

Effects of Canine-Assisted Intervention on the Mental Health of Higher Education students: a systematic review.

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The aim of this systematic review was to evaluate existing literature exploring the effects of canine assisted intervention (CAI) on the mental health of Higher Education (HE) students. A literature search was performed on 14th January 2021 for studies that investigated the effects of CAI on HE students. Thirty-three papers (6093 participants) encompassing 37 studies were included in this review. Study design varied in research objective, intervention type, timing, procedure, and measures. The Effective Public Health Practice Project Quality Assessment Tool found studies ranged in quality from moderate (n=7) to weak (n=30). The review identified CAI has a positive effect on levels of anxiety and stress in HE students. Key limitations of the studies include confounding influences during the intervention as well as a lack of control groups and standardized measures. Furthermore, intervention and procedures ranged substantially in design and application making direct comparisons difficult. The authors conclude two main outcomes from the review. Firstly, CAI improves mental health in HE students, in particular anxiety and stress. Secondly, CAI has a social benefit, encouraging communication and a shared experience. However, a number of methodological limitations of the studies are identified and reviewed. To conclude, this systematic review reveals strong support for the use of CAI in HE students as a form of therapy.

Keywords: Canine-Assisted-Intervention, Higher Education, Mental Health, Anxiety

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Mental health is a growing public health concern. A recent longitudinal study (Kwong et al., 2021) found an increase in anxiety and a reduction in well-being as a result of the pandemic, particularly in young people and those with pre-existing health conditions. This is supported by Pierce et al. (2020), who found levels of mental distress increased in the UK population from 18.9% pre pandemic, to 27.3% just one month into the 2020 lockdown. Adolescents in particular, experienced an increase of symptoms related to depression (Wright et al., 2021), and Stewart et al., (2022) found clinical threshold levels of both anxiety and depression were exacerbated which negatively impacting mental health. Students in Higher Education (HE: education beyond secondary level, usually offered at a university or college) commonly suffer from mental health issues, in particular, stress, anxiety, and depression (e.g., Binfet & Passmore, 2016; Broglia, et al., 2021; Daltry & Mehr, 2015; Dell et al., 2015; Pollard et al., 2021). Andrews and Wilding (2004) found that 9% of students without signs of depression prior to enrolment in HE developed clinical depression mid-way through the course, and 20% suffered clinically significant anxiety levels during their time in HE. Similarly, Richardson et al. (2015) revealed that 17% of UK university students suffered from depression and a further 12% experienced an anxiety disorder. More recently Savage et al. (2021) reported a decrease in HE students well-being levels alongside an increased in perceived stress, and Catling et al. (2022) found both anxiety and depression levels increased as a result of COVID-19. One point of concern is that these studies only identify clinically significant depression and anxiety. These prevalence rates would be alarmingly higher if they also considered subclinical conditions.

HE students may experience periods of stress for a range of reasons (e.g., see Saleh et al., 2017). Specifically, Brown (2016) reports that increased tuition fees and student loans, alongside negative consequences of social media can increase risk of mental health issues in the current generation of university students. HE students may also experience greater levels of stress, anxiety, and depression than previous generations due to factors such as increased living costs or a lack of employment (Eisenberg, Gollust, Golberstein, & Hefner, 2007; Richardson et al., 2015). In addition, it has been suggested university students are at an age in which mental health issues are most likely to manifest (Richardson et al., 2015), a stage whereby young adults transitioning from childhood to adulthood poses an additional developmental challenge (Hunt & Eisenberg, 2009).

Currently the support for students struggling with mental health issues follows a traditional route (Kivlighan et al., 2021; Priestley et al., 2021; Rückert, 2015) which typically includes sessions with a trained professional schooled in the area of mental health issues (Adams et al., 2017; Brown, 2016; Goodman, 2017). However, these can often be restricted as they focus on issues within a particular moment in time (Goodman, 2017) or are time limited (Priestley et al., 2021) rather than providing ongoing support. Given that 94% of HE institutions found the demand for counselling services had increased, and that less than 29% of universities had an explicit mental health or well-being strategy in place (Thorley, 2017), it is clear that much more is needed to support HE students with mental health issues. This is even before one considers the yet known effects of the Covid-19 pandemic on students' mental health (Son et al., 2020), and whether the current cohort of HE students who started their education during the pandemic will require even more additional support.

The use of animals in therapy or animal assisted therapy (AAT) is not uncommon, nor is it new. Beck (2000) cites Florence Nightingale as identifying that animals were a good companion for the sick, and Hart (2000), in a discussion on the psychosocial benefits of animal companions, argues that animals enhance quality of life and provide unconditional support. Within AAT, the use of canines is a growing area of interest (e.g. Binfet et al., 2018; Buttelmann & Römpke, 2014; Crossman et al., 2015; Elmaci & Cevizci, 2015; Smith, 2013), and much of the research to date focuses on the benefits of the interaction between humans and canines on mental health issues such as stress, anxiety, and depression (e.g., Buttelmann & Römpke 2014; Crossman et al., 2015; Dell et al., 2015). Other studies focus on benefits of this interaction on a

range of medical conditions with more severe physical manifestations such as acute postoperative pain (Sobo et al., 2006), post-traumatic stress disorder (PTSD, Dietz et al., 2012), cancer (Johnson, et al., 2008), and disability (Wrinkle et al., 2011). For the purpose of this review, the term ‘canine assisted intervention’ (CAI, Manville, et al., 2022), see also Hartwig & Binfet, 2019a, 2019b; Silas et al., 2019) will be used to cover all dog or canine interaction used for therapeutic purposes.

The range of mental health issues HE students face during their time enrolled at university is wide (Brown, 2016; House of Commons, 2020; Kaparounaki, et al., 2020; The Insight Network, 2020). In addition, the need for support is on the rise (The Insight Network, 2020; Thorley, 2017). Therefore, it is possible that CAI within the HE sector will benefit not only the mental health issues experience by HE students, but also become an additional tool that universities can adopt to address the increased need for support. Despite the published studies and reviews discussing the benefits of human and canine interaction on student mental health (e.g., Adamle et al., 2009; Adams et al., 2017; Crump & Derting, 2015; Dell et al., 2015), to the author’s knowledge existing literature has not been reviewed in a *systematic* manner in relation to the benefits of this interaction in HE students. As such, a review of the published work would be beneficial in order to amass existing findings in order to draw an overall conclusion on the effectiveness of CAI in this population. Furthermore, it would be useful to evaluate existing findings about specific elements of CAI, such as whether the duration or location of the intervention is important in its effectiveness. Therefore, using the PRISMA statement checklist as a guidance tool (Moher et al., 2009, PRISMA statement checklist, item number 4, objectives), this review will address three objectives:

Objective 1: Identify, discuss, and evaluate existing evidence exploring the benefits of the interaction between human and canine on the mental health of students in HE, in particular anxiety, stress, and depression.

Objective 2: Explore the individuals experience of positive psychological functioning, relationships with others, and an awareness of self.

Objective 3: Examine whether current CAI studies are methodologically limited with specific focus on study design and specificity within this, participants, and sample size.

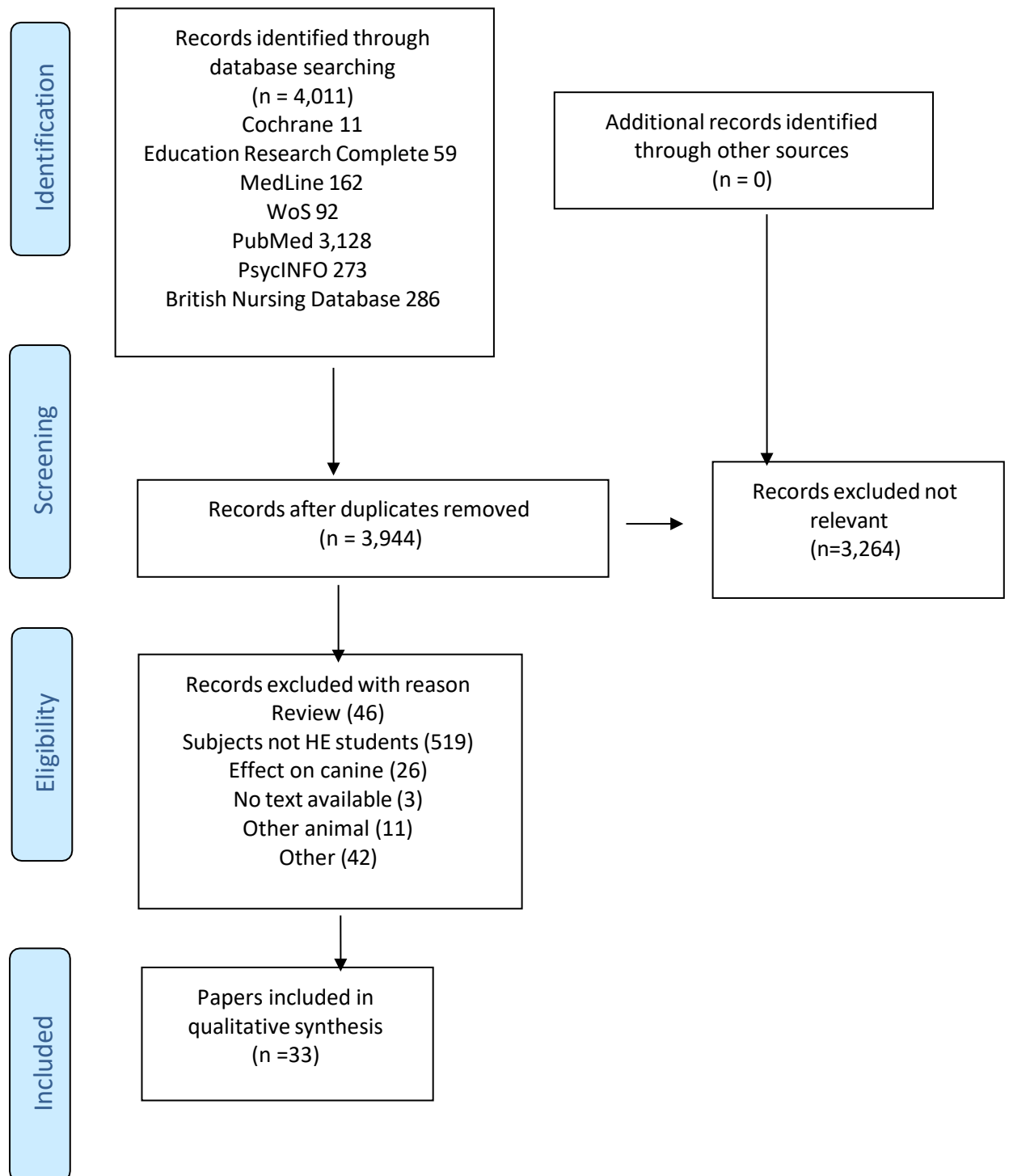
Methods

Literature search

Literature was searched for and identified in the form of journals from 1950 until 2021 (see Appendix 1 for search term). Seven databases were searched on 14th January 2021 to identify relevant papers: British Nursing Database, Cochrane Library, Education Research Complete, MEDLINE, PsycINFO, PubMed, and Web of Science. These databases were chosen based on the journals and types of papers published which includes medicine, mental health, and allied health care, education and psychology, zoology, veterinary science, interaction between animal and human, and all papers included physical interaction with a canine. No protocol was registered and therefore not included.

Study Selection

Figure 1: PRISMA Flow Diagram



(Adapted from Moher et al., 2009)

Eligibility criteria was based on item 4 of PRISMA's statement PICO and included: (1) studies published in English (P), (2) use of real dogs (I), (3) HE students as participants (P), (4) addressed mental health (O), well-being (O), stress (O), anxiety or depression (O), (5) any sample size (P), and (6) any intervention involving a real canine (with or without a comparison group, (C)). Reviews, studies not published in English, all grey literature and repetitions were excluded. There were no relevant HE student meta-analyses or systematic reviews. As a final but vital exclusion, all studies, meta-analyses or systematic reviews using school children as participants were removed leaving only HE students. Studies were independently screened for relevance by KM and co-authors (KN, CS, MM, SW and GR), and disagreements resolved through discussion. Unresolved discrepancies were resolved between KM and GR. The search term resulted in a total of 4,011 papers. After applying the exclusion criteria this yielded 33 papers in total (see PRISMA flow diagram, Figure 1). Of these 33 papers, three are multi- study papers (Crump & Derting, 2015; McArthur & Syrnyk, 2018; Trammell, 2017), bringing the total number of studies to 37. It is important to note that this review included all papers where the intervention was a real canine regardless of study design (with or without control/comparator and pre-post measures). The authors felt the field of researching the impact of CAI in the mental health of HE students in empirically peer reviewed papers is in its infancy, therefore the results of any paper that had been peer reviewed held some value. As the field progresses, future research should focus on interventions with only control/comparator groups and pre/post measures, which provide more robust evidence that the intervention has changed mental health and wellbeing.

Data Extraction

Data was extracted from each of the 37 studies to identify key elements (Appendix 2). Using the *Data Collection Form for Intervention Reviews: RCT and non-RCT* (Cochrane, 2022) as a template, a data extraction tool was created to identify key characteristics/variables of each paper. These key elements fall into three main categories. Firstly, key characteristics of the study including country of origin, sample population size, age range, participant mental health, socioeconomic status, and whether they were rewarded for their participation. Secondly, study methodology including aims, study type, design and setting, interaction type and duration, use of control and/or comparison groups, inclusion/exclusion criteria, number of canines, canine- to-human ratio, perception of canine, effect size, power sample calculation, and statistical analysis used. Finally, study outcomes including results and limitations.

Assessment of Study Quality

The Quality Assessment Tool for Quantitative Studies from the Effective Public Health Practice Project was applied to assess the quality of studies to identify potential bias or confounding factors (Effective Public Health Practice Project, 2009). Study qualities were evaluated using six categories: selection bias, study design, confounders, blinding, data collection methods, and withdrawal and dropouts. For selection bias, 78% of studies were rated as fair (participants somewhat likely to represent the target population) and 22% as poor (participants not likely to represent the target population). 22% of the studies were rated as good in study design (randomized control trial (RCT) or controlled clinical trial), 65% as fair (cohort analytical or case control, cohort design or interrupted time series studies), and 13% as poor (any other, or method not stated). Confounders were rated as good in 78% of studies

(controlled for 80% of relevant confounders), fair in 8% (controlled for 60-79% of relevant cofounders), and poor in 14% (controlled for 60% or less of relevant confounders, or confounders were not described). Blinding was rated as fair in 8% of studies (intervention status of participants are not made aware to the outcome assessor, or participants are not aware of the research question) and 92% were rated as poor (intervention status of participants is made aware to the outcome assessor, and participants are aware of the research question). The data collection method was rated as good in 46% of studies (data collection tools are valid and reliable), fair in 11% (data collection tools are valid but not reliable or reliability is not described), and poor in 43% (data collection tools are not valid, or neither validity nor reliability are described). Finally withdrawals/drop outs were rated as good in 16% of studies (follow up rate is 80% or above), fair in 22% of studies (follow up rates are 60-79%), and poor in 62% (follow up rates are 60% or less). Studies were rated by KM and co-authors KN, CS, MM, SW), and disagreements were resolved through discussion. Unresolved discrepancies were discussed between KM and GR.

Results

Appendix 2 presents a summary of the 37 studies.

Terminology

A range of terminologies were used to describe CAI. Seven of the 37 studies (18.92%) used AAT, and a further 12 (32.43%) used the term Therapy Dog. Three studies (8.11%) adopted the term Therapy Dog alongside an alternative term: Barker et al. (2016) used Therapy Dog Intervention, Daltry and Mehr (2015) Dog Therapy Outreach Program, and Dell et al. (2015) utilized Dog Therapy Program. Five studies (13.51%) used Animal Assisted Activities (AAA), two (5.41%) Canine Therapy, and Wilson (1987, 1991) applied the term 'effect of pet'. Two (5.41%) adopted a variation of 'dog-assisted': Grajfoner et al. (2017) used Dog-Assisted Intervention, and Wood, et al. (2018) Dog-Assisted Therapy. The remaining six studies (16.22%) utilized a variation of animal, canine, dog, and pet. Adamle et al. (2009) used the term Pet Therapy, Crossman et al. (2015) Animal Visitation Program, Delgado et al. (2018) Canine Play Intervention, Silas et al. (2019) Canine Assisted Intervention (CAI), Stewart and Strickland (2013) Human-Animal Intervention, and Thelwell (2019) used dog interaction.

Sample

Sample size ranged from 44 - 1960 participants ($M = 183$). Of the 37 studies, seven (18.92%) had fewer than 50 participants ($M = 41$), 24 studies (64.86%) between 51-150 ($M = 85$), and six (16.22%) used over 151 participants ($M = 629$). Ages ranged from 17-57 with a mean age of 21.17. Fifteen studies (40.54%) did not indicate ages and were therefore excluded from the calculations. Gender balance ranged from 100% to 55% females, 43% to 0% males, and 4.7% to 2% other. One study (2.70%) reported a transgender population and in five (13.51%) only female students were recruited. All participants were recruited within the university they were associated with.

Canine

Of the 37 studies, Wilson (1987, 1991) used a friendly dog, one study (2.70%) employed a companion dog (Stewart et al., 2014), and in Wood et al.'s (2018) study the canines were training to become Guide dogs. Buttelmann & Römpke (2014) did not identify the canine's status, and Thelwell (2019) used a house-trained dog. In the remaining 31 studies (83.78%) all canines were classed as therapy dogs/canines. Handlers or canine owners were present during all

data collection. Twenty-three studies (62.16%) gave specific canine breed and canine ages ranged from 10 months to 11 years, the remaining 14 (37.84%) did not include this information. Breeds included Collies, Golden Retrievers, Greyhounds, a Rhodesian Ridgeback, and Labradors alongside mixed breeds. Twelve studies (32.43%) utilized one canine in their research, one study (2.70%) 2 canines, and another (2.70%) three. One study (2.70%) had five canines, 18 studies (48.65%) used five or more canines, and in four studies (10.81%) the number of canines was unclear.

Study Design

Within the 37 studies, there were five different study designs. Fifteen studies (40.54%) employed an intervention only design with no control or comparison group, and 13 studies (35.14%) had a control group alongside an intervention group. Two studies (5.41%) had a comparison group alongside an intervention group but no control group and six of the studies (16.22%) used a comparison design examining an intervention group against a comparison and control group. The last study, (2.70%) Shearer et al., 2016) was a two-phase study. Phase one had an intervention alongside a comparison group and phase two used a comparison, an intervention and a control group.

Using an intervention only design, Dell et al. (2015) had other well-being activities available at the same time including hand and body massages and snacks however these were not all available on all campuses that took part in the study. Two studies (5.41%) had a canine or a human in the room while participants watched a traumatic film and one (2.70%) asked participants in the experimental group to interact with a real canine while the comparison group viewed images of the same dog. In the two studies (2.70%) that had a comparison group but no control group, one asked the comparison group to read (Muckle & Lasikiewicz, 2017), and another had participants complete number and word tasks either with or without the canine present (Stewart & Strickland, 2013). Additionally, of the three papers (8.11%) that used a multi-study design, a combination of designs were adopted. Crump and Derting's (2015) first study consisted of both an experimental and control group and study two only used a canine group. Both of McArther and Syrnyk's studies (2018) used only a canine group, and in Trammell's (2017) three studies, study one had an experimental group and studies two and three had both experimental and control groups. Hall (2018) identified long term effects (16 weeks) as part of their discussion, while Binfet (2017) and Shearer et al. (2016) carried out follow up data collection sessions 2 weeks post-intervention, and Dell et al. (2015) and Ward-Griffin, et al. (2018) 3 months and 10 hours respectively.

Study Location

Of the 37 studies, 29 (78.38%) were carried out in a private room and five (13.51%) in a common area on campus where students could come and go. In two of the studies (5.41%) the location was unclear and one (2.70%) described the location as being in an *appropriate area*.

Measures and instruments

Thirty-one studies (83.78%) adopted quantitative measures, one (2.70%) qualitative measures and five (13.51%) adopted mixed methods. A total of 29 standardized measures were used (see table 1 for full details). Of the 37 studies, 33 (89.19%) applied both pre and post measures. A further four (10.81% Adamble et al., 2009; Daltry & Mehr, 2015; Dell et al., 2015; McArther & Syrnyk, 2018) only used post measures.

Table 1.

Full list of standardized measures used including measure and the number of items per measure.

Variable	Measure	Items per Measure
Anxiety	Audience Anxiousness Scale	12
Anxiety	Burns Anxiety Inventory	32
Anxiety	State Trait Anxiety Inventory	20
Stress	Perceived Stress Scale	10
Stress	Stress Arousal Checklist	2 (subscales)
Depression	Becks Depression Inventory	21
Anxiety and Depression	Hospital Anxiety and Depression Scale	14
Life satisfaction of subjective well-being	Satisfaction with Life Scale	5
Well-being	Warwick-Edinburgh Mental Well-Being Scale	14
Mindfulness	Five Fact Mindfulness Questionnaire	39
Homesickness	Homesickness Questionnaire	33
Loneliness	University Of Philippines Loneliness Scale	25
Sense of belonging	Sense of Belonging in School	14
Connectedness to campus	Connectedness to Campus McAndrew's Measure of Rootedness	1
Attitude towards animals	Animal Attitude Scale	20
Experiences with a canine	Experiences with Dog Inventory	13
Attitudes towards pets	Pet Attitude Inventory	18
Human Animal Bonding	Pet Attitude Scale	18
Happiness	Subjective Happiness Scale	4
Current mood, stress, and arousal	Affect Measure	3
Positive and Negative Affect	Positive and Negative Affect Schedule	10
Mood	UWIST Mood Adjective Check List	24
Mood	Mood Tracking Scale	10
Self Esteem	Self-State Esteem Scale	20
Functional social support in chronically ill persons	Medical Outcomes Study Social Support Survey	8
Assesses attitudes	Semantic Differential	3 (dimensions)
Measures effective therapeutic relationships	Session Rating Scale	4
Credibility and expectancy	Credibility/Expectant Questionnaire	6

Intervention duration

The duration of CAI ranged in all 37 studies from 2 minutes to 2.5 hours. Table 2 details intervention duration and the number of studies with this duration.

Twenty-seven of the studies (72.97%) had the intervention at only one time point, while ten (27.03%) had multiple interventions. Sessions were spaced out over a two week to three month period with a minimum of two sessions (McArthur & Syrnyk, 2018; Trammell, 2019) and maximum of 16 sessions (Hall, 2018) available to participants.

Table 2.

Summary of intervention duration and number of studies per duration

Intervention duration	Number of studies
5 minutes	1 (2.7%)
10 minutes	3 (8.11%)
11 minutes	1 (2.7%)
13.5 minutes	1 (2.7%)
15 minutes	8 (21.62%)
20 minutes	4 (10.81%)
30 minutes +	14 (37.84%)
7-10 minutes	1 (2.7%)
2-30 minutes	1 (2.7%)
5-60 minutes	1 (2.7%)
5 minutes - 2 hours	1 (2.7%)
No duration specified	1 (2.7%)

Intervention activity

Of the 37 studies, 13 (35.14%) had participants take part individually. Buttellmann and Römpke (2014) assigned participants to a canine, fish, plant, or no interaction control group, Crossman et al. (2015) asked participants to play with a canine, view images of the canine, or be part of the control group by simply waiting, and Lass-Hennemann et al. (2014) assigned participants to one of four groups. All four groups watched a traumatic film however, the real dog group sat with a real dog, the toy dog group sat with a life sized toy Collie, and the friendly human group was accompanied by a previously unknown female graduate student. The alone group watched the film on their own. In their later study Lass-Hennemann, et al. (2018) had all participants watch a traumatic film. Following this the dog group interacted with a canine for 15 minutes, the dog-film group watched a film clip of someone interacting with a dog for 15 minutes, and the alone group relaxed for 15 minutes. Stewart and Strickland (2013) allocated specific tasks to participants in the presence of a canine which included Monk and Conrad's clerical tasks (basic maths and proof reading), and Wilson (1987, 1991) had participants read quietly or out loud with a canine present. Grajfoner et al. (2017) had the intervention group interact with both the canine and handler, and the control group interact with the handler only. Thelwell (2019) had the intervention group interact with a canine and the control group watched a video of a dog, and Machová et al. (2020) had a canine intervention group, a relaxation comparison group who used anti-stress cubes, coloring books and a phone with music, and a no activity control group. Delgado et al. (2018), Fiocco & Hunse (2017) and Ward-Griffin et al. (2017) asked participants to simply interact and play with a canine.

Five of the studies (13.51%) chose to have participants interact with the canine in groups in a busy area on campus where students could choose the level of interaction. A further 19 (51.35%) had participants interact with the canine in groups in a private room. None of the studies reported following any pre-published report, manual or procedure. Of the 37 studies, only 5 (7.4%) employed pre and post measures alongside a canine intervention group, a control group,

and a comparator group (studies described above). In exploring the effects of CAI on four different intervention groups, Butteltmann and Römpke's (2014) induced anxiety by having participants create a presentation on an unfamiliar subject. Following the intervention, all groups experienced a reduction in anxiety. This was greatest in the fish group (↓ 58.2%) when compared to the canine (↓ 56.2%) or plant (↓ 45.6%) groups, however the canine group showed more signs of enjoyment evidenced through laughter, and anxiety levels fell lower than the induced anxiety levels. Butteltmann and Römpke's (2014) were not alone in reporting CAI not as effective as a comparison group. In Lass-Hennemann, et al.'s (2014) study, both the canine and friendly group were comparable in reducing anxiety, however in their later study (Lass-Hennemann, et al., 2018), it was reported that the CAI group experienced a greater reduction in anxiety when compared against both the comparison and control group. Crossman et al.'s (2015) followed the results of Lass-Hennemann, et al. (2018) reporting the greatest reduction in anxiety was experienced by the canine group when compared to the comparison and control groups. These results were also mirrored by Machová et al. (2020) who found participants that interacted with a canine experienced a greater reduction in stress when compared to the comparison and control groups.

Outcomes

Outcomes measured by the studies include anxiety, stress, depression, homesickness, and loneliness while social benefits included CAI taking on the role of a facilitator and encouraging social interaction.

Anxiety

Of the sixteen studies (43.24%) that measured anxiety, 13 identified that CAI effectively reduced anxiety (see Appendix 2 for a summary of details). Five of these studies applied a stressor to elicit higher levels of anxiety before then looking at whether that anxiety was reduced following the interaction. Eleven studies (29.73%) measured existing anxiety without applying a stressor.

Three of the studies (8.11%) did not report entirely supportive results. Stewart and Strickland (2013) demonstrated that not all participants experienced a decrease in state anxiety simply with the presence of a dog. Additionally, Butteltmann and Römpke (2014) reported a reduction in anxiety following CAI (↓ 56.2%) but also a decrease in anxiety in participants who interacted with a fish (↓ 58.2%) and plant (↓ 45.6%). While those in the fish group had a greater decrease in anxiety compared to the CAI group it was found that anxiety levels of participants who interacted with a dog dropped lower than induced anxiety levels and that the CAI group laughed more during interaction indicating a sign of enjoyment. Lass-Hennemann, et al. (2014) also found CAI was not the most effective intervention as results from participants who were accompanied by a canine during the applied stressor were comparable to those who were accompanied by a friendly human.

Physiological measures as an indicator of anxiety were used in seven studies (18.92%), however only four (10.81%) recorded a decrease in BP as a result of CAI (Jarolmen & Patel, 2018; Muckle & Lasikiewicz, 2017; Wood et al., 2018; Wilson, 1987). Lass-Hennemann et al. (2014, 2018) found physiological and endocrine stress markers increased as a result of their applied stressor but were not moderated by the canine intervention. Butteltmann & Römpke (2014) removed all physiological measures (blood pressure (BP) and heart rate (HR)) as over 50% of participants did not indicate a positive effect in relation to anxiety, and it was felt BP and HR were influenced by other physical factors such as speech and movement.

Stress

Twenty-two (59.46%) of the studies explored the effect of CAI on stress, with 17 (identifying a reduction in stress following CAI (see Appendix 2). Four of the studies (10.81%) did not find CAI to be effective in reducing self-reported stress levels (Barker et al., 2016; Crump & Derting, 2015 [study 1 and study 2]; Stewart & Strickland, 2013). An additional study, Griscti and Camilleri (2020), using physiological measures found that the presence of a canine had no effect on HR. Therefore, five studies failed to find CAI to be an effective intervention.

In addition to Griscti & Camilleri (2020), six other studies used a physiological measure (HR, BP, saliva nerve growth factor, (sNGF), heart rate variability (HRV)). Barker et al. (2016) found the majority of sNGF levels were undetectable and suggested that the stressor was not sufficient enough to cause an effect, therefore supporting their lack of an effect of CAI on self-reported stress. Similarly, Machová et al. (2020) found no significant reduction in systolic or diastolic BP in those who took part in a 10-minute canine interaction session compared to the control or comparison groups. Shearer et al. (2016) also found no significant change in HRV following CAI. Instead, the comparison (mindfulness) group showed higher HRV indicating the act of mindfulness may help students manage stress. As the only study to find any significant effect, Delgado et al. (2018) found all physiological markers of stress (systolic and diastolic BP, pulse, and salivary cortisol) decreased with the presence of a canine.

Depression

Depression was measured by two (5.41%) of the 37 studies. Shearer et al. (2016) found no significant difference between dog interaction and mindfulness groups as measured by the BDI. In addition, Hall (2018) excluded depression due to an abnormal distribute of the scores at the beginning and end of the semester.

Related to depression, two studies (5.41%, Dell et al., 2015; Stewart et al., 2014) identified a benefit of CAI on participants feelings of loneliness. The commonality between these studies was group rather than individual participation, therefore, not only did the participants benefit from the therapeutic value of CAI, but also the positive influence of social interaction with other humans.

Social benefits

Six studies (16.22%) found social factors had a positive influence on the benefit of CAI. Adamle et al. (2009) demonstrated CAI allowed students to build social relationships, and Binfet and Passmore (2016) identified CAI reduced feelings of homesickness. Participants found social interactions born from a non-judgemental environment allowed them to chat and make friendships that otherwise would not have been formed. Shearer et al. (2016) demonstrated the social environment supported short term anxiety and dysphoria reduction, and both Binfet (2017) and Stewart et al. (2014) found CAI provided social support. Additionally, Binfet (2017) found this social support element corresponded with improving stress buffers, Stewart et al. (2014) recognised a relaxed setting was created for the therapy session to take place, and participants in Dell et al.'s (2015) study felt CAI allowed them to meet new people however as this only represented .07% of participants (n=3) it is at best, a minor finding.

Discussion

The aim of this systematic review was to assess and evaluate existing research on the benefits of CAI on anxiety, stress, depression, and feelings of well-being in HE students. The search identified 33 papers from 20 peer reviewed journals totaling 37 studies. Both male and female participants took part with ages ranging from 17-57. The systematic review demonstrated that study design, intervention activities, intervention duration, and measurements of mental health used were diverse in approach and application. As a result of this, and the blend of

comparisons of different treatments with different comparators, the many outcomes have been summarised under two main outcomes in relation to the benefits of CAI for HE students: (1) mental health benefits, and (2) social benefits. In addition, the systematic review identified a number of methodological limitations within the studies.

Outcome One: Mental Health Benefits

Thirty (81.08%) of the 37 studies reviewed found CAI effectively reduced a range of negative emotions. Sixteen studies explored the benefits of CAI on anxiety levels in HE students with thirteen identifying that in some capacity, interaction with a canine reduced participants anxiety levels. The results are particularly compelling as studies varied substantially in how anxiety was measured (see Appendix 2). Another variation in study design were the number of canines used across studies which makes comparing studies difficult. While most studies recorded how many canines were used (Lass-Hennmann, 2014, 2018; Thelwell, 2019; Wood et al., 2018), others (e.g., Dell et al., 2015) did not record canine numbers, or for how long participant interaction lasted. Additionally, although Delgado and Toukonen (2018) allocated one canine per participant, there were two dogs working in the data collection area. If one was not busy participants were allowed to interact with both dogs, however this frequency was not recorded adding another issue when comparing studies. As a result, it is difficult to infer whether the number of canines had an impact on the effect of CAI on anxiety levels.

In the thirteen studies that did indeed find a positive effect of CAI on anxiety levels, it is important to note some also demonstrated reductions in anxiety in non-canine comparison or control groups. For example, Shearer et al. (2016) found that while the canine group recorded a greater reduction in anxiety in comparison to a no-intervention control group, the comparison group receiving a mindfulness intervention, with activities including breathing and basic yoga, demonstrated significantly lower state anxiety than the canine group. Similarly, Spruin et al. (2020) on using a canine group, mindfulness therapy comparison group, and a control group found the mindfulness group to be as effective as the canine group in reducing student anxiety levels. Therefore, in comparison to other interventions, CAI may not always be the most effective intervention to address anxiety levels.

Stress was also consistently found to be significantly reduced following CAI with 16 studies that looked at stress indicating stress relief post CAI intervention. From the largest to the smallest, the studies varied in study design including the group size in which participants experienced CAI (see Appendix 2), whether participants took part individually (Delgado et al., 2018; Fiocco & Hunse, 2017), or in larger groups (Adamle et al., 2009; Binfet et al., 2018; Daltry & Mehr, 2015). Importantly, similar to the anxiety based studies, across a range of CAI designs, stress levels were reduced in 17 studies. One difficulty with drawing conclusions from these studies is the lack of control groups. While some (e.g., Barker et al., 2016; Griscti & Camilleri, 2020; Ward-Griffin et al., 2017) demonstrated reductions in stress in a canine group in comparison to a control group, many others (e.g., Binfet et al., 2018; Dell et al., 2015; McArthur & Syrnyk, 2018; Wilson, 1987, 1991; Wood et al., 2018) did not compare CAI to a control group.

Aside from the common theme that CAI has a beneficial effect on anxiety (e.g., Hall, 2018) and stress (e.g., Fiocco & Hunse, 2017) in studies who adopted a more rigorous approach with appropriate control groups, CAI sessions conducted with an informal and unstructured design also demonstrated a positive impact of CAI on stress (e.g., Daltry & Mehr, 2015) and anxiety (e.g., Stewart et al., 2014). This indicates that the best practice study design has yet to be identified and that components such as duration, human-to-canine ratio, or location need further research to identify optimum parameters for effective CAI.

While many of the studies in this review report on the positive impact of CAI on anxiety and stress, there is far less discussion in relation to the benefits on depression with only two of the 37 studies exploring this (Hall, 2018; Shearer et al., 2016). This may be because depression is often a long-term issue occurring throughout one's life, rather than a state issue, making it

harder to address with a one off brief intervention. However, it is possible that long term CAI, used in a similar fashion to that of CAI in military personnel suffering with PTSD (Stern et al., 2013), may be beneficial to those suffering with depression. Future research is required to determine whether CAI can reduce depression in HE students.

Outcome Two: Social benefits

The second main outcome of the systematic review was the evidence of social benefits as a result of CAI. Studies such as Shearer et al. (2016), identified the social element of CAI as being a strong contributing factor to reductions in anxiety levels, although ultimately the canine interaction was the key factor. It was also demonstrated that the social environment of CAI aided students in forming friendships that otherwise would not have been made by encouraging a less formal social environment (Binfet & Passmore, 2016). CAI may therefore be particularly suitable for first year students who are adjusting to a new life and community (Nauta et al., 2019), and for whom the transition to university can be particularly stressful.

A problem with many of the studies exploring CAI is that canine handlers were actively involved in the intervention, including answering questions about the canine (e.g., Barker et al., 2016; Binfet et al., 2018; Dell et al., 2015; Silas et al., 2019) or interacting with participants alongside the canines (e.g. Adamle et al., 2009). Some studies addressed the impact of having handlers actively involved in the canine sessions and the contribution towards CAI. For example, participants in Dell et al.'s (2015) study, described the handlers as being *phenomenal* while another described 'the lady' as being *nice* suggesting handlers had a positive effect on the impact of CAI. Given the finding that social interaction may enhance the benefits of CAI, the fact that in some studies, handlers were actively involved has implications when drawing conclusions about the effectiveness of CAI. That is, it precludes the ability to ascertain how much of the benefit is a direct result of CAI itself as opposed to the social interaction between participants and handler. Furthermore, having handlers present and actively involved may have encouraged canines to better interact with participants (and vice versa) which could have had an effect on overall results.

An additional issue concerns studies conducted as an outreach program as students interacted with the dog in an informal setting, and both intervention and data collection were carried out in a busy common area of a popular residential hall with any number of external influences (Daltry & Mehr, 2015; Dell et al., 2015). In comparison, studies where data collection took place in a private room (e.g. Binfet, 2017) arguably provides more compelling evidence that any effect of CAI is a result of the intervention rather than social influences. In addition, participants in studies who did not complete pre-intervention measures (e.g. Daltry & Mehr, 2015; Dell et al., 2015) may have been more relaxed compared to those that did however without these pre-intervention results this is impossible to know. More importantly, the added benefit of a group and social element, as well as participants choosing to take part or being able to dictate the level and timing of the interaction, may have in turn resulted in a more positive outcome.

Methodological limitations

Despite the consistent finding that CAI is an effective intervention for HE students, many of the studies are limited by significant methodological limitations. Crucially, the lack of independent control groups limits the studies with only 20 of the 37 studies including some form of control group. While 14 of the 15 studies without a control group still concluded a benefit of CAI, these conclusions should be made with caution. The lack of a RCT design is also problematic. Only four studies (Binfet, 2017; Crossman et al., 2015; Griscti & Camilleri, 2020; Spruin, et al., 2020), specifically state they followed a RCT design using pre and post standardized measures, with both an experimental and control group in a controlled laboratory setting. However it is of note that eleven others seem to adopt an RCT approach. As a final point, of the 37 studies reviewed, only seven (Buttelmann & Röpcke; 2014; Crossman et al., 2015;

Lass-Hennemann et al., 2014, 2018; Machová et al., 2020; Shearer et al., 2016; Spruin, et al., 2020) applied both pre and post measures alongside a comparator and control group. While this does not deter from the results of the other 30 studies, it does mean these results are less robust in evidencing that CAI has had an impact on changes in mental health and well-being as there is no baseline to make comparisons to.

For four of the studies the impact of external influences in carrying out long term CAI over a number of weeks could be problematic. While longitudinal studies are essential for tracking long term benefits of CAI and are arguably ideal in allowing participants to become accustomed to the therapy method, it is impossible to control for what may take place between data collection sessions and subsequently impact the results. Additionally, there is the possibility of participants becoming too familiar with the study increasing the likelihood of demand characteristics and social desirability.

There are two further problematic elements within the 37 studies: age range and sample size. The age range in the 37 studies varied as the youngest participant was 17 and the oldest 57 ($M=21.17$). This is problematic as different stages of life and development could affect the results with research supporting the claim that being older may allow one to deal with anxiety or depression by having better control of, or being better at regulating ones emotions (e.g., Lawrie & Phillips, 2016; Scheibe & Blanchard-Fields, 2009). Sample size is also a recurring issue as none of the studies include power calculations to demonstrate sufficient sample sizes. Further empirical research is therefore required on an HE population with adequate sample sizes focusing on appropriate age groups.

Internal factors with regards to participants' existing mental health are also often unaccounted for in the studies. In the 33 studies that carried out pre-intervention measures, some participants chose to take part if they self-identified with the study (for example, homesickness, Binfet & Passmore, 2016), and two studies excluded participants undergoing psychotherapeutic treatment (Lass-Hennemann et al., 2014, 2018). Only one study (Machová et al., 2020) reported whether participants had pre-existing mental health conditions or were undergoing other therapy which may affect how they approach and receive CAI and possibly impact results.

The lack of specificity in study design adds to the limitations of the studies reviewed. For example, some did not report how long each student spent with the canine (e.g., Daltry & Mehr, 2015; Stewart et al., 2014) and others (e.g., Dell et al., 2015) had large dropout rates introducing a possible issue of characteristic bias between those that stayed and those that dropped out. There may have been an issue with recruitment or the intervention itself may have, for the participant, been unsatisfactory, potentially skewing results if those finding CAI unhelpful subsequently dropped out. Additionally, the location in which data collection was carried out may limit the generalization of findings as five of the studies were conducted in a large busy area on campus introducing external influences which may have had an effect on canine behavior and participants experiences of CAI. Finally, data collection using informal evaluation forms or purpose created questionnaires (e.g., Daltry & Mehr, 2015; Machová et al., 2020; McArthur & Svrnky, 2018; Trammell, 2017) could also lead to results being left open to interpretation in comparison to studies using objective standardized measures that have a wealth of evidence supporting usage and validity.

To conclude, this systematic review identifies that despite the many differences in study design and intervention type, CAI generally has a positive effect on the mental health of HE students particularly in addressing anxiety and stress levels. It is clear that mental health issues are abundant in HE students during their time enrolled in university (Eisenberg et al., 2007; Richardson et al., 2015; The Insight Network, 2020; Thorley, 2017). Given the rise in the need for counselling support (Thorley, 2017) and the increase in stress, anxiety, and depressive thoughts, particularly due to the Covid-19 pandemic (e.g., Son et al., 2020), combatting mental health issues in this population requires significant attention. In light of this, the results from this systematic review are important as they identify strengths and areas of improvement within the

field of CAI so that the use of canines as a therapy tool to support HE student's mental health can benefit from evidence that certain elements have been confirmed as being best practice. One significant limitation of this systematic review is the inability to carry out a meta-analysis. While this was one of the initial aims of the review, after reviewing the relevant studies it became apparent that study design, intervention activity and duration, location, and measurements used were far more diverse than expected. As a result of this diversity, and the mix of comparisons of different treatments with different comparators, it was decided that each combination needed to be considered separately. The second limitation relates to the number of studies that adopted both pre and post measures alongside a comparison and control group. Only seven studies applied comparison/control groups and pre/post measures, therefore it was decided to include all applicable study designs. As the field progresses, and more studies are published, a systematic review limited to only the most robust studies (i.e., with control/comparator groups and pre/post measures) would be useful. The outcomes themselves are also quite diverse, leading to further difficulties with a meta-analysis. Despite this weakness, the systematic review demonstrates that specific protocol, a manual or guidelines, has yet to be produced that can be followed when conducting CAI to ensure optimum results are achieved.

While determining these specific guidelines requires further research and experimentation, based on this review, the recommendation would be to focus on the use of a RCT study design, intervention activity and duration, the impact of a social environment in the form of individual versus grouped participants, and the location of the study. The involvement of the handler on the effectiveness CAI and would also benefit from further understanding. These could then be used to build a framework for effective and efficient CAI.

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Appendices

Appendix 1

Search Terms used:

("animal therapy" OR "animal assisted activit*" OR "animal interaction" OR "animal visitation" OR "animal support" OR "animal assisted therapy" OR AAT OR "pet therapy" OR "pet assisted activit*" OR "pet interaction" OR "pet visitation" OR "pet support" OR "pet assisted therapy" OR "canine therapy" OR "canine assisted activit*" OR "canine interaction" OR "canine visitation" OR "canine support" OR "canine assisted therapy" OR "dog therapy" OR "dog assisted activit*" OR "dog interaction" OR "dog visitation" OR "dog support" OR "dog assisted therapy") AND (canine* OR dog) AND (anxiety OR stress OR depression OR mental health OR well-being) AND (school OR student OR college OR university OR campus OR educat*).

Appendix 2.

Summary of participants, study design and outcome

First Author/Date	Terminology	Sample size	Participant age	Number of sessions	Timing (mins / hours)	Group numbers	Canine per group	Study Design	Measures used	Intervention activity	Outcome post intervention	Study quality (EPHPP)
Adamle, N. 2009	Pet Therapy	246	17-25	1	20 minutes + mingle session	50	5	Intervention only	Pet Therapy Program questionnaire	Canine interaction	Pet therapy program could be a temporary substitute to fill the void left by previous support systems for stressful periods and could be a catalyst to form new relationships	3
Barker, S. B. 2016	Therapy Dog Intervention	78	18+	1	15 minutes	Not specified	5	Intervention and control group	Perceived Stress Scale (PSS), VAS, sNGF	Intervention group: Canine interaction. Control group: drawing a diagram representing current life situation	A brief dog intervention therapy session statistically reduces students perceived stress	2
Binfet, J. T.	AAT	44	18-22	8	45 minutes	3-4	1	Intervention	McAndrew's	Intervention group:	AAT reduced feelings of	3

2016

								and	Measure	Canine	homesickness	
								control group	of Rootedness, Satisfaction with Life Scale, Connectedness to Campus, Focus group	interaction. Control group: Informed they were on an 8 week 'wait list' and to continue with usual daily business	, increases feelings of satisfaction with life, feelings connected to campus and the well-being of 1st year students' experiences with homesickness	
Binfet, J., T. 2017	Canine Therapy	163	17- 49	1	20 minutes	3-4	1	Intervention and control group	PSS, Homesickness Questionnaire, Sense of Belonging Scale	Intervention group: Canine interaction. Control group: Course based reading material	A 20 minute canine therapy session reduces stress and homesickness, and increases an affinity for campus community	3
Binfet, J., T. 2018	Canine Therapy	1960	--	6-7	20 minutes	3-4	1	Intervention only	VAS-Stress	Canine interaction	Canine therapy intervention reduces stress	3
Buttelmann, D. 2014	AAT	71	18.8 - 29.8	1	5 minutes	1	1	Intervention, comparison	STAI, Audience Anxiousness Scale,	Intervention group: Canine interaction.	All 3 conditions found anxiety reducing	2

								and control group	Pet Attitude Scale, systolic/diastolic BP and HR	Comparison group: fish and plant interaction. Control group: No interaction, participants asked to 'wait'	effects. The canine group was not more effective than the fish comparison group but was more effective than the plant group	
Crossman, M. 2015	Animals Visitation Program	67	22-37	1	7 + 3 optional minutes	1	1	Intervention, comparison and control group	STAI, Positive and negative affect schedule (PANAS), Credibility /Expectancy Questionnaire, Semantic Differential, Experiences with Dog Inventory	Intervention group: Canine interaction. Comparison group: Viewed images of the canine. Control group: No interaction, participants asked to 'wait'	AVP reduces anxiety and negative mood and increases positive moods. Supports existing AVP already in use	3
Crump, C. 2015	Study 1 - AAA	27	18-25	1	15 minutes	4	2	Intervention and	Stress Arousal Checklist,	Intervention group: Canine	AAA decreases psychological	3

									BP, HR	interaction.	stress and	
								control group		Control group: took part in non-stressful activity including playing cards, listening to music, read and texting	increased psychological arousal. No significant effect on diastolic BP,HR or levels of salivary cortisol	
	Study 2 - AAA	61	18-25	1	30 minutes	4	2	Intervention group only	Stress Arousal Checklist, BP, HR	Canine interaction	AAA decreases psychological stress and increased psychological arousal. No significant effect on diastolic BP,HR or levels of salivary cortisol	3
Daltry, R., M. 2015	Dog Therapy Outreach Program	54	18-32	15	2 hours	15-20	2	Intervention only	Informal evaluation form	Canine interaction	Provides stress relief and comfort, and increases potential access to counselling services	3

Delgado, C. 2018	Canine Play Intervention	48	18-57	1	15 minutes	1	1	Intervention only	PSS, VAS-Mood, BP, Cortisol	Canine interaction	Dogs can moderate effects of stress. Improvement in mood and perceptions of stress and a positive change in psychological measures	3
Dell, C., A. 2015	Dog Therapy Program	403	--	2	5-60 minutes, no clear record	Not specified	--	Intervention only	PSS, VAS-Mood, BP, Cortisol	Canine interaction	Therapy dogs offer love and support and reduce stress	3
Fiocco, A., J. 2017	Therapy Dog	61	18-47	1	10 minutes	1	1	Intervention and control group	Therapy dogs offer love and support and reduce stress.	Intervention group: Canine interaction. Control group: No interaction, participants told to relax	Interacting with a dog for 10 minutes may significantly buffer stress response to a subsequent stressor	3
Grisetti, O. 2020	Phase 1 -Dog Therapy	24	20-31	8	2.5 hours	24	1	Intervention and control group	Wrist HR monitor	Canine present during a lecture	The presence of a dog reduces stress	3

	Phase 2 -Dog Therapy	38	--	8	2.5 hours	38	1	Intervention and control group	Purpose written questionnaire	Canine present during a lecture	The presence of a dog has a calming effect on students	
Grajfoner, D. 2107	Dog-Assisted Intervention	132	17-34	1	20 minutes	1	1	Intervention and control group	Warwick-Edinburgh Mental Well-Being Scale (WEMWBS), STAI, UWIST Mood Adjective Check List (UMACL)	Intervention group: Canine + handler interaction. Control group: Handler interaction	20 minute session led to significantly greater improvements in student well-being and anxiety	3
Hall, D. 2018	Therapy Dog	109	21-56	60	2-30 minutes, no clear record	Not specified	1	Intervention and control group	Hospital Anxiety and Depression Scale (HADS),	Intervention group: Canine interaction. Control group: No canine interaction over the duration of the study	Therapy dogs on campus during a semester decrease anxiety symptoms	3
Jarolmen, J. 2018	AAT	86	18-39	1	15 minutes	Not specified	1	Intervention and	Systolic/diastolic BP	Intervention group: Canine	Significant difference found in the	3

								control group		interaction. Control group: No canine interaction, participants were asked to sit behind a privacy screen	reduction in BP levels between experimental and control group. BP viewed as an indication of anxiety levels	
Lass-Hennemann, J. 2014	Therapy Dog	80	--	1	11 minutes	1	1	Intervention, comparison and control group	STAI-S, PANAS, systolic, diastolic BP, ECG, Cortisol, STAI-Trait, Pet Attitude Scale (PAS)	Activity: traumatic film clip Intervention group: Canine interaction. Comparison group: toy dog or friendly person companion. Control group: Alone	Presence of a dog reduces subjective experienced anxiety and negative affect after a traumatic film clip	2
Lass-Hennemann, J. 2018	Therapy Dog	60	--	1	15 minutes	1	1	Intervention, comparison and	STAI-State, PANAS, systolic, diastolic	Intervention group: Canine interaction. Comparison	Presence of a dog reduces subjective experienced anxiety, less	3

								control group	BP, ECG, Cortisol,	group: participants	negative affect and	
									STAI-T, PAS, Beck's Depression Inventory (BDI)	watched a video of canine interaction Control group: No interaction, participants told to relax alone	more positive affect after a traumatic film clip	
Machová, K. 2020	AAA	93	19-44	1	10 minutes	1	1	Intervention, comparison and control group	Purpose written questionnaire. BP, HR.	Intervention group: Canine interaction. Comparison group: relaxing tasks Control group: No interaction, activity not given	AAA significantly improves mood and stress but not HR or BP was HAI	3
McArthur, A., D. 2018	Study 1 – AAT	80	--	1	90 minutes	Not specified	6	Intervention only	Purpose written questionnaire	Canine interaction	AAT improves self-reported perceived mood	3
	Study 2 - AAT	38	--	1	90 minutes	Not specified	6	Intervention only		Canine interaction	AAT improves mood (pre compared to post)	3

Muckle, J. 2017	AAA	62	--	3	60 minutes	Not specified	Unclear	Intervention and comparison group	Animal Attitudes Scale, PSS, STAI, State Self Esteem Scale, systolic and diastolic BP	Intervention group: Canine interaction. Comparison group: Quiet reading	AAA has a positive effect on psychological and physiological markers of stress. Reductions found in perceived anxiety, systolic BP and state self-esteem	3
Shearer, A. 2016	Phase 1- AAT	26	--	4	60 minutes	Not specified	1	Intervention and control group	STAI (mood inventory), PANAS, BDI, Five Facet Mindfulness Questionnaire, HRV,	Intervention group: Mindfulness meditation. Active control group: Canine interaction	AAT reduces anxiety	2
	Phase 2- ATT	48	--	4	60 minutes	Not specified	1	Intervention, comparison and control group	STAI (mood inventory), PANAS, BDI, Five Facet Mindfulness	Intervention group: Mindfulness meditation group. Comparison group: Canine	AAT reduces anxiety	

									Questionnaire, HRV	interaction. Control group: no interaction, no activity given		
Silas, H., J. 2019	CAI	754 students	--	1	90 minutes	126	15-17	Intervention only	VAS-Stress	Canine interaction	CAI reduces student and handler stress however canines stress increased (compared to measures of observed home stress) as a result of performing CAI	2
		40 handles *	17-60	6								
		40 canines *	Bitches Mage = 4.75	6								
			Dog – not stated									
Spruin, E. 2020.	Therapy Dog	94	18-46	1	30 minutes	1	1	Intervention, comparison and	STAI, Mood Tracking Scale	Intervention group: Canine interaction. Comparison	Therapy dogs reduces anxiety as effectively as mindfulness	3

								control group		group: Mindfulness.	therapy	
										Control group: Psychologica l support with a student advisor		
Stewart. A. 2013	Human Animal Interaction	128	18-57	1	13.5 minutes	1	1	Interve ntion and compar ison group	STAI	Activity: Clerical tasks Intervention group: Canine interaction Comparison group: No canine interaction during clerical task	Companion animals may provide stress relief for those in average stress jobs with positive feelings about companion animals but may have no effect for those in high stress jobs who do not already enjoy animal companionsh ip	2
Stewart. A. 2014	AAT	55	--	20-24	2 hour drop in session	10-15	1	Interve ntion only	Burns Anxiety Inventory,	Canine interaction	AAT decreases self-reported	2

									University of Philippine		anxiety and loneliness. AAT	
									s Loneliness Scale, Session Rating Scale, Outreach program evaluation form		outreach intervention programs may be effective and efficient in supporting the demands of the expanding student body	
Thelwell , E., L., R. 2019.	Dog interaction	82	18-23	1	10 minutes	1	1	Interve ntion and control group	PAS, STAI, PANAS- Expanded form	Intervention group: Canine interaction Control group: Watch a video about dogs	Dog interactions reduced anxiety levels and improved mood scores.	3
Tramme ll, J., P. 2017	Study 1 – Therapy Dogs	127	--	1	2 hour drop in session	Not specified	7	Interve ntion only	Purpose written stress questionna ire	Canine interaction	Therapy dogs are associated with a small decrease in stress	3
	Study 2 – Therapy Dogs	44	--	1	15 minutes	Not specified	6	Interve ntion and control group	Purpose written stress questionna ire	Intervention group: Canine interaction. Control group: Watch a movie about dogs	Therapy dog group showed larger reductions in stress compared to the control group. There was no relation to exam performance	3

	Study 3 – Therapy Dogs	45	--	1	15 minutes	Not specified	5	Interven- tion and control group	Purpose written stress questionnaire	Intervention group: Canine interaction. Control group: Watched a movie about dogs	Therapy dog interaction immediately after a class had no effect on exam related stress reduction. However a (small) reduction in stress did predict better exam related performance	3
Tramme ll, J., P. 2019.	Therapy Dog	44	--	2	Not specified	2	1	Interven- tion and control group	Affect measures, PSS	Activity: learning task Intervention group: Canine interaction. Control group: Alone	Interacting with a therapy dog decreases arousal and stress and increases happiness	3
Ward- Griffin, E. 2017	Therapy Dog	246	--	1	90 minutes	Not specified	7-12	Interven- tion and	Satisfactio n with Life, Subjective	Intervention group: Canine interaction.	Therapy dogs on campus can have a positive	3

control group	Happiness Scale, PANAS, PSS, Medical Outcome Study Social Support Survey	Control group: No canine interaction over the duration of the study	effect on students well-being including reductions in stress and an increase in happiness and energy levels immediately post interaction. Negative affect and perceived stress decreased and perceived social support increased 10 hours post-intervention
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Wilson, C., C. 1987	Effect of Pet	92	18-39	1	3 x 10 minutes	1	1	Intervention only	STAI, Pet Attitude Inventory, BP, HR	Reading aloud, reading quietly, and canine interaction	Interacting with a pet affects physiological and psychological response by lowering response levels and reduces anxiety levels	3
Wilson, C. 1991	Effect of Pet	92	18-39	1	3 x 10 minutes	1	1	Intervention only	STAI, Pet Attitude Inventory, BP, HR	Reading aloud, reading quietly, canine interaction (all participants)	Interacting with a pet affects physiological and psychological response by lowering response levels and decrease anxiety levels	3
Wood, E. 2018	Dog-Assisted Therapy	131	--	1	15 minutes	6	1-2	Intervention only	STAI, BP	Canine interaction	Decrease in state anxiety and systolic and diastolic BP	3

* excluded from data extraction figures