Chapter 12
Neurological Perspectives on Pets and the Elderly: The Truth About Cats, Dogs and Grandparents

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Abstract The last century and the beginning of the current one have seen an increase in the number of elderly people in society. Ageing is generally associated with an increase in dependency, multimorbidity and social isolation, but old people with a healthy ageing process are able to fully operate in society, by being important contributors to several processes and serving as mentors to the younger generation. Does owning a pet have any advantage for an elderly individual? Pets are helpful in terms of social, emotional, cognitive and motor capacities of their elderly owners, but they also can be a source of trouble. The benefits and hazards of having a pet for an elderly population are reviewed in the light of the more frequent neurological changes presented after 65 years of age. In spite of some very interesting studies about pet ownership in the elderly, there are still several questions to be answered. Pet ownership can be, together with changes in mentality and changes in political and social issues, a positive factor for a healthy ageing process in the elderly, as can be seen when we review and evaluate data obtained in various studies, so far.

Keywords Pet ownership · Therapy dogs · Elderly · Ageing · Disablement

12.1 Introduction

The last century and the beginning of the current one have seen an increase in the number of elderly people in society, due to several reasons, namely, reduction in death rates at younger ages and medical improvements, which have contributed

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towards an increased survival after age 65. Around 80% of life years generally lost because of death due to preventable medical causes were eliminated, and world life expectancy more than doubled over the past 200 years (WHO 2015). Average life span has risen from 47 to 73 years in the last century, and this led to an increase in the number of elderly people living in the community (Fries 1980). These changes, together with the observed decrease in birth rates as well as migrant mobilizations particularly in the Old Continent, placed ageing as an important problem of the political agenda. Currently, only Japan has a high percentage of elderly population, reaching 30%, but, in the middle of the twenty-first century, this proportion will also be reached in various countries in Europe, North America, South America and Asia (WHO 2015; Fries 1980; Engelman et al. 2010).

Ageing is generally associated with an increase in dependency, multimorbidity and social isolation. All of these factors will contribute towards a dependency effect of the elderly population, which, if occurring, will push social security to its limits in the countries where it occurs (Raleigh 1999). An increase in labour years from 65 to 67 years in some countries was implemented in order to help with social security burden, and increases in retirement age to 70, or even 74 years, are currently being debated in Britain and Japan (Manton et al. 1993, 1995). The ageing effect is not only a social problem, but it is also a real economic problem: Ikegami and Campbell in 1995 suggested that in 2025, the economic growth in Japan could be compromised by the number of elderly people living in the country. Currently, Japanese life expectancy continues to be the world's highest, with a mean value of 83.7 years of life (WHO 2015).

The association of ageing societies with economic and social problems is related to old people being perceived as a dependent, frail group with multimorbidity. However, retrospective studies suggest that a 70-year-old person in 2005 had a better health status than a person of the same age in 1970, and a similar decline in multimorbidity and dependence has been observed in several retrospective and prospective studies (Vetter 2010). This trend may allow elderly people to live autonomously in the community and enable them to be economically relevant to society, by pursuing their previous work, carrying out voluntary work or conducting important work in the community through political and social intervention. Reduction in multimorbidity and dependence in elderly people will result from multiple actions in prevention and construction of a healthy ageing process, in accordance with various indications from the World Health Organization and other international and national health agencies. Societies which are able to implement a prevention system that generates healthy elders may allow old individuals to live healthier lives, with all the social and economic dividends that are obtained with that scenario (WHO 2015).

Ageing well depends upon the creation of opportunities for good health, in order to allow elderly people to take an integrative part in the society and enjoy independent and high quality of life. Old people with a healthy ageing process are able to fully operate in society, by being important contributors to several processes and serving as mentors to the younger generation (EuroHealthNet). This implies political and environmental changes allowing elderly people to have access to (a) education and lifelong learning processes; (b) regular physical activity; (c) various

support services; (d) a healthy environment with accessibility for elderly people with disabilities; (e) new technologies; (f) adequate, healthy diet and nutrition habits; (g) long-term care; (h) employment and volunteering opportunities; and (i) social inclusion and participation in society.

Pet ownership can be, together with changes in mentality and changes in political and social issues, a positive factor for a healthy ageing process in the elderly, as can be seen when we review and evaluate data obtained in various studies, so far.

12.2 The Importance of Pets for Reaching Healthy Physical and Social Old Age: My Pet, My Doctor

The importance of pet ownership around the world is significant: 83% of Australians have had a pet somewhere in their lives; 68% of New Zealanders have a pet, the highest percentage in the world. The number of pets, particularly in urban areas, is increasing: pet ownership has more than tripled in the USA since the 1970s, and, currently, around 69 million Americans have dogs, and 74 million Americans have cats, while 191 million Brazilians have birds (PetFoodIndustry 2018). A study performed by the American Veterinary Medical Foundation showed that 36.5% of households in the USA had dogs, 30.4% had cats, 3.1% had birds and 1.5% had horses, with some owners owning more than one pet (AVMA 2012). More interesting is to know that 36% of American pet owners give their dog birthday presents, 9 out of 10 American pet owners consider their pet to be part of the family and 50% of pet owners in the USA admit to talking to their pet (Pet Secure 2018). From a previous utilitarian position as guardians against mice or burglars, dogs and cats have somehow climbed up the social ladder and become a part of our lives. What can their importance be when we reach the final decades of our lives and become old?

12.2.1 Granny and Her Pet: A Health Advantage or Another Brick in the Wall?

Elderly pet owners are special. Ageing is a time of harvesting all the good and bad things life gave us, but it is also a time of loss: loss of work and social position, loss of friends and family and loss of health. Loss creates fear, sadness and depression, as well as the feeling of being unable to be in control of our own life. A pet, as a form of a permanent friendship and a family member, can be a constant element in the life of an elderly person and an important contributor to good physical, mental and social health. Social and environmental factors are important issues in old people's health as described by some authors (Cassel 1976; Pohnert 2010), and pet ownership, while contributing to social and environmental stability, can be an important part of elderly life *Satisfaction*.

Physical health is defined not only by the absence of chronic conditions or symptoms but also by health practices including regular physical activity, sufficient hours of sleep, regularity of meals and avoidance of smoking and drinking. Physical health, however, is not the only aspect of what is called successful ageing or the ability to achieve old age with the capacity and the will to enjoy it. Old people's definitions of successful ageing include among other learning new things; sense of humour; spirituality; mental, psychological, physical and social health; life satisfaction; and having a sense of purpose (Bowling 2005). In some aspects, pet ownership can be an important way of attaining successful ageing because of pet effects upon physical and social health and life satisfaction while giving a sense of purpose to their owners' lives.

Some reports suggest that pet ownership is important to elderly people because it may promote more physical activity, and hence healthier habits in elderly patients, with measurable results. Pet owners may indeed have more regular physical activity than non-pet owners, according to some authors (Oka and Shibata 2009; Ruzić et al. 2011; Kuban et al. 2016). For instance, in the study by Kuban et al. (2016) involving 270 haemodialysed individuals with a mean age of 62.7 years, 43% had a dog at home, and these were more frequently out for a walk than non-dog owners, even when they had a longer time of haemodialysis than non-dog owners. The authors concluded that a dog could be an important factor for physical activity in these dog owners. Ruzić et al. (2011) evaluated elderly patients during the first year after myocardial infarction: the group that performed a regular dog walking three times daily had a better cardiac performance after 1 year than the group of non-dog owners. Another study in 177 men and 174 women who replied to mailed enquiries, aged between 20 and 80 years, suggested that dog owners walked significantly more time per week than non-dog owners (Brown and Rhodes 2006). This study also showed that dog ownership, due to the obligation of caring and pampering the dog, was a major factor contributing to the increase in walking and exercise time (Brown and Rhodes 2006), giving the owners a sense of purpose. Oka et al. also concluded that dog owners reported having more physical activity than other pet (such as cat) owners or non-pet owners in a study involving 5253 Japanese adults who replied to an online questionnaire (Oka and Shibata 2009). More recently, a survey of people with social, economic and health problems found that, in this social group, owning a pet was associated with increased physical activity (Nagelhout et al. 2017). Furthermore, a study which used an activity monitor in elderly volunteers – activPAL accelerometer – showed that an independent old person owning a pet dog had an increase in time spent walking when compared to non-dog owners of the same age (Dall et al. 2017). In this study, pet owners walked for more minutes at a moderate pace and presented fewer sitting events. This allowed the authors to conclude about a possible positive effect upon pet owners' activity profile and health, when compared to non-pet owner-matched counterparts (Dall et al. 2017). Thorpe et al. showed that elderly dog owners were more likely than non-pet owners to engage in non-exercise-related pet walking, but did not differ from non-pet owners in walking for exercise

or any other physical activity (Thorpe Jr et al. 2006). This would show the effect of owning a pet upon physical activity, particularly in elderly people, since a large number of older adults do not engage easily in physical activity. These results were also consolidated by a meta-analysis performed with 29 published articles, which suggested that there is in fact a positive relationship between dog ownership and pet-related physical activity (Christian et al. 2013). In this context, a recent study, which observed a sequential number of subjects with coronary disease, reported that having a pet was associated with decreased coronary artery risk, and this was more apparent in dog owners than in cat owners. Furthermore, the number of years of keeping a pet, walking and playing with it, seems to be related to a reduced coronary risk in pet owners (Xie et al. 2017).

Pets may increase their owners' physical activity levels by getting them to play, walk and generally move more in order to attend to their needs, since a pet is mostly dependent upon their owner. And this involves not only walking the dog daily but also a vast amount of other types of mobility actions related to pet ownership. Even for elderly people without mobility problems, pets can still help to improve mobility. In an interview-based study of 23 rural elderly people, Scheibeck et al. (2011) showed that dog owners walked every day, thereby doing regular physical activity. The same was observed by Yabroff et al. (2008), who evaluated a large number of old adults in California and found a moderate relationship between owning a pet and performing physical exercise, if the pet evaluated was a dog. In general, research studies agree that elderly dog owners are physically more active than non-dog owners (Christian et al. 2013), which may help to prevent motor disability or compensate for acquired motor disability over the years.

In contrast, other authors claimed that there was no significant effect of pet ownership on pet owners' health, after controlling for several factors such as health habits, human social support and owners' attachment to the pet (Winefield et al. 2008). A report using data from the English Longitudinal Study did not find any relationship between pet ownership and lung function, grip strength, chair raising time, balance and memory, among other markers of ageing, in a population of around 9000 individuals in which one third of them owned a pet (Batty et al. 2017). In addition, a survey based on the Nord-Trøndelag Health Study (The HUNT Study) found no evidence of any association between improved health (measured by all-cause mortality) and physical activity levels associated with dog ownership (Torske et al. 2017).

One should take into account that, besides important differences in the populations under analysis as well as in research methodologies between the previous studies, apparent discrepancies in the association between pet ownership and health parameters may also suggest that physical activity in the elderly is not the only marker or the only aspect of good health that can be supported by a pet. In fact, some other aspects are also important: pet ownership is directly associated with mental health changes due to love and companionship obtained from the human-animal interaction, but also from social interchanges with neighbours as well as from intergenerational contacts obtained through the same pet.

12.2.2 A Pet as a Stress-Reducing Factor: Are We What We Play?

Apart from the unconditional love that we obtain from pets, they like to play and have attention given to them, and this will force their owners to play with them and respond to their attention needs. Playing with pets increases owners' exercise levels and changes their mood, decreasing the influence of the autonomous sympathetic system, which can contribute towards increasing survival after myocardial infarction, as has been shown in some studies (Friedmann et al. 2003; La Rovere and Pinna 2014). For some owners, the anti-stress factor that owning a pet represents translates into decreased hypertension levels, decreased heart rate and reduced cholesterol plasma levels (Baun et al. 1984; Allen et al. 2002; Virués-Ortega and Buela-Casal 2006). Elderly subjects who owned dogs and who performed regular physical activity with their pets more frequently had serum triglyceride levels in the normal range than those who did not own dogs Dembicki et al. This aspect may be reflected in other health effects, namely, in terms of risk of cardiovascular disease. Thus, in spite of gaps in knowledge, research seems to suggest that elderly pet owners have better health, less depression and a much higher rate of survival 1 year after a heart attack and are less likely to have a heart attack than non-pet owners (Friedmann et al. 2003; Müllersdorf et al. 2010). This may be due to the fact that having a pet decreases the sympathetic system arousal, as previously mentioned, and also reduces anxiety and depression at the same time. Aiba et al. (2012) demonstrated that owning a pet was an independent and a positive factor for reducing cardiac autonomic imbalance in 191 patients with a mean age of 69 ± 8 years and who had diabetes, high blood pressure and hyperlipidaemia. Other authors showed that even simple and passive processes such as watching an aquarium may have soothing effects, decrease pulse rate, increase skin temperature and decrease muscle tension in elderly people (DeSchriver and Riddick 1990). In fact, humoural chemical changes such as decreases in cortisol and increases in dopamine and endorphin serum levels have been shown to be related to times playing and petting dogs (Odendaal and Meintjes 2003). Finally, the American Heart Association suggests that pet ownership may contribute towards a reduction of cardiac disease, since improved outcomes in relation to hypertension, obesity, diabetes, hyperlipidaemia, autonomic function, cardiovascular reactivity and survival have been reported for individuals with cardiovascular disease (Levine et al. 2013). Other studies dispute these findings. Parker et al. (2010) analysed 424 pet owners in a cardiac unit who replied to a questionnaire: pet owners, when compared to non-pet owners, were more frequently readmitted or died after hospitalization due to a cardiac event, and this was worse for cat owners. Again, it is difficult to compare specific populations, such as the ones attending cardiac units, with the general population evaluated in the majority of studies. All published results need to take features of the populations under study into account, because these features, by themselves, may explain differences observed.

12.2.3 Health Services: A Pet a Day Keeps the Doctor Away?

For elderly people, who are sometimes in vulnerable situations, either due to social isolation or health problems, a pet may significantly contribute to their quality of life (Heuberger 2017; White et al. 2017; Beck and Meyers 1996; but see also Winefield et al. 2008). In older adults, the importance of good health is related to their ability to maintain autonomy and stay in their homes and to use social and health services less frequently. Health-care use has become a measure that reflects outcomes of physical health, mental health and mortality in elderly people (Seeman and Crimmins 2001). Due to their fragility in terms of health but also in terms of economic and social difficulties, older people will use health services not only due to their health problems but for other reasons as well: need of social interaction, psychosomatic symptoms related with fear and anxiety and need of reassurance from their doctor about their health. In this regard, Siegel et al. (1990) surveyed 938 subjects for 12 months and found that pet owners were less frequently going to the doctor, both in normal and also in stressful times: again, dog ownership showed a more significant impact than cat ownership or other pets. Similarly, a telephonic survey in Australia, in which 60% of the individuals had a pet, also suggested that elderly pet owners had fewer doctor visits, less medication usage and fewer chronic health issues than non-pet owners (McHarg et al. 1995). A study using data from the Canadian Health Ministry database showed a significant difference in the use of medical services between pet owners and non-pet owners, with longer hospital stays for non-pet owners: in general, pet owners seemed to be significantly more autonomous in their daily living, better able to solve problems and happier with their everyday life (Raina et al. 1999). In addition, a longitudinal study carried out both in Germany and Australia, in which a population of health responders was followed up from 1996 to 2001, demonstrated in both countries that people that had always owned a pet had significantly fewer doctor visits than those who had ceased to have a pet or had "never" had one. Health gains were also seen in people who had acquired a pet in the last years of the study. In this study, the impact of pet ownership was reduced when controlled for other confounding variables, but the impact was still important (Headey and Grabka 2007).

12.2.4 Boris and My Friends: The Social Role of Pets?

Studies in elderly people also provide another clue to the effect of pets on human life. In a very aged population, the presence of an animal provides a sensation of companionship, so many times lost after the bereavement of a spouse, a sister or a son and a feeling of validation when one wakes up and has to interact with a being that depends upon you and which is seriously happy when you return home. Probably also because of pet ownership, pet owners are able to overcome more stress and have more psychological health than non-pet owners, and, when victims

of violence, pet owners mentioned their pets as an important source of emotional support (Siegel 1990; McNicholas et al. 2005; Krause-Parello 2012; Stanley et al. 2014).

For an isolated elder, with loss of social contacts, due to retirement, lack of family support and death of spouse and friends, a pet can be an object of love and affection: pet owners have a specific attachment to animals as described in a study with functional MRI by Hayama et al. in 2016. In this study, pet owners showed greater cerebral activity than non-pet owners while watching photographs of pets, and such activity involved visual attention networks but also the insula, which is a brain structure that plays a role in compassion and empathy. In fact, other authors even show that dog owners are emotionally attached to their pets and their family, at similar levels (Flynn 2000; Cooke 2013; Walsh 2009). In addition, social isolation associated with old age can also be reduced by the presence of a pet. Walking a dog or a cat is a social adventure: people ask questions about the dog, how it behaves and how nice it is (a friendly dog is a natural conversation starter). This promotes social bridges between people of similar ages as well as across different generations and even facilitates conversation for shy people. For instance, pet owners are more likely to talk to their neighbours while walking their dog (Hara and Shimada 2007; Tissot 2011). Thus, the decrease in social networks that takes place due to professional retirement as well as due to the loss of friends and family may be compensated by new acquaintances, which are encouraged through pet ownership. This may give elderly people a new sense of community and belonging, as well as the social interactions that are necessary to feel fulfilled. In a community study based upon telephone surveys, Wood et al. (2015) were able to show the integrative role of pets in a community, with an increased interaction between pet owners, but also with non-pet owners, who often interact with pet owners through the pets of the latter.

The most widely used definition of health is that by the World Health Organization, which regards health as a "complete state of physical, social and mental well-being and not merely the absence of disease or infirmity" (WHO 2014). Pets, either because they seem to improve health indicators and help with loneliness and depression or because they are part of the family and an important member of one's social life (for pet owners at least), seem to be an active contributor towards an improvement of an elderly pet owners' health status.

12.3 Neurological Changes with Ageing

Since the ability to cope with stressors decreases with advancing age, age-related chronic diseases are frequent and a source of disablement among the elderly. Apart from normal ageing-related acquired limitations, such as changes in vision or audition, changes in mobility and changes in cognition, all of which have a certain degree of variability, a large number of elderly people are affected by disablement, defined as the limiting consequences of chronic health conditions. In a UK-based study, the prevalence of disablement increased in a step-by-step

manner, over the years, from 7% in those aged 40–49 years to 68% for those aged 80 years and above (Stuck et al. 1999). Seeman et al. demonstrated, in 2010, that older Americans faced progressive disability even in recent generations. The WHO report on disablement shows the presence of a disproportionate representation of older people in the group of disabled persons, with rates of disability much higher in elderly persons above 80 years of age (WHO 2011). Even if, in recent years, there has been an improvement in disability levels across generations, due to elders possibly being increasingly healthier (due to better nutrition, better health care and better avoidance of disease), there is still physical deterioration that is perceived in everyday life (WHO 2015).

Neurological changes associated with ageing are some of the most important changes a person can suffer, because they significantly interfere with functionality and quality of life. We are born more or less the same way, but we will age differently, according to genetics, environment and our personal history.

12.3.1 The Special Ones – I: Guide Pets for Sensorial Deprivation?

As we get older, even without any pathological issues involved, we will present changes in sensorial systems, namely, visual difficulties, due to changes in the capacity to react and accommodate to light and darkness, insufficiency of convergence, restricted range of eye movements and changes in visual fields. Difficulties in hearing are also frequently reported by the elderly population, due to progressive hearing loss, which most frequently involves difficulty in perception of the human voice. A reduction of the sense of taste may induce changes in food habits, and a reduced sense of smell may increase the possibility of eating rotten food or being unable to feel poisonous gas, for instance (Adams 2005). Pets, trained for special functions, can be of great help: a trained dog may be able to show a different behaviour if confronted with a noxious smell, for instance, and can be helpful in drawing attention to it – this is being increasingly used in some pathological situations, such as diabetes and cancer (Horvath et al; Hardin et al. 2015).

In addition, pets can also be an important asset in terms of hearing loss if they are trained to warn their owners about incoming phone calls, various different noises around or even those made by an intruder. Trained hearing dogs are able to alert their owners to specific sounds such as doorbells, smoke alarms, telephone ringing or people calling their own name. They are also able to help in managing sounds from outside the house (Guest 2006). Apart from their utility, these pets create other significant changes in their owners' lives. In a longitudinal study carried out by the Hearing Dogs for Deaf People organization, which followed up 51 recipients of a hearing dog, such recipients reported significant improvement in independence, social involvement and in response to sounds from the environment after receiving a hearing dog, which was also associated with lower levels of tension, depression and anxiety (Valentine et al. 1993).

Guide dogs for people with vision problems are also an obvious choice: dogs can guide people outside the house, can help people go to the supermarket and can help people maintain one's routine and autonomy. Guide dogs follow a course of basic obedience and are mostly trained to bring their human owners through a series of hazards and obstacles and to ignore any commands that will endanger the life of the human who holds the leather handle attached to the dog (Prestrude and O´Schea 1996). Loneliness and social exclusion are difficult problems that elderly people with eyesight difficulties frequently perceive. Thus, the maintenance of a social routine is very important, and, in this context, the effects pets have on social life of their owners, apart from the effects as guides, are also quite important. Cats, as well as other animals which cannot be used as guide pets, are less interesting to elders who cannot see because they are of no use in guidance outside the house. However, one cannot forget that even such pets help to keep company and, being a part of the family, also help to reduce the sense of isolation.

In the elderly population, a hearing or visual guide dog, apart from the independence that it provides, can also bring a new interest to life, by providing a bond with another living being. White et al. (2017) analysed the quality of life and attachment styles of 73 owners of service dogs and showed that the owner-service dog relationship is unique and interdependent and enhanced the quality of life of the owner.

12.3.2 The Special Ones – II: Pets to Improve Mobility and Promote Independency

Risk factors associated with a functional decline in elderly people were identified by Stuck et al. and included (1) poor self-perceived health, (2) smoking, (3) vision impairment, (4) low frequency of social contacts, (5) low level of physical activity, (6) no alcohol use compared with moderate use, (7) increased and decreased body mass index, (8) lower-extremity functional limitation, (9) cognitive impairment, (10) depression and (11) disease burden (comorbidity) (Stuck et al. 1999). An increase in years of life will bring changes that are not pathological but that are going to impact upon everyday life of a person. Ageing is associated with reduced speed in walking and performing daily activities, decreased coordination and reduced muscular power, due to a progressive decrease in the amount of nervous system cells that coordinate the process, as well as in the muscular and tendinous cells involved in motor function (Adams 2005). Sensitivity is also decreased, and even without pathological features such as neuropathies and movement disorders, old people will fall more frequently than younger ones, which increases their comorbidities with fractures and immobility, which in turn leads to more reduced mobility and further falls. When there is a high degree of dependency and mobility difficulties, assistance dogs can be helpful: they are important to the mobility of dependent elders, by contributing to an increase in freedom and independence. Assistance dogs are helpful in catching things, opening doors and fetching the phone and, in addition, are able, as seen before, to improve the social life of their owners, by getting frequent gestures of friendliness from strangers and by

increasing social interactions of their owners (Hart 1998; Eddy et al. 1988). Also, service dogs for people with mobility problems can alleviate the mental burden of daily activities and have been shown to subjectively improve physical functioning of their owners. This has been confirmed in a comparative study between service dog owners with mobility problems and those who, in spite of similar problems, had not yet been able to obtain a service dog (Shintani et al. 2010).

In fact, in terms of mobility, there is an almost linear dose-response relationship between health status and physical exercise, mostly if individuals were previously sedentary, particularly in older adults (Hills et al. 2015). Older people perceive their health-related status in terms of the amount of physical exercise they can perform (Eifert et al. 2014) although very few are able to exercise in the way needed to achieve health results. Mobility decline can be prevented with exercise, and exercise in itself is related to improvement in several health problems in the elderly (Frankel et al. 2006; Montero-Fernández and Serra-Rexach 2013; Chen et al. 2014; VanSwearingen and Studenski 2014). Walking is a very affordable exercise, which allows people to go out of their homes, get information about their environment and also socialize. In elderly subjects, a walking training programme resulted in improvements in mobility, lower limb strength and aerobic endurance as compared with a control group, which had not been enrolled in such a programme (Magistro et al. 2014). Other studies also showed that regular walking can be a very important part of a programme to maintain elderly people healthy and autonomous (Mosallanezhad et al. 2014; Forte et al. 2015). Thus, physical activity is one of the key points in disability prevention, and low levels of physical activity are associated with several health problems in the elderly (Bastone et al. 2015).

It should be borne in mind that the effect of a dog on physical activity will be more apparent in people who do not generally exercise, who are not fond of exercise (and who, without a pet, would not leave the sofa, etc.) or who have very few incentives to do physical exercise. Thus, positive effects of pet-related physical exercise may be less noticeable in cultures such as those from northern Europe or in adolescents and young adults, who are generally more active and more prone to doing regular physical exercise. For elderly people with walking limitations due to osteoarticular degeneration or balance problems, walking the dog may be the sole incentive to perform some physical exercise (Cutt et al. 2008). Again, the type of pet may be important. In a recent case-control study in older adults, which compared pairs of cat or dog owners with non-pet owners, pet owners had fewer health conditions, but cat owners had a higher body mass index and less activity per day, than dog owners (Heuberger 2017).

When there is an effective relationship between a pet and its owner, pets can change one's health by influencing behavioural factors and everyday life patterns. Cats move around and like to play; horses need to be walked and pampered. Dogs need to be played with and walked, and responsible pet owners will exercise with them even in bad weather, also because their owners derive positive outcomes from the perception that their pets are enjoying the experience (Westgarth et al. 2017). Dog owners do feel an obligation towards their dogs, in this regard, either because of its health or because the pet feels happy when outside, and this happiness is perceived by the owner. Happiness observed in a pet helps to create such a sense

of obligation and a social impact in their lives; in addition, having a routine is important for elderly owners. Activity-related benefits of pet ownership in older adults seemed to be limited to dog owners, who engaged in the greater overall physical activity (Campbell et al. 2017). Even in situations in which walking the dog can vary between 1 hour every day and 1 hour every week, dog owners are in general still more active than non-dog owners (Bauman et al. 2001; Cutt et al. 2007; Suminski et al. 2005). In contrast, physical activity levels of cat owners do not increase or at least not significantly, as reported by several authors (Dembicki and Anderson 1996; Oka and Shibata 2009; Thorpe Jr et al. 2006; Yabroff et al. 2008). All the activity provided by a pet, and the sense of obligation associated with being a responsible pet owner, generates a sense of importance and reduced feelings of loneliness in an elderly person, who is generally retired and with little social life (Ong et al. 2016; Boss et al. 2015; Dury 2014) So, even if there were no advantages in terms of physical exercise, the feelings of belonging and importance that the pet keeping "job" implies will be very important to the mental health of the elderly owner of a pet.

Horses are special types of companion animals, considering how difficult it is to call them pets. Horse owners claim a different type of relationship with their pet, which allows an active interaction and a different sort of companionship than the one present with smaller animals (Endenburg 1999; Robinson 1999). Horse riding has been shown to be associated with improvement in balance and stability in elderly subjects from the community (Homnick et al. 2015; Aranda-García et al. 2015; Kang 2015). Furthermore, horse riding was also associated with improvement in lower limb strength and whole body reaction in elderly subjects, probably due to the continuous movement of the horse, generating an increase in muscle tonus due to the constant muscular contraction obtained in response to the animal movement (Yu et al. 2014). Using a horse riding simulator, an improvement in balance and functional capacity was found in elderly patients with osteoarthritis of the knee (Kim 2016). Horse riding for prolonged time allows greater overall postural stability, thereby allowing a better coordination of vestibular and somesthetic information in elderly people (Olivier et al. 2017). Horse riding effects were observed not only in the locomotor system: Kim et al. (2015) showed an improvement in the EEG responses in elderly people after horseback riding for 8 weeks, when compared to a control group, suggesting that horseback was also able to improve cerebral functions in this group.

12.3.3 The Special Ones – III: Pets that Have Emotional and Cognition Effects (My Pet, My Psychiatrist)

Being a result of progress and civilization, old age should be a time of joy and happiness, with a fulfilled life, and family and friends around. However, as previously mentioned, old age is more frequently an age of loss: loss of work due to retirement or to poor health, loss of family and friends that moved away or died,

loss of economic capacities and loss of environmental clues to changes. It is difficult to deal with these changes, and feelings of sadness, depression and loneliness may be present in elderly people (Boss et al. 2015; Dury 2014). Animals by themselves and without any training can be of therapeutic benefit due to their presence and their companionship. Pets seem to be able to give love and affection without asking for anything in return, and this can compensate for several losses present in elderly people's lives. In a survey of 5210 men and women from the English Longitudinal Study of Ageing, pet ownership was associated with loneliness in elderly women, possibly because having a pet was used as a compensatory factor (Pikhartova et al. 2014). Loneliness and depression in the elderly are related to progressive poor health, loss of socialization, loss of mobilization and presence of physical disease. In this context, the presence of a pet, as reported in another survey of 830 primary care patients who lived alone, was associated with a happy mood and a decreased report of loneliness (Stanley et al. 2014). Even in experimental conditions, pets are able to reduce anxiety and fear in their owners. For instance a decrease in anxiety levels was seen in a controlled experiment which involved exposure to a tarantula: subjects who were holding and playing with a real pet at the time they were put in contact with the tarantula showed fewer anxiety effects than subjects who did not interact with pets during the experiment (Shiloh et al. 2003).

Saunders et al. (2017) reviewed the possible mechanisms whereby pets may contribute to human psychological well-being and health in general. Two theories were reported: the "main effects hypothesis", which suggests that pets have diffuse effects on human lives, and the "buffering hypothesis" which puts forward that pets are helpful mainly when stressful factors are present – as seen before. Some research with stressors in laboratory suggests that this effect is important (Shiloh et al. 2003; Allen et al. 2002). Beetz et al. (2012) suggested a possible role for oxytocin in order to integrate both hypotheses and explain several effects regarding human-animal relationships.

Oxytocin is related to love and companionship and is one of the hormones associated with a feel-good factor, to which both animals and humans respond and which induces anti-stress effects, namely, decreased cortisol levels and blood pressure (Uvnäs-Moberg 1998), as well as increased pain threshold (Petersson et al. 2017). Oxytocin also increases trust (Kosfeld et al. 2005) and causes anxiolytic effects (Heinrichs et al. 2003). Nagasawa et al. (2015) showed increased levels of oxytocin in owners visually interacting with dogs, and vice versa, which suggests that the mechanism that improves health in pet owners is the same mechanism that allows the formation of a human-animal bond. Oxytocin is also present in high quantities when a positive human-dog relationship is present, a situation which is also associated with lower cortisol levels (Schreiner 2016). However, the bond established between owner and pet is different from person to person and depends on the link reached between them, on the personality of the owner and of the pet and also on the owner's experience, among other factors (Calvo et al. 2016a; Calvo et al. 2016b; Cline 2010). Maybe that is the reason why different studies of the effect of having a pet upon psychological and mental distress have shown varying results. For instance, Winefield et al. (2008) interviewed 314 elderly subjects who owned

pets and found no effect of their ownership upon their health and well-being. In contrast, Enmarker et al. (2015) studied 12,093 elderly people and reported that non-pet owners had lower levels of anxiety and fewer depression feelings than pet owners and also that male cat owners were less depressive than female cat owners: health status was not related with pet ownership in this group. Another study in 2551 older adults found that pet owners had higher levels of psychoticism and more depressive symptoms and female pet owners had poorer health (Parslow et al. 2005). We could, of course, argue that owning a pet would contribute to maintaining a certain balance, and that might be the reason for having one if you suffer from mental health problems. That might account for the results from the previous studies. In this context, a study involving a convenience sample of 169 elderly female pet owners who replied to psychological profile questionnaires found a significant relationship between loneliness, depressed mood and pet attachment support (Krause-Parello 2012), suggesting that the relationship with pets had a very special support role in the owners' lives. This also may explain the results of the Nord-Trøndelag Health Study, which suggested that non-pet owners had the lowest scores for depression in an evaluation of 12,093 subjects (Enmarker et al. 2015).

More positive results were seen for pet ownership in terms of reducing anxiety and depression symptoms, in the work of Garrity et al. (1989): these authors used a phone survey in a sample of elderly Americans and showed that pet attachment significantly predicted depression but not illness experience, and in the particularly stressed bereaved subjects, pet ownership and strong attachment were significantly associated with lower levels of depression. This is in line with the findings from the previously mentioned study by Krause-Parello (2012) in older women, which showed that pet ownership and pet attachment were positively related as a form of support for loneliness and depression feelings. In fact, animal-assisted therapy in nursing home residents has been reported as positive, when compared with a control group with no animal-assisted therapy, both in terms of loneliness scores (Perelle and Granville 1983) and social scores (Banks and Banks 2002). Another study in 35 volunteers showed that being able to be with a pet dog while waiting for electroconvulsive therapy (ECT) treatments improved the levels of fear and anxiety (Barker et al. 2003). In addition, an Australian study of 68 nursing home residents showed that animal-assisted therapy was associated with lower levels of depression and fewer loneliness feelings, as well as with less fear and confusion: this was even more apparent when a resident dog was in scene, but also with a visiting dog, which allowed the authors to claim an important effect of resident dogs in nursing homes (Crowley-Robinson et al. 1996).

However, authors also disagree in this field. While elderly pet owners have a higher executive function than non-pet owners, their depressive score was identical to that of non-pet owners in the study designed by Branson et al. (2016). In a recent systematic review on patient-dog interactions, Lundqvist et al. (2017) suggested that there was a minor to moderate effect of dog-assisted therapy in psychiatric conditions. No association between pet ownership and relief of depressive symptoms was found in 8785 adults in the English National Study of Ageing (Batty et al. 2017), and Cherniack and Cherniack after revising the literature claimed that

"taken together, these studies imply a rather modest benefit at best for animals in depressed individuals" (Cherniack and Cherniack 2014).

12.3.4 Pathological Ageing and Assisted Animal Therapy

Ageing may be associated with neurodegenerative disorders, namely, dementia and movement disorders. There is a large group of studies relating the effect of pets and assisted animal therapy, mostly in nursing home residents, in the neurodegenerative field. Nursing home residents are a part of the elderly population in specific situations, mostly those with disabilities that prevent them from living at home, with those disabilities being not only cognitive but also frequently motor and sensorial, with depressive feelings and difficulties adjusting to an autonomous life. In a study using an animal-assisted therapy protocol that varied from no exposure to 1-week exposure or to 3-week exposure of assisting animals in a small number of elderly people, Banks and Banks (2002) were able to show that animal-assisted therapy was able to reduce the feelings of loneliness in the studied individuals. In residents with cognitive impairment, the presence of a dog reduced behavioural changes such as agitation and promoted social interaction among patients and staff by itself (Richeson 2003). In another study, the use of therapy dogs in a psychiatric ward was associated with decreased heart rates and a consistent reduction of agitation on the ward when the dogs were present (Walsh et al. 1995). Similarly, the presence of fish in aquariums in the dining room of a nursing care home for Alzheimer's patients was able to promote better appetite and an increase in weight in these patients, when compared with a control group. (Edwards and Beck 2002). Moretti et al. (2011) evaluated pet therapy in ten elderly patients with dementia and other psychiatric ailments: this study showed improvements after 6 months of pet-assisted therapy both in the geriatric depression scale and in cognitive scores (assessed using the Mini-Mental State Examination – MMSE), when compared with a control group, suggesting an effect not only on depression but also on the cognitive capacity of these patients. In another study, animal-assisted therapy was used for 6 months in a random group of Alzheimer's disease patients, and this approach was associated with an improvement in depression (assessed using the Geriatric Depression Scale – GDS) as well as in cognitive parameters (MMSE) (Menna et al. 2016). Furthermore, Swall et al. (2015) reported the use of animal-assisted therapy in demented patients with behavioural problems and concluded that the time spent with a dog allowed the patients to report memories and feelings, with pets creating an opportunity to reach the patient on a cognitive level. In another study, involving severely demented patients, no changes in cognition or neuropsychiatric symptoms were found with animal-assisted therapy (Mossello et al. 2011): however, this study reported a decrease in anxiety and sadness levels, as well as an increase in motor activity after animal-assisted therapy in these patients, when compared with control subjects. This also occurred in the study conducted by Kanamori et al. (2001) in patients with senile dementia: seven subjects subjected to animal-assisted therapy were analysed

with a cognitive scale (MMSE), a scale of daily living activities salivary cortisol levels, with all of these parameters showing improvements when compared with a control group. Thus, the presence of a dog seems to calm demented patients, allowing them to remember past pets, and encourages their mobility and their interpersonal contact, and, on the whole, in spite of the small numbers and very different methodologies of the existing studies, it seems to have a positive impact upon behaviour and, in some reports, upon cognition.

In a meta-analysis of papers reporting using animal-assisted therapy in elderly subjects up to January 2009, Virués-Ortega et al. (2012) found that this type of approach significantly improved social functioning of the nursing home residents, with a moderate effect upon depression and behavioural disturbances, particularly in patients with dementia. In fact, dementia patients seem to obtain some favourable results with animal-assisted therapy. Friedmann et al. (2015) studied elderly nursing home residents in whom a high percentage had dementia (60%) and/or depression (50%), 10% had behavioural problems and 5% had anxiety. All patients were on medication. Patients were subdivided into two groups; one of the groups was visited by animals, in the context of animal-assisted therapy, for 3 months, while the other group was the control group. At the end of the study, depression score values in the group visited by an animal were reduced, but no changes were seen in the use of medication.

However, not all studies have shown positive results with animal-assisted therapy. Phelps et al. (2008) found no improvement in depression, mood or levels of social interaction in elderly patients in a nursing home that received weekly dog visits. In addition, no differences were found in a study by Thodberg et al. (2016) between two groups of elderly patients in nursing homes, in which one group was submitted to biweekly sessions of dog therapy. Although their sleep hours improved, no changes were observed in cognition, weight, BMI, depression or daily life functions, in comparison with controls.

12.4 The New Age Pets

More recently, researchers started using robotic pets in elderly care, because such pets are easy to command, are predictable and are also cleaner than living pets, thereby avoiding some of the negative traits the latter can present. In an experience involving interaction of demented patients with “AIBO”, a metal robot that responds to spoken commands, Tamura et al. (2004) claimed that severely demented patients were able to increase communication, suggesting that robotic pets may be a tool to use in rehabilitation of these patients. of these patients. A randomised trial with the baby seal robot “PARO” showed that elderly subjects with dementia presented a long-term reduction effect in agitation and depression as compared with a control group with similar characteristics that did not interact with the robot (Jøranson et al. 2015). A similar study with the same robot, carried out in Japan in 2014 (Takayanagi et al. 2014), showed that elderly people with moderate to severe dementia had

increased positive responses to the robot pet when compared with a stuffed animal. Banks et al. (2008) compared the effects of a living dog and a robotic dog in a resident home for elderly people in order to assess differences in their ability to treat loneliness in the elderly population. Both types of animal-assisted therapy (AAT) showed improvements in the levels of loneliness of the residents, and although the robot animal group scored lower in some aspects of the scale used to assess attachment, both AAT showed a positive impact in terms of reducing loneliness in the elderly. Kramer et al. compared three different types of visits to a residential home of elderly people: a person visiting alone, a person visiting with a live dog and a person visiting with the metal pet robot AIBO. All three types of visits increased communication and interaction by the elderly, but both the living dog and AIBO were more effective than the living visitor, with AIBO provoking more attention and conversations than the live dog (Kramer et al. 2009).

12.5 Granny and Her Pet: The Bad Things

In every cloud there is a silver lining and vice versa: with all the positive aspects reported in the literature, having a pet should be a very positive experience. However, for elderly people, pets can be difficult to have and to keep. In fact, most of the times, elderly people will not have a pet in old age, more so if there was not a pet around when they were young.

Mobility difficulties associated with loss of equilibrium result in frequent falls, mostly nonfatal but specifically hazardous in an elderly population. The National Electronic Injury Surveillance System (NEISS) from the USA reported around 86,000 falls/year involving either a cat or a dog (2001–2006), with dogs being responsible around 88% of the times for the falls. These records showed that women tended to fall more than men, which can be more problematic since elderly women more frequently have osteoporosis and suffer worse consequences from a fall than men, namely, fractures. Pets were associated with falls in a predictive model for elderly people (Pluijm et al. 2006), and Kurrie et al. (2004) reported a series of elderly patients with fractures from falls due to their pets, most commonly dogs and cats but also birds, goats and even a donkey. This is even more important since, according to an official report, "falls are the leading cause of fatal injury and the most common cause of nonfatal trauma-related hospital admissions among older adults" (NCOA 2018).

Dogs can also be associated with human injuries related to walking a pet on a leash (Willmott et al. 2012), and both cats and dogs can cause lesions due to bites and scratches and car accidents (Blunck et al. 2013). And we must remember the fragility of the elderly population in relation to infections and contaminations through contact with animals (e.g. Simpson et al. 2000; Stull et al. 2012).

Apart from falls, taking care of a pet can be strenuous, when there is no correlation between the level of energy of the owner and that of the pet. The constant need for attention of a small furry friend can be difficult to compensate and may worsen the

feeling of incapacity, instead of improving the owner's mood (Graf 1999). Mobility difficulties may reduce activity outside the house and create the problem of "Who would walk the dog? Because I cannot walk by myself…". And, of course, pets are also expensive; food and toys and vaccines are important, but lots of elderly people do not have enough money to spend on them. In fact, sometimes, in order to care for their pets, elderly people even reduce the amount they spend on their own food or medication (Toohey and Rock 2018). Pets are also a source of worry – "Who will take care of it if I go first?" (Smith et al. 1992; Graf 1999). Family and friends may be of some help with that. I still remember the happiness of some owner when his pet friend, in his case a donkey, was cared for by one of his friends. Additionally, pets can be a source of grief: the kind of grief referred is comparable to the one felt when losing a close friend or family member, more so if you are older and your circle of friends is being reduced. For a lonely old person, a pet can offer distraction, can fight boredom and can give a purpose, and its death means an enormous empty space that can worsen other problems such as depression and cognitive problems (Clements et al. 2003).

12.6 Conclusions

Elderly pet owners are considered to be more confident, with fewer feelings of loneliness and less afraid of the world than non-pet owners. Pet ownership seems to ease depression and agitation in demented patients. However, some studies are contradictory. In spite of all these benefits, older persons are worried of having a pet, either because of their own health and fragility or because of financial concerns or their ability to care for the pet.

In spite of all the benefits we can see for pet ownership, it is difficult to convince an elderly person that never had pets around or that is very frail to have one. Pet ownership by the elderly needs to be adapted: a young and playful dog can be a disaster, a very lazy pet is not sufficiently demanding and an angry pet can make an elderly person's life a misery. More and more, we need to have pets and owners adapted to each other and suited for each other. It is a relationship for life, after all.

References

Adams V (2005) The neurology of ageing. In: Ropper AH, Brown RH (eds) Adams and Victor principles of neurology. McGraw-Hill Medical, New York, ISBN: 0-07-141620-X

Aiba N, Hotta K, Yokoyama M, Wang G, Tabata M, Kamiya K, Shimizu R, Kamekawa D, Hoshi K, Yamaoka-Tojo M, Masuda T (2012) Usefulness of pet ownership as a modulator of cardiac autonomic imbalance in patients with diabetes mellitus, hypertension, and/or hyperlipidemia. Am J Cardiol 109(8):1164–1170. https://doi.org/10.1016/j.amjcard.2011.11.055

Allen K, Blascovich J, Mendes WB (2002) Cardiovascular reactivity and the presence of pets, friends, and spouses: the truth about cats and dogs. Psychosom Med 64(5):727–739

American Veterinarian Medical Association (AVMA) (2012). https://www.avma.org/KB/Resources/Statistics/Pages/Market-research-statistics-US-Pet-Ownership-Demographics-Sourcebook.aspx. Accessed June 2018

Aranda-García S, Iricibar A, Planas A, Prat-Subiran JA, Angulo-Barroso RM (2015) Comparative effects of horse exercise versus traditional exercise programs on gait, muscle strength, and body balance in healthy older adults. J Aging Phys Act 23(1):78–89. https://doi.org/10.1123/japa.2012-0326

Banks MR, Banks WA (2002) The effects of animal-assisted therapy on loneliness in an elderly population in long-term care facilities. J Gerontol A Biol Sci Med Sci 57(7):M428–M432

Banks MR, Willoughby LM, Banks WA (2008, Mar) Animal-assisted therapy and loneliness in nursing homes: use of robotic versus living dogs. J Am Med Dir Assoc 9(3):173–7. https://doi.org/10.1016/j.jamda.2007.11.007

Barker SB, Pandurangi AK, Best AM (2003) Effects of animal-assisted therapy on patients anxiety, fear, and depression before ECT. J ECT 19(1):38–44

Bastone AC, Ferriolli E, Teixeira CP, Dias JM, Dias RC (2015) Aerobic fitness and habitual physical activity in frail and nonfrail community-dwelling elderly. J Phys Act Health 12(9):1304–1311. https://doi.org/10.1123/jpah.2014-0290

Batty GD, Zaninotto P, Watt RG, Bell S (2017) Associations of pet ownership with biomarkers of ageing: population based cohort study. BMJ 359:j5558. https://doi.org/10.1136/bmj.j5558

Bauman AE, Russell SJ, Furber SE, Dobson AJ (2001) The epidemiology of dog walking: an unmet need for human and canine health. Med J Aust 175(11–12):632–634

Baun MM, Bergstrom N, Langston NF, Thoma L (1984) Physiological effects of human/companion animal bonding. Nurs Res 33(3):126–129

Beck AM, Meyers NM (1996) Health enhancement and companion animal ownership. Annu Rev Public Health 17:247–257

Beetz A, Uvnäs-Moberg K, Julius H, Kotrschal K (2012) Psychosocial and psychophysiological effects of human-animal interactions: the possible role of oxytocin. Front Psychol 3:234. https://doi.org/10.3389/fpsyg.2012.00234

Blunck H, Owsley C, MacLennan PA, McGwin G (2013) Driving with pets as a risk factor for motor vehicle collisions among older drivers. Accid Anal Prev 58:70–74. https://doi.org/10.1016/j.aap.2013.04.019

Boss L, Kang DH, Branson S (2015) Loneliness and cognitive function in the older adult: a systematic review. Int Psychogeriatr 27(4):541–553. https://doi.org/10.1017/S1041610214002749

Bowling A (2005) What is successful ageing and who should define it? BMJ 2005:331. https://doi.org/10.1136/bmj.331.7531.1548

Branson S, Boss L, Cron S, Kang DH (2016) Examining differences between homebound older adult pet owners and non-pet owners in depression, systemic inflammation, and executive function. Anthrozoös 29(2):323–334

Brown SG, Rhodes RE (2006) Relationships among dog ownership and leisure-time walking in Western Canadian adults. Am J Prev Med 30(2):131–136

Calvo P, Bowen J, Bulbena A, Tobeña A, Fatjó J (2016a) Highly educated men establish strong emotional links with their dogs: a study with monash dog owner relationship scale (MDORS) in committed Spanish dog owners. PLoS One 11(12):e0168748. https://doi.org/10.1371/journal.pone.0168748

Calvo P, Fortuny JR, Guzman S, Macias C, Bowen J, Garcia ML, Orejas O, Molins F, Tvarijonaviciute A, Ceron JJ, Bulbena A, Fatjo J (2016b) Animal assisted therapy (AAT) program as a useful adjunct to conventional psychosocial rehabilitation for patients with schizophrenia: results of a small-scale randomized controlled trial. Front Psychol 06:7. https://doi.org/10.3389/fpsyg.2016.00631

Campbell J, Dwyer JJM, Coe JB (2017) Intervention mapping to develop a print resource for dog-walking promotion in Canada. J Vet Med Educ 44(2):234–246. https://doi.org/10.3138/jvme.1115-189R

Cassel J (1976) The contribution of the social environment to host resistance: the Fourth Wade Hampton. Am J Epidemiol 104:107–123

Chen CH, Chen YJ, Tu HP, Huang MH, Jhong JH, Lin KL (2014) Benefits of exercise training and the correlation between aerobic capacity and functional outcomes and quality of life in elderly patients with coronary artery disease. Kaohsiung J Med Sci 30(10):521–530

Cherniack EP, Cherniack AR (2014) The benefit of pets and animal-assisted therapy to the health of older individuals. Curr Gerontol Geriatr Res 2014:1–9, Article ID 623203. https://doi.org/10.1155/2014/623203\2014.08.004

Christian H, Westgarth C, Bauman A, Richards EA, Rhodes R, Evenson K, Mayer JA, Thorpe RJ (2013) Dog ownership and physical activity: a review of the evidence. J Phys Act Health 10:750–759. https://doi.org/10.1123/jpah.10.5.750

Clements PT, Benasutti KM, Carmone A (2003) Support for bereaved owners of pets. Perspect Psychiatr Care 39(2):49–54. https://doi.org/10.1016/j.kjms

Cline KM (2010) Psychological effects of dog ownership: role strain, role enhancement, and depression. J Soc Psychol 150(2):117–131. https://doi.org/10.1080/00224540903368533

Crowley-Robinson P, Fenwick DC, Blackshaw JK (1996, April) A long-term study of elderly people in nursing homes with visiting and resident dogs. Appl Anim Behav Sci 47(1–2):137–148. https://doi.org/10.1016/0168-1591(95)01017-3

Cooke BK (2013) Extended suicide with a pet. J Am Acad Psychiatry Law 41(3):437–443

Cutt H, Giles-Corti B, Knuiman M, Burke V (2007) Dog ownership, health and physical activity: a critical review of the literature. Health Place 13(1):261–272

Cutt HE, Knuiman MW, Giles-Corti B (2008) Does getting a dog increase recreational walking? Int J Behav Nutr Phys Act 5:17. https://doi.org/10.1186/1479-5868-5-17

Dall PM, Ellis SLH, Ellis BM, Grant PM, Colyer A, Gee NR, Granat MH, Mills DS (2017) The influence of dog ownership on objective measures of free-living physical activity and sedentary behaviour in community-dwelling older adults: a longitudinal case-controlled study. BMC Public Health 17:496. https://doi.org/10.1186/s12889-017-4422-5

Dembicki D, Anderson J (1996) Pet ownership may be a factor in improved health of the elderly. J Nutr Elder 15(3):15–31

DeSchriver M, Riddick C (1990) Effects of watching aquariums on elders' stress. Anthrozoös 4(1):44–48

Dury R (2014) Social isolation and loneliness in the elderly: an exploration of some of the issues. Br J Community Nurs 19(3):125–128

Eddy J, Hart LA, Boltz RP (1988) The effects of service dogs on social acknowledgments of people in wheelchairs. J Psychol Interdiscip Appl 122(1):39–45. https://doi.org/10.1080/00223980.1988.10542941

Edwards NE, Beck AM (2002) Animal-assisted therapy and nutrition in Alzheimer's disease. West J Nurs Res 24(6):697–712

Eifert EK, Wideman L, Oberlin DJ, Labban J (2014) The relationship between physical activity and perceived health status in older women: findings from the Woman's College Alumni Study. J Women Aging 26(4):305–318. https://doi.org/10.1080/08952841.2014.906878

Endenburg N (1999) Perceptions and attitudes towards horses in European societies. Equine Vet J Suppl 28:38–41

Engelman M, Canudas-Romo V, Agree EM (2010) The implications of increased survivorship for mortality variation in aging populations. Popul Dev Rev 36(3):511–539

Enmarker I, Hellzén O, Ekker K, Berg AG (2015) Depression in older cat and dog owners: the Nord-Trøndelag Health Study (HUNT)-3. Aging Ment Health 19(4):347–352. https://doi.org/10.1080/13607863.2014.933310

Flynn C (2000) Pet abuse and the role of companion animals in the lives of battered women. Violence Against Women 6(2):162–177. https://doi.org/10.1177/10778010022181778

Forte R, Boreham CA, De Vito G, Pesce C (2015) Health and quality of life perception in older adults: the joint role of cognitive efficiency and functional mobility. Int J Environ Res Public Health 12(9):11328–11344. https://doi.org/10.3390/ijerph120911328

Frankel JE, Bean JF, Frontera WR (2006) Exercise in the elderly: research and clinical practice. Clin Geriatr Med 22(2):239–256; vii

Friedmann E, Thomas SA, Stein PK, Kleiger RE (2003) Relation between pet ownership and heart rate variability in patients with healed myocardial infarcts. Am J Cardiol 91(6):718–721

Friedmann E, Galik E, Thomas SA, Hall PS, Chung SY, McCune S (2015) Evaluation of a pet-assisted living intervention for improving functional status in assisted living residents with mild to moderate cognitive impairment: a pilot study. Am J Alzheimers Dis Other Dement 30(3):276–289. https://doi.org/10.1177/1533317514545477

Fries JF (1980) Aging, natural death, and the compression of morbidity. N Engl J Med 303(3):130–135

Garrity TF, Stallones LF, Marx MB, Johnson TP (1989) Pet ownership and attachment as supportive factors in the health of the elderly. Anthrozoös 3(1):35–44

Graf S (1999) The elderly and their pets. Supportive and problematic aspects and implications for care. A descriptive study. Pflege 12(2):101–111

Guest CM, Collis GM, McNicholas J (2006) Hearing dogs: a longitudinal study of social and psychological effects on deaf and hard-of-hearing recipients. J Deaf Stud Deaf Educ Spring 11(2):252–61.

Hara T, Shimada T (2007) Effects of exercise on the improvement of the physical functions of the elderly. J Phys Ther Sci 19(1):15–26. https://doi.org/10.1589/jpts.19.15

Hardin DS, Anderson W, Cattet J (2015) Dogs can be successfully trained to alert to hypoglycemia samples from patients with type 1 diabetes. Diabetes Ther 6(4):509–517

Hart L, Hart B, Bergin B (1987) Socializing effects of service dogs for people with disabilities. Anthrozoös 1(1):41–44

Hayama S, Chang L, Gumus K, King G, Ernst T (2016) Neural correlates for perception of companion animal photographs. Neuropsychologia 85:278–286. https://doi.org/10.1016/j.neuropsychologia.2016.03.018

Headey B, Grabka MM (2007) Pets and human health in Germany and Australia: National longitudinal results. Soc Indic Res 80(2):297–311

Heinrichs M, Baumgartner T, Kirschbaum C, Ehlert U (2003) Social support and oxytocin interact to suppress cortisol and subjective responses to psychosocial stress. Biol Psychiatry 54:1389

Heuberger R (2017) Associations of pet ownership with older adults eating patterns and health. Curr Gerontol Geriatr Res 2017:1–9, Article ID 9417350. https://doi.org/10.1155/2017/9417350

Hills AP, Street SJ, Byrne NM (2015) Physical activity and health: "What is old is new again". Adv Food Nutr Res 75:77–95. https://doi.org/10.1016/bs.afnr.2015.06.001

Homnick TD, Henning KM, Swain CV, Homnick D (2015) The effect of therapeutic horseback riding on balance in community-dwelling older adults: a pilot study. J Appl Gerontol 34(1):118–126. https://doi.org/10.1177/0733464812467398

Horvath G, Järverud GA, Järverud S, Horváth I (2008, Jun) Human ovarian carcinomas detected by specific odor. Integr Cancer Ther 7(2):76–80. https://doi.org/10.1177/1534735408319058

Ikegami N, Campbell J (1995) Medical care in Japan. N Engl J Med 333:1295–1299

Jøranson N, Pedersen I, Rokstad AM, Ihlebæk C (2015) Effects on symptoms of agitation and depression in persons with dementia participating in robot-assisted activity: a cluster-randomized controlled trial. J Am Med Dir Assoc 16(10):867–873. https://doi.org/10.1016/j.jamda.2015.05.002

Kanamori M, Suzuki M, Yamamoto K, Kanda M, Matsui Y, Kojima E, Fukawa H, Sugita T, Oshiro H (2001) A day care program and evaluation of animal-assisted therapy (AAT) for the elderly with senile dementia. Am J Alzheimers Dis Other Demen 16(4):234–239

Kang KY (2015) Effects of mechanical horseback riding on the balance ability of the elderly. J Phys Ther Sci 27(8):2499–2500. https://doi.org/10.1589/jpts.27.2499

Kim SK, HwangBo G (2017) The effects of horse-riding simulator exercise on balance in elderly with knee osteoarthritis. J Phys Ther Sci 29(3):387–389. https://doi.org/10.1589/jpts.29.387

Kim SR, Cho SH, Kim JW, Lee HC, Brienen M, Cho BJ (2015) Effects of horseback riding exercise therapy on background electroencephalograms of elderly people. J Phys Ther Sci 27(7):2373–2376. https://doi.org/10.1589/jpts

Kosfeld M, Heinrichs M, Zak PJ, Fischbacher U, Fehr E (2005) Oxytocin increases trust in humans. Nature 435:673–676. https://doi.org/10.1038/nature03701

Kramer SC, Friedmann E, Bernstein PL (2009) Comparison of the effect of human interaction, animal-assisted therapy, and AIBO assisted therapy on long-term care residents with dementia. Anthrozoös 22(1):43–57. https://doi.org/10.2752/175303708X390464

Krause-Parello CA (2012) Pet ownership and older women: the relationships among loneliness, pet attachment support, human social support, and depressed mood. Geriatr Nurs 33(3):194–203. https://doi.org/10.1016/j.gerinurse.2011.12.005

Kuban M, Królikowski J, Nowicki M (2016) Dog ownership status and self-assessed health, lifestyle and habitual physical activity in chronic hemodialysis patients. Hemodial Int 20(3):447–452. https://doi.org/10.1111/hdi.12398

Kurrie SE, Day R, Cameron ID (2004) The perils of pet ownership: a new fall-injury risk factor. Med J Aust 181:682–683

La Rovere MT, Pinna GD (2014) Beneficial effects of physical activity on baroreflex control in the elderly. Ann Noninvasive Electrocardiol 19(4):303–310. https://doi.org/10.1111/anec.12170

Levine G, Allen K, Braun LT, Christian HE, Friedmann E, Taubert K, Thomas SA, Wells D, Lange R (2013) Pet ownership and cardiovascular risk a scientific statement from the American Heart Association. Circulation 127:2353–2363. https://doi.org/10.1161/CIR.0b013e31829201e1

Lundqvist M, Carlsson P, Sjödahl R, Theodorsson R, Levin LA (2017) Patient benefit of dog-assisted interventions in health care: a systematic review. BMC Complement Altern Med 17:358. https://doi.org/10.1186/s12906-017-1844-7

Magistro D, Liubicich ME, Candela F, Ciairano S (2014) Effect of ecological walking training in sedentary elderly people: act on aging study. Gerontologist 54(4):611–623. https://doi.org/10.1093/geront/gnt039

Manton KG, Corder LS, Stallard E (1993) Estimates of change in chronic disability and institutional incidence and prevalence in the elderly population from 1982, 1984 and 1989-National Long Term Care Survey. J Gerontol B 47:S153–S166

Manton KG, Stallard E, Corder LS (1995) Changes in morbidity and chronic disability in the US elderly population from 1982, 1984 and 1989-National Long Term Care Survey. J Gerontol 50B:S194–S204

McHarg M, Baldock C, Headey B, Robinson A (1995) National people and pets survey. Urban Animal Management Coalition, Sydney

McNicholas J, Gilbey A, Rennie A, Ahmedzai S, Dono J, Ormerod E (2005) Pet ownership and human health: a brief review of evidence and issues. BMJ 331:1252–1125

Menna LF, Santaniello A, Gerardi F, Di Maggio A, Milan G (2016) Evaluation of the efficacy of animal-assisted therapy based on the reality orientation therapy protocol in Alzheimer's disease patients: a pilot study. Psychogeriatrics 16(4):240–246. https://doi.org/10.1111/psyg.12145

Montero-Fernández N, Serra-Rexach JA (2013) Role of exercise on sarcopenia in the elderly. Eur J Phys Rehabil Med 49(1):131–143

Moretti F, De Ronchi D, Bernabei V, Marchetti L, Ferrari B, Forlani C, Negretti F, Sacchetti C, Atti AR (2011) Pet therapy in elderly patients with mental illness. Psychogeriatrics 11(2):125–129. https://doi.org/10.1111/j.1479-8301.2010.00329.x

Mosallanezhad Z, Salavati M, Sotoudeh GR, Nilsson Wikmar L, Frändin K (2014) Walking habits and health-related factors in 75-year-old Iranian women and men. Arch Gerontol Geriatr 58(3):320–326. https://doi.org/10.1016/j.archger.2013.11.008

Mossello E, Ridolfi A, Mello AM, Lorenzini G, Mugnai F, Piccini C, Barone D, Peruzzi A, Masotti G, Marchionni N (2011) Animal-assisted activity and emotional status of patients with Alzheimer's disease in day care. Int Psychogeriatr 23(6):899–905. https://doi.org/10.1017/S1041610211000226

Müllersdorf M, Granström F, Sahlqvist L, Tillgren P (2010) Aspects of health, physical/leisure activities, work and socio-demographics associated with pet ownership in Sweden. Scand J Public Health 38(1):53–63. https://doi.org/10.1177/1403494809344358

Nagasawa M, Mitsui S, En S, Ohtani N, Ohta M, Sakuma Y, Onaka T, Mogi K, Kikusui T (2015) Social evolution. Oxytocin-gaze positive loop and the coevolution of human-dog bonds. Science 348(6232):333–336. https://doi.org/10.1126/science.1261022

Nagelhout GE, Spruijt R, Postma N, Hogeling L, de Vries H (2017) Barriers and facilitators for health behavior change among adults from multi-problem households: a qualitative study. Int J Environ Res Public Health 14(10):1229. https://doi.org/10.3390/ijerph14101229

National Council on Aging (NCOA) (2018). https://www.ncoa.org/news/resources-for-reporters/get-the-facts/falls-prevention-facts/

National Electronic Injury Surveillance System from USA (NEISS). https://www.cpsc.gov/Research%2D%2DStatistics/NEISS-Injury-Data

Odendaal JS, Meintjes RA (2003) Neurophysiological correlates of affiliative behaviour between humans and dogs. Vet J 165(3):296–301

Oka K, Shibata A (2009) Dog ownership and health-related physical activity among Japanese adults. J Phys Act Health 6(4):412–418

Olivier A, Faugloire E, Lejeune L, Biau S, Isableu B (2017) Head stability and head-trunk coordination in horseback riders: the contribution of visual information according to expertise. Front Hum Neurosci 11:11. https://doi.org/10.3389/fnhum.2017.00011

Ong AD, Uchino BN, Wethington E (2016) Loneliness and health in older adults: a mini-review and synthesis. Gerontology 62(4):443–449. https://doi.org/10.1159/000441651

Parker GB, Gayed A, Owen CA, Hyett MP, Hilton TM, Heruc GA (2010) Survival following an acute coronary syndrome: a pet theory put to the test. Acta Psychiatr Scand 121(1):65–70. https://doi.org/10.1111/j.1600-0447.2009.01410.x

Parslow RA, Jorm AF, Christensen H, Rodgers B, Jacomb P (2005) Pet ownership and health in older adults: findings from a survey of 2,551 community-based Australians aged 60–64. Gerontology 51:40–47. https://doi.org/10.1159/000081433

Perelle IB, Granville DA (1983) Assessment of the effectiveness of a pet facilitated therapy program in a nursing home setting. Soc Anim 1:91–100

Pet Secure (2018) Pet secure: protecting your pets. https://www.petsecure.com.au/pet-care/a-guide-to-worldwide-pet-ownership

Petersson M, Uvnäs-Moberg K, Nilsson A, Gustafson LL, Hydbring-Sandberg E, Handlin L (2017) Oxytocin and cortisol levels in dog owners and their dogs are associated with behavioral patterns: an exploratory study. Front Psychol 8:1796. https://doi.org/10.3389/fpsyg.2017.01796

PetFoodIndustry (2018). https://www.petfoodindustry.com/articles/5845-infographic-most-of-world-owns-pets-dogs-are-tops

Phelps KA, Miltenberger RG, Jens T, Wadeson H (2008) An investigation of the effects of dog visits on depression, mood, and social interaction in elderly individuals living in a nursing home. Behav Interv 23(3):181–200. https://doi.org/10.1002/bin.263

Pikhartova J, Bowling A, Victor C (2014) Does owning a pet protect older people against loneliness? BMC Geriatr 20(14):106. https://doi.org/10.1186/1471-2318-14-106

Pluijm SMF, Smit JH, Tromp EAM, Stel VS, Deeg DJH, Bouter LM, Lips P (2006) A risk profile for identifying community-dwelling elderly with a high risk of recurrent falling: results of a 3-year prospective study. Osteoporos Int 17:417–425. https://doi.org/10.1007/s00198-005-0002-0

Pohnert TS (2010) The effect of pet ownership on physical well-being in older adults. PhD thesis, Virginia Commonwealth University

Prestrude A, O'Shea J (1996) Dogs in service to humans. In: Greenberg G, Haroway M (eds) Comparative psychology: a handbook. Garland, New York

Raina P, Waltner-Toews D, Bonnett B, Woodward C, Abernathy T (1999) Influence of companion animals on the physical and psychological health of older people: an analysis of a one-year longitudinal study. J Am Geriatr Soc 47(3):323–329

Raleigh VS (1999) Trends in world population: how will the millenium compare with the past? Hum Reprod Update 5(5):500–505

Richeson NE (2003) Effects of animal-assisted therapy on agitated behaviors and social interactions of older adults with dementia. Am J Alzheimers Dis Other Demen 18(6):353–358

Robinson IH (1999) The human-horse relationship: how much do we know? Equine Vet J Suppl (28):42–45

Ruzić A, Miletić B, Ruzić T, Persić V, Laskarin G (2011) Regular dog-walking improves physical capacity in elderly patients after myocardial infarction. Coll Antropol 35(Suppl 2):73–75

Saunders J, Parast L, Babey SH, Miles JV (2017) Exploring the differences between pet and non-pet owners: implications for human-animal interaction research and policy. PLoS One 12(6):e0179494. https://doi.org/10.1371/journal.pone.0179494

Scheibeck R, Pallauf M, Stellwag C, Seeberger B (2011) Elderly people in many respects benefit from interaction with dogs. Eur J Med Res 16(12):557–563. https://doi.org/10.1186/2047-783X-16-12-557

Schreiner PJ (2016) Emerging cardiovascular risk research: impact of pets on cardiovascular risk pre-vention. Curr Cardiovasc Risk Rep 10(2):8. https://doi.org/10.1007/s12170-016-0489-2

Seeman TE, Crimmins EM (2001) Social environment effects on health and aging: integrating epidemiologic and demographic approaches and perspectives. Ann N Y Acad Sci 954:88–117

Seeman TE, Merkin SS, Crimmins EM, Karlamangla AS (2010) Disability trends among older Americans: National Health and Nutrition Examination Surveys, 1988–1994 and 1999–2004. Am J Public Health 100(1):100–107. PMCID: PMC2791257, https://doi.org/10.2105/AJPH.2008.157388, PMID: 19910350

Shiloh S, Sorek G, Terkel J (2003) Reduction of state-anxiety by petting animals in a controlled laboratory experiment. J Anxiety Stress Coping 16(4):387–395. https://doi.org/10.1080/1061580031000091582

Shintani M, Senda M, Takayanagi T, Katayama Y, Furusawa K, Okutani T, Kataoka M, Ozaki T (2010) The effect of service dogs on the improvement of health-related quality of life. Acta Med Okayama 64(2):109–113

Siegel JM (1990) Stressful life events and use of physician services among the elderly: the moderating role of pet ownership. J Pers Soc Psychol 58(6):1081–1086

Simpson AJ, Matusiewicz SP, Greening AP, Crompton GK (2000) Pet ownership and asthma morbidity. Respir Med 94:91–92. Article No. rmed. 1999.0695

Smith DW, Seibert CS, Jackson FW 3rd, Snell J (1992) Pet ownership by elderly people: two new issues. Int J Aging Hum Dev 34(3):175–184

Stanley IH, Conwell Y, Bowen C, Van Orden KA (2014) Pet ownership may attenuate loneliness among older adult primary care patient who live alone. Aging Ment Health 18(3):394–399. https://doi.org/10.1080/13607863.2013.837147

Stuck AE, Waltherta JM, Nikolaus T, Büla CJ, Hohmann C, Beck JC (1999) Risk factors for functional status decline in community-living elderly people: a systematic literature review. Soc Sci Med 48(4):445–469. https://doi.org/10.1016/S0277-9536(98)00370-0

Stull JW, Peregrine AS, Sargeant JM, Weese JS (2012) Household knowledge, attitudes and practices related to pet contact and associated zoonoses in Ontario, Canada. BMC Public Health 12:553. https://doi.org/10.1186/1471-2458-12-553

Suminski RR, Poston WS, Petosa RL, Stevens E, Katzenmoyer LM (2005) Features of the neighborhood environment and walking by U.S. adults. Am J Prev Med 28(2):149–155

Swall A, Ebbeskog B, Lundh Hagelin C, Fagerberg I (2015) Can therapy dogs evoke awareness of one's past and present life in persons with Alzheimer's disease? Int J Older People Nursing 10(2):84–93. https://doi.org/10.1111/opn.12053

Takayanagi K, Kirita T, Shibata T (2014) Comparison of verbal and emotional responses of elderly people with mild/moderate dementia and those with severe dementia in responses to seal robot PARO. Front Aging Neurosci 6:257. https://doi.org/10.3389/fnagi.2014.00257

Tamura T, Yonemitsu S, Itoh A, Oikawa D, Kawakami A, Higashi Y, Fujimooto T, Nakajima K (2004) Is an entertainment robot useful in the care of elderly people with severe dementia? J Gerontol A Biol Sci Med Sci 59(1):83–85

Thodberg K, Sørensen LU, Christensen JW, Poulsen PH, Houbak B, Damgaard V, Keseler I, Edwards D, Videbech PB (2016) Therapeutic effects of dog visits in nursing homes for the elderly. Psychogeriatrics 16(5):289–297. https://doi.org/10.1111/psyg.12159

Thorpe RJ Jr, Kreisle RA, Glickman LT, Simonsick EM, Newman AB, Kritchevsky S (2006) Physical activity and pet ownership in year 3 of the Health ABC study. J Aging Phys Act 14(2):154–168

Tissot S (2011) Of dogs and men: the making of spatial boundaries in a gentrifying neighborhood. City Community 10(3):265–284. https://doi.org/10.1111/j.1540-6040.2011.01377.x

Toohey AM, Rock MJ (2018) Disruptive solidarity or solidarity disrupted? A dialogical narrative analysis of economically vulnerable older Adults' efforts to age in place with pets. Public Health Ethics 12(1):15–29. https://doi.org/10.1093/phe/phy009

Torske MO, Krokstad S, Stamatakis E, Bauman A (2017) Dog ownership and all-cause mortality in a population cohort in Norway: the HUNT study. PLoS One 12(6):e0179832. https://doi.org/10.1371/journal.pone.0179832

Uvnäs-Moberg K (1998) Oxytocin may mediate the benefits of positive social interaction and emotions. Psychoneuroendocrinology 23(8):819–835. https://doi.org/10.1016/S0306-4530(98)00056-0

Valentine D, Kiddoo M, LaFleur B (1993) Psychosocial implications of service dog ownership for people who have mobility or hearing impairments. Soc Work Health Care 19(1):109–125. https://doi.org/10.1300/J010v19n01_07

VanSwearingen JM, Studenski SA (2014) Aging, motor skill, and the energy cost of walking: implications for the prevention and treatment of mobility decline in older persons. J Gerontol A Biol Sci Med Sci 69(11):1429–1436. https://doi.org/10.1093/gerona/glu153

Vetter N (2010) The epidemiology of aging. In: Fillit H, Rockwood K, Kenneth K (eds) Brocklehurst's textbook of geriatric medicine, 7th edn. Saunders Elsevier, Philadelphia

Virués-Ortega J, Buela-Casal G (2006) Psychophysiological effects of human-animal interaction: theoretical issues and long-term interaction effects. J Nerv Ment Dis 194(1):52–57

Virués-Ortega J, Pastor-Barriuso R, Castellote JM, Población A, Pedro-Cuesta J (2012) Effect of animal-assisted therapy on the psychological and functional status of elderly populations and patients with psychiatric disorders: a meta-analysis. Health Psychol Rev 6(2):197–221. https://doi.org/10.1080/17437199.2010.534965

Walsh F (2009) Human-animal bonds I: the relational significance of companion animals. Fam Process 48(4):462–480. https://doi.org/10.1111/j.1545-5300.2009.01296.x

Westgarth C, Christley RM, Marvin G, Perkins E (2017) I walk my dog because it makes me happy: a qualitative study to understand why dogs motivate walking and improved health. Int J Environ Res Public Health 14(8):936. https://doi.org/10.3390/ijerph14080936. PMID: 28825614

White N, Mills D, Hall S (2017) Attachment style is related to quality of life for assistance dog owners. Int J Environ Res Public Health 14(6):pii: E658. https://doi.org/10.3390/ijerph14060658

WHO (2011) Library World report on disability. ISBN 978 92 4 156418 2

WHO (2014) Basic documents, 48th edn. WHO, Geneva

WHO (2015) World report on ageing and health. WHO, Geneva

Willmott H, Greenheld N, Goddard R (2012) Beware of the dog? An observational study of dog-related musculoskeletal injury in the UK. Accid Anal Prev 46:52–54. https://doi.org/10.1016/j.aap.2011.10.004

Winefield HR, Black A, Chur-Hansen A (2008) Health effects of ownership of and attachment to companion animals in an older population. Int J Behav Med 15(4):303–310. https://doi.org/10.1080/10705500802365532

Wood L, Martin K, Christian H, Nathan A, Lauritsen C, Houghton S, Kawachi I, McCune S (2015) The pet factor – companion animals as a conduit for getting to know people, friendship formation and social support. PLoS One 10(4):e0122085. https://doi.org/10.1371/journal.pone.0122085. PMID: 25924013

Xie ZY, Zhao D, Chen BR, Wang YN, Ma Y, Shi HJ, Wang YZM, Wang LS (2017) Association between pet ownership and coronary artery disease in a Chinese population. Medicine 96(13):e6466. https://doi.org/10.1097/MD.0000000000006466

Yabroff KR, Troiano RP, Berrigan D (2008) Walking the dog: is pet ownership associated with physical activity in California? J Phys Act Health 5:216–228

Yu CH, Piao YJ, Kim K, Kwon TK (2014) The effects of an 8-weeks training on postural control for the elderly. Int J Precis Eng Manuf 15(1):161–168