high prevalence of persons suffering from dementia at different stages. Written informed consent was obtained from all participants or their relatives. Participants could withdraw from the study at any point. The study was approved by the Scientific Ethical Committee of Denmark and the Danish Data Protection Agency. To ensure that the participants could receive dog-assisted visits after the end of the experimental period, we chose only nursing homes that were able to continue this practice subsequently.

Exclusion criteria were allergic reactions to or fear of dogs, but we saw neither. In two cases, the nursing homes had a section with a resident cat. Residents in these two sections were not included because of the different level of animal contact.

### Design

The design of the study was a randomized complete block design. Each nursing home was a block, and the participants were assigned randomly to one of three visit types after informed consent had been given.

### The interventions

Each visit involved an individual accompanying the 'animal' and an observer. The animal was either an animal, a robot seal, or a soft toy cat. The observer made direct observations of the residents' behavioural interactions and conversations with and about the animal during the visit. These behavioural data are presented elsewhere (Thodberg *et al.*, accepted for publication in *Anthrozoös*). For each participant, we scheduled 12 biweekly visits between 0900 and 1600, on either Mondays and Wednesdays or Tuesdays and Thursdays, for 6 weeks. The time of the visits was chosen to suit the daily rhythm of the individual participant, as some residents were more active in the morning and some in the afternoon. The residents met the same visitor, the same 'animal', and one of two observers during each visit. Each visitor and observer visited an equal number of residents with each 'animal'. In each nursing home there were a total of two visitors and two observers, and the observers followed each visitor an equal number of times. Each visitor visited approximately 15 residents in each nursing home.

We used two dogs per nursing home, one for each visitor. The visitor was not the owner of the dog, but part of the project staff. The dogs were approximately the same size and were retrievers or retriever mixes (one golden retriever, male, age: 5 years; two Labrador retrievers, one male, age: 3 years, one female, age: 8 years; one Labrador retriever/Siberian husky mix, male, age: 6 years). The dogs were not trained especially for this task. Three of them were approved by a Danish organization, TrygFonden Visitor Dogs (http://www.besoegshunde.dk), that certifies family dogs and their owners to work as volunteers with dog-assisted interventions in nursing homes. The last dog was not certified but fulfilled the same criteria of good health and appropriate behavioural reactions. All dog owners had liability insurance for their dog. The dogs were carefully looked after throughout the study, and no situations occurred in which the welfare of the dogs was at risk.

The robot seal, PARO® (http://www.parorobots.com/), is a so-called 'mental commitment robot' developed mainly for people suffering from dementia.[22] The seal is shaped like a baby harp seal with white synthetic fur and weighs 2.8 kg. The robot is interactive and responds to sound, touch, light, and being tilted by movement and vocalization. It can move its neck vertically and horizontally, paddle with its front and rear flippers, and blink its eyelids. The sounds emitted are squeal like.

The soft toy cat ('Billy the Cat', www.empathiepuppen.de/) is an 'empathy therapy puppet' developed for people with special needs. It has synthetic grey and white fur, weighs 0.95 kg, and is not interactive.

Each visit lasted 10 min. This visit duration was based partly on the procedures used in other studies and partly on pilot studies made before the onset of data collection. The pilot study suggested that 10 min was an appropriate duration for residents with severe cognitive impairment, as these persons were often unable to pay attention for much longer. We aimed at making each visit as pleasant as possible, and we adjusted the communication to the cognitive level of the resident. Regardless of the 'animal' the visitor brought, the visit followed a few guidelines in order to standardize the visits. The 'animals' had to be within reach of the resident for at least 80% of the time, unless the resident clearly showed no interest at all or disapproved of contact with the 'animal'. To make the dog available for touch, it stood or sat next to the resident. All dogs were on a lead. The robot seal and toy cat were held in the arms of the visitor, and if requested by the resident, it would be placed in his or her lap. During the first visit, the 'animal' was introduced to the resident, who was encouraged to make contact and interact with the 'animal' both verbally and by touching it. The initial conversation was related to animals in general, unless the resident wanted to talk about something else or changed the subject. The visitor positioned herself close by the resident, and the observer placed herself in the background to be able to view the situation. The observer remained in the background but joined the conversation when it felt natural.

## Measures

### *Psychiatric measures*

The participants were interviewed by a project nurse in the week before and after the visit period and scored on four psychiatric scales (all scored through interview and observation). We used the Mini-Mental State Examination (MMSE) to measure participants' cognitive state; the Gottfries-Bråne-Steen scale (GBS) to evaluate their disabilities, language, psychiatric symptoms, average daily living function, and behaviour;[23] the Geriatric Depression Scale (GDS) to screen for depressive symptoms;[24] and the Confusion Assessment Method (CAM) to assess possible symptoms of delirium.[25] The instruments chosen are validated for this population and cover relevant and important aspects and general issues.

If the participant was unable to answer specific questions of the psychiatric scales due to impairment of vision, hearing, or due to general reluctance, the questions were taken out of the total score, as the failure to reply did not reflect the mental state of the participant.

### *Sleep measures*

We collected sleep data overnight on four occasions: (i) one night in the week before the 6-week intervention period (before); (ii) one night in the third week (week 3); (iii) one night in the sixth week (week 6); and (iv) one night in the week after the intervention period (after). This enabled us to compare sleep measures before the intervention period with measures collected during and after the intervention period had ended. The nights chosen for data collection during the intervention period were on days when the resident had received a visit. Therefore, the sleep data were collected on the night after the 5th or the 6th visit and again on the night after the 11th or 12th visit. Three sleep parameters were measured: (i) actual sleep time (min); (ii) sleep efficiency (%), which was the estimated time spent sleeping relative to the time spent in bed; and (iii) a fragmentation index, which was an estimate of restlessness. We used accelerometers based on actigraphy technology (Actiwatch 4; CamNtech, Cambridge, UK). These are small devices worn on the wrist that measure and record physical movement and give an estimate of a range of sleep parameters. An epoch length of 1 min was chosen, and the data were analyzed by specially developed software (Sleep Analysis 5 version 5.32; CamNtech).

On days when sleep measurements were taken, participants wore the device on their non-dominant wrist. If this arm was paralysed, the other arm was used. The devices were attached by the nursing home staff between 1300 and 1700 and taken off before 1100 the following day. The following times were noted: (i) the time the device was attached; (ii) bedtime; (ii) the time when the resident got out of bed in the morning; and (iv) the time when the device was taken off. Five participants did not want to wear the device or repeatedly took it off, so they were excluded from this part of the data collection.

### *Weight and height (BMI) measures*

The nursing home staff measured the height and weight of the participants before and after the 6-week visit period, and based on this, participants' BMI were calculated. The participants were weighed with their clothes on. Those who were unable to use a bathroom scale were weighted in a lift scale.

### *Description of the population*

Basic information for each participant was given by the staff and included age, time lived in the nursing home, dementia diagnosis, and gender. Not all residents were diagnosed, even though they showed clear signs of having some form of dementia. Therefore, the MMSE and GBS scores do not always reflect the actual percentage of residents with a dementia diagnosis.

## Statistics

A significance level of 0.05 was used in all statistical analyses. The results are presented as means ± SD or as medians and interquartile range.

### *Effect of visit type*

The effect of visit type on sleep parameters was analyzed in a linear mixed model with sleep duration, sleep efficiency, and sleep fragmentation as response variables (SAS Institute, Cary, NC, USA). The three sleep variables, which were measured during week 3, week 6, and the week after visits stopped, were

**Table 1** Description of the study population ($n$ = 100)

| Nursing home | Age† (years) | Time lived in the nursing home (months) | Percentage with a dementia diagnosis | Percentage of women | Number of participants receiving each visit type (dog, robot, toy cat) |
|---|---|---|---|---|---|
| 1 ($n$ = 22) | 86.5 [83.0; 89.0] | 30.0 [13.0; 70.0] | 22.7 | 59.1 | 7, 8, 7 |
| 2 ($n$ = 23)‡ | 89.0 [80.0; 93.0] | 25.0 [6.0; 31.0] | 26.1 | 65.2 | 8, 9, 6 |
| 3 ($n$ = 27) | 84.0 [79.0; 90.0] | 21.0 [14.0; 36.0] | 37.0 | 77.8 | 10, 9, 8 |
| 4 ($n$ = 28) | 81.5 [67.5; 87.5] | 32.0 [11.5; 68.0] | 32.1 | 71.4 | 10, 9, 9 |
| Total ($N$ = 100) | 85.5 [79.0; 90.0] | 24.5 [12.5; 50.0] | 30.0 | 69.0 | 35, 35, 30 |

The age of participants and the time lived in the nursing home are given as medians with the interquartile range. †The nursing homes differed with regard to the age of the residents ($\chi^2$ = 10.1; degrees of freedom = 3; $P < 0.05$). ‡In nursing home 2, one resident dropped out before being allocated to a visit treatment.

compared with the variables measured in the week before the visits started. Fixed effects in the model were visit type and sex. Covariates were the response values, MMSE score, and GDS score in the week before the visits started, as well as age; the nursing home was entered as a random effect.

The effects of visit type on the psychiatric measures (GDS, MMSE, GBS), weight, and BMI were analyzed in a similar linear mixed model. Fixed effects were visit type and sex. Covariates were the response values from the week before the visits began. Age and MMSE score from before the visits were included in all models. For this analysis, the psychiatric scales were corrected for the participants' ability and reluctance to answer when the scales were scored.

### *Changes over time*

To test whether the parameters had changed during the experimental period, the differences between GBS scores, weight, and BMI from before and after were analyzed by Student's $t$-test. The differences in MMSE and GDS scores over time were tested using the non-parametric Wilcoxon signed-rank test for repeated measures, as the differences over time were not normally distributed.

Very few participants scored on the CAM scale, and these data were therefore excluded from analysis.

Differences in baseline measures between nursing homes were analyzed by the Kruskal–Wallis test.

The results are presented as means ± SD or as medians and interquartile range.

## RESULTS

Of the 124 enrolled participants, 23 dropped out during the experimental period. Table 1 shows demographic data and information about the 100 participants in the four nursing homes who completed the study. The residents who did not complete the study were equally distributed between the three visit types (dog: 8; robot seal: 8; toy cat: 7).

### Sleep

Participants in the dog visit group slept longer in week 3 ($F_{2,37}$ = 4.99; $P$ = 0.01) but this effect was not found at 6 weeks or after the visits stopped (Fig. 1). We found visit type did not affect sleep efficiency or sleep fragmentation. The mean values for sleep efficiency and sleep fragmentation are shown in Table 2.

### Psychiatric scales

We found that visit type did not affect any of the MMSE ($F_{2,91}$ = 0.35; $P > 0.05$), GBS ($F_{2,90}$ = 0.41; $P > 0.05$), or GDS ($F_{2,82}$ = 0.85; $P > 0.05$) recorded in the week after the last visits. The psychiatric measures, however, changed over the experimental period (Table 3). We found a decrease in the MMSE score ($S$ = –483; $P < 0.05$) and an increase in the GBS score ($t$ = 2.06; $P < 0.05$), indicating an overall worsening in participants' cognitive function. However, the GDS score decreased ($S$ = –420; $P < 0.05$), meaning that depressive symptoms decreased during the experimental period.

### Weight and BMI

We found no effect of visit type on weight ($F_{2,88}$ = 0,13; $P > 0.05$) or BMI ($F_{2,86}$ = 0.33; $P > 0.05$) (Table 3), and these measures did not change over the experimental period (weight: $t$ = –1,31, $P > 0.05$; BMI: $t$ = –1.10, $P > 0.05$).

## DISCUSSION

Visit type affected neither the psychiatric measures nor weight and BMI, and we found that the dog visits only had a transient effect on sleep duration in the first part of the 6-week visit period. However, during the

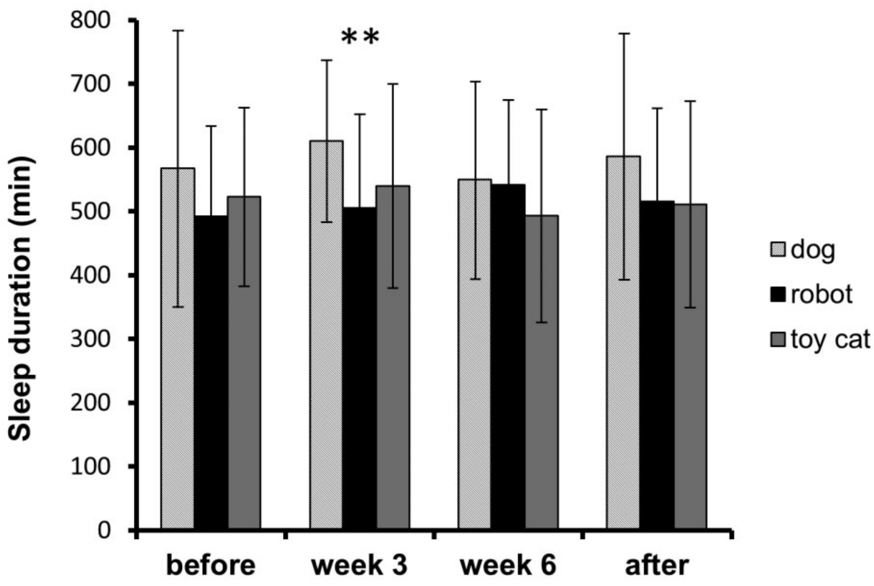


**Figure 1** Sleep duration (min) in residents receiving visits accompanied by either a dog, a robot, or a toy cat. In week 3, sleep duration was longer for residents receiving dog visits than for those receiving visits from a robot or a soft toy cat ($F_{2,37} = 4.99$; $P = 0.01$). The results are shown as means ± SD.

**Table 2** Mean values of the sleep measures

| | Sleep duration (min) | | | | Sleep efficiency (%) | | | | Sleep fragmentation (index) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Week | Before | 3 | 6 | after | Before | 3 | 6 | after | Before | 3 | 6 | After |
| Dog | 567 ± 207 | **610 ± 127** | 549 ± 155 | 586 ± 193 | 77 ± 19 | 81 ± 11 | 78 ± 15 | 79 ± 18 | 49 ± 30 | 57 ± 32 | 60 ± 30 | 52 ± 32 |
| Robot | 481 ± 148 | **498 ± 146** | 542 ± 133 | 516 ± 146 | 70 ± 15 | 73 ± 15 | 78 ± 11 | 75 ± 15 | 53 ± 20 | 58 ± 26 | 54 ± 22 | 63 ± 23 |
| Toy cat | 531 ± 146 | **540 ± 163** | 493 ± 167 | 511 ± 162 | 80 ± 12 | 80 ± 15 | 74 ± 20 | 74 ± 17 | 41 ± 26 | 54 ± 33 | 56 ± 30 | 56 ± 35 |
| Total | 527 ± 171 | 549 ± 151 | 532 ± 150 | 539 ± 169 | 76 ± 16 | 78 ± 14 | 77 ± 15 | 76 ± 17 | 48 ± 26 | 56 ± 30 | 57 ± 27 | 57 ± 30 |

Data are presented as means ± SD. In week 3, sleep duration (shown in bold) was longer for residents receiving dog visits than those receiving visits from a robot or a soft toy cat ($F_{2,37} = 4.99$; $P = 0.01$).

same period, the participants' condition deteriorated, as their cognitive impairment (based on the MMSE and GBS) worsened. The fact that the number of depressive symptoms (GDS score) decreased could be an unspecific effect of participating in the experiment.

We found that visit type did not have any effect on the development of depressive symptoms. A few other studies have looked at depression in relation to dog visits, but they had conflicting findings.[2,3,5–7] However, the size and methodology of these studies varies, which makes it difficult to compare the results. Two of the studies found no reduction in depressive symptoms in relation to dog visits, but they differed in a range of aspects, including visit type and study period length.[5,6] Zisselman *et al*. studied a population of moderately impaired nursing home residents who received group visits on five successive days,[5] whereas Lutwack-Bloom *et al*. performed individual visits three times per week over 6 months.[6] In the latter study, the impairment level was unspecified.

One relatively small study by Le Roux and Kemp found a significant reduction in depressive symptoms (measured by the Beck Depression Inventory),[2] whereas Travers *et al*. found conflicting results within their larger study based on which depression scale they used, but the GDS showed no effect.[3] In both cases, the elderly received a weekly visit for 6 weeks or more,[2,3] and the level of cognitive impairment of the study population was either moderate to severe or not stated.[2,3] The dog contact in both studies was offered to groups of nursing home residents instead of individually, and therefore, the effect could also be due to the social interaction with other residents during the visit. The choice of control group is another design element that often varies in these studies. Le Roux and Kemp used a 'negative' control group that did not receive an alternative activity,[2] whereas the studies

**Table 3** Values of the psychiatric measures, weight, and body mass index, before and after the 6-week intervention

| Nursing home | Variable | | Statistics |
|---|---|---|---|
| | Before | After | |
| MMSE† | | | |
| 1 (*n* = 22) | 20.0 [9.0; 23.0] | 20 [7.0; 25.0] | |
| 2 (*n* = 23) | 15.0 [7.0; 21.0] | 13.0 [5.0; 19.0] | |
| 3 (*n* = 27) | 7.0 [3.0; 17.0] | 6.0 [2.0; 16.0] | |
| 4 (*n* = 28) | 16.0 [6.5; 21.0] | 15.5 [8.0; 20.0] | |
| Total (*n* = 100) | 14.0 [5.5; 21.0] | 13.0 [3.5; 20.0] | $S = -483$; $P < 0.05$ |
| GBS† | | | |
| 1 (*n* = 22) | 37.3 ± 28.5 | 36.9 ± 27.4 | |
| 2 (*n* = 23) | 41.3 ± 19.1 | 44.0 ± 19.0 | |
| 3 (*n* = 27) | 56.7 ± 26.3 | 61.0 ± 29.1 | |
| 4 (*n* = 28) | 41.4 ± 20.5 | 47.3 ± 23.3 | |
| Total (*n* = 100) | 44.6 ± 24.6 | 48.0 ± 26.2 | $t = 2.06$; $P < 0.05$ |
| GDS | | | |
| 1 (*n* = 22) | 3.0 [1.0; 5.0] | 2.0 [1.0; 5.0] | |
| 2 (*n* = 23) | 2.0 [1.0; 5.0] | 2.0 [1.0; 4.0] | |
| 3 (*n* = 27) | 2.0 [1.0; 5.0] | 2.0 [0.0; 3.0] | |
| 4 (*n* = 28) | 1.5 [0.0; 3.5] | 1.5 [1.0; 3.0] | |
| Total (*n* = 100) | 2.0 [1.0; 5.0] | 2.0 [1.0; 3.5] | $S = -420$; $P < 0.05$ |
| BMI† | | | |
| 1 (*n* = 21) | 26.7 ± 6.3 | 26.2 ± 6.0 | |
| 2 (*n* = 22) | 25.2 ± 4.7 | 24.9 ± 4.5 | |
| 3 (*n* = 23) | 22.8 ± 5.3 | 23.6 ± 5.2 | |
| 4 (*n* = 28) | 26.2 ± 4.1 | 25.9 ± 4.1 | |
| Total (*n* = 91–94) | 25.2 ± 5.2 | 25.2 ± 4.9 | $t = -1.10$; $P > 0.05$ |
| Weight (kg) | | | |
| 1 (*n* = 22) | 68.9 ± 19.3 | 67.9 ± 18.9 | |
| 2 (*n* = 26) | 67.7 ± 15.7 | 66.9 ± 14.9 | |
| 3 (*n* = 27) | 63.8 ± 15.3 | 66.0 ± 14.0 | |
| 4 (*n* = 28) | 73.8 ± 15.7 | 72.7 ± 16.0 | |
| Total (*n* = 93–97) | 68.7 ± 16.6 | 68.6 ± 15.9 | $t = -1.31$; $P > 0.05$ |

Data are shown as either medians and interquartile range or means ± SD. The difference between pre- and post-intervention levels were analyzed by either Student's *t*-test (GBS, BMI, weight ) or Wilcoxon signed-rank test (MMSE and GDS). †The nursing homes differed with regard to the residents' pre- and post-intervention MMSE scores ($\chi^2 = 9.49$; df = 3; $P < 0.05$ and $\chi^2 = 9.43$; df = 3; $P < 0.05$, respectively), post-intervention GBS scores ($\chi^2 = 10{,}09$; df = 3; $P < 0.05$), and pre-intervention BMI ($\chi^2 = 7.88$; df = 3; $P < 0.05$). BMI, body mass index; df, degrees of freedom; GBS, Gottfries-Bråne-Steen scale; GDS, Geriatric Depression Scale; MMSE, Mini-Mental State Examination.

that found AAT had no effect on depression had alternative activities, including visits from a person without a dog,[6] other activities,[5] or visits including other objects as in the present study. This difference in study design could presumably explain some of the contradictory results, as a larger contrast between visit types with regard to, for example, activity level could affect the results.

We found that the cognitive function of participants as a group worsened in the experimental period, but this increase in impairment level did not differ according to visit type. No studies of a reasonable size have found that dog visits can affect the cognitive capacity of nursing home residents.[5,26–28] However, Moretti *et al*. found that MMSE score tended to increase after 6 weeks in moderately impaired nursing home residents who received weekly dog visits in groups.[7] Our results are hardly surprising as dementia is a progressive brain disease, and it would be unrealistic to expect therapeutic activities to reverse the progression.

In our search for objective long-term measures, we included sleep quality as a potential parameter. We found that participants who received dog visits slept for longer on the test night in week 3. This result indicates that dog visits may have a positive effect compared to the alternative visits, but because we are the first to use sleep quality to evaluate AAT and because of the sporadic result, cautious interpretation of this finding is necessary. We suggest that more studies should be conducted using actigraphy technology before conclusions are drawn about whether sleep quality is a suitable and powerful measure in this context.

Our use of weight and BMI also originate from the attempt to find an objective non-invasive measure, but we did not find any indication of an effect in the present study.

We did not find evidence of a longer lasting effect of dog visits on nursing home residents. This could be attributable to the intensity of the dog visits being relatively low; it is possible that greater interaction with the dog by, for instance, feeding, grooming, playing, and walking it, could have an effect. However, the results from the behaviour observations made during the visits showed that the residents interacted significantly more with the dog and the interactive robot seal than the soft toy cat (Thodberg *et al*., accepted for publication in *Anthrozoös*). The residents who received visits from a dog or a robot seal had more tactile and visual contact than those meeting a soft toy cat, and they also talked more with the interactive 'animals'. These results indicate that dog visits may satisfy needs for communication and tactile stimulation and thereby enhance the life quality of the residents.

One limitation to the study is the relatively short visit duration of 10 min, and we cannot exclude that longer visits would have given another response. To our knowledge, the effect of different intervention durations has not yet been studied. We are aware that different intervention lengths have been used (e.g. 10 min,[29] 30 min,[2,6] or 1 h or more[5,30,31]) but in many different settings and with different study questions. Our choice of 10 min was based on pilot visits in which we observed that severely demented residents, in particular, were often unable to maintain their attention for much longer. Furthermore, using the dog owners as visitors instead of experimental staff could have made the dogs more confident during the visits, which could potentially affect the results. The use of experimental staff, however, ensured standardization of the visits. Our choice of using only large dogs was another way of standardizing the visits. Small dogs may have been optimal for some residents, but an investigation of optimal dog sizes would have required a larger sample size and was not within the scope of the present study.

In conclusion, we found that dog visits did not affect measures of depression, cognitive function, or BMI. A transient effect was found on sleep duration, but because this is the first study measuring sleep quality as an effect goal of AAT, more experiments are needed to determine whether this is a valid parameter to measure the effects of dog visits in this population. Although no long-term effects were found, there may still be beneficial short-term effects that warrant the use of dog visits as a non-pharmacological intervention in nursing homes. Future research should focus on refining the use of dog visits to make them more interactive and tailored to the individual recipient.

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