Animal-Assisted Therapy to Treat Depression in Adolescent Oncology Patients

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Abstract

Depression is a mental health condition that affects individuals across all age groups, but is especially prevalent among adolescents due to numerous biological and psychosocial factors. Depression is also especially prevalent among cancer patients due to treatment side effects, uncertainty about the future, and general disease related distress and pain. Considering that adolescents are already at-risk for depression, they are put even further at-risk if they develop cancer. The comorbidity of cancer and depression can exacerbate cancer symptoms and increase rates of mortality. Both formal and informal human-animal interactions have demonstrated promising outcomes in lessening depressive symptoms, with multiple studies lending support to animal-assisted therapy (AAT). However the effectiveness of AAT on adolescents, particularly those with cancer, remains understudied. By addressing existing research gaps in the literature on AAT for adolescent oncology patients suffering from depression, we can develop effective interventions specific to this vulnerable population.

Keywords: depression, adolescents, cancer, psycho-oncology, animal-assisted therapy

Depression

Depression is a common mental disorder that persistently and negatively affects how a person feels, thinks, and acts (Ong et al., 2006; Sharpley, et al., 2020; National Institute of Mental Health (NIMH), 2015; World Health Organization (WHO), 2017; American Psychiatric Association (APA), 2013). According to the Diagnostic and Statistical Manual-Fifth Edition (DSM-5), a diagnosis of Major Depressive Disorder requires a persistent disturbance of mood and a loss of interest or pleasure in roughly all previously enjoyed activities, in addition to at least four other symptoms (APA, 2013). Depression can be long lasting or recurrent, and substantially impairs an individual's capacity to function or cope with daily life, namely his ability to work, sleep, eat, and maintain relationships (NIMH, 2015; WHO, 2017). Depression discourages social support from others (Cong & Silverstein, 2011), as well as healthy and constructive behavior (Schilling et al., 2013), and can affect anyone regardless of age, race, gender, or socioeconomic status (NIMH, 2015).

The two most common sub-categories of depression are major depressive disorder (MDD), also referred to as a major depressive episode (MDE) or episodic depression, and persistent depressive disorder (PDD), also known as dysthymia (Schramm et al., 2020; NIMH, 2015; WHO, 2017). The classification of an individual's depression is dependent on the number and severity of symptoms and the duration of the symptoms (Schramm et al., 2020; NIMH, 2015; WHO, 2017). MDD involves depressive symptoms that have lasted for at least two weeks, and substantially interfere with the individual's daily life (Schramm et al., 2020; NIMH, 2015; WHO, 2017, APA, 2013). Almost 20% of Americans will experience an MDE in their lifetime, and approximately 80% of those individuals will have more than one episode (Singh & Gotlib, 2014; Hischfeld 2012; Bulloch et al. 2014). The prevalence of MDE is higher among adult

females (10.5%) compared to adult males (6.2%) (NIMH, 2020). PDD is a chronic form of depression in which an individual has experienced symptoms that are typically less severe, but for a period of at least two years (Schramm et al., 2020; NIMH, 2015; WHO, 2017, APA, 2013).

There is a wide range of behavioral and physical symptoms that are caused by depression (Sharpley, et al., 2020). Common symptoms are persistent feelings of sadness, emptiness, irritability, hopelessness, worthlessness, or guilt (Cheung & Kam, 2017; Sharpley, et al., 2020; NIMH, 2015; WHO, 2017, APA, 2013). Other common symptoms include decreased energy, change in appetite or weight, difficulty concentrating, and irregular sleep patterns (Cheung & Kam, 2017; Sharpley, et al., 2020; NIMH, 2015; WHO, 2017, APA, 2013). Depression is also a crucial predictor of suicide, and suicidal thoughts, attempts, or recurrent thoughts of death are often symptoms (Chou & Chi, 2003; Sharpley, et al., 2020; NIMH, 2015; WHO, 2017, APA, 2013). Depending on the number and severity of the symptoms that an individual displays, depressive episodes can be categorized as mild, moderate, or severe (WHO, 2017, APA, 2013).

There are many different factors that can cause depression (NIMH, 2015). Various research has found genetic, biological, environmental, and psychological links to the disorder. (NIMH, 2015; Enmarker et al., 2015; Sharply et al., 2020; Cacioppo et al., 2010; Ge et al., 2017). Depression has been linked to hormonal imbalances, and deficiencies in neurotransmitter systems such as the dopaminergic and serotonergic systems (Sourey, 2001; Dillon et al. 2014; Sharpley, et al., 2020). It has also been associated with life events like financial stressors, the death of a loved one, and personal illness, especially when an individual is already genetically susceptible to become depressed (Sharply et al., 2020; Cacioppo et al., 2010; Ge et al., 2017). Feelings of loneliness and social isolation are also predictors of depression, and are often a symptom among elderly individuals (Enmarker et al., 2015) and teens (Nangle et al. 2003).

Depression in Teens

In the early 20th century, G. Stanley Hall published his book *Adolescence*, coining the term as the period when one starts puberty to when one enters their early twenties (as cited in Kett, 2003). Hall ultimately dubbed this period a time of "storm and stress," during which teenagers change on an individual level and develop a sense of identity, often while feeling sensitive, reckless, self-conscious, and depressed. He argued that children do not smoothly transition into adults, rather there is the universal experience of a "new birth" through adolescence, which is filled with inner turmoil, newly formed identities, and risk-taking behaviors (Kett, 2003). This is partially attributed to the fact that adolescent brains are not fully developed and will not fully develop until an individual's early 20s. This is shown in Figure 1, which displays the diminishment of gray matter and development of white matter as a person gets older (Gogtay et al., 2004).

In his article "Adolescent Storm and Stress, Reconsidered," Jeffery Jensen Arnett notes that research generally supports the idea that adolescents are more prone to emotional extremes during this period (Arnett, 1999). As children develop into adolescents, their risk for depression sharply increases (Merikangas et al. 2010; NIMH, 2015). This is especially true for females (Maughan, 2013; NIMH, 2015). In the United States, approximately 3.8 million adolescents aged 12 to 17 (over 15% of the age group) have experienced at least one MDE (NIMH, 2015). It is estimated that of these 3.8 million individuals, only 43.3% have received treatment (NIMH, 2015). Rising rates of depression in recent years and a lack of proper treatment have to led suicide becoming the second leading cause of death in the U.S. for individuals aged 10-34 (NIMH 2021, Center for Disease Control and Prevention (CDC), 2021). Teens who suffer from depression may be irritable, have low self-esteem, or get into trouble at school (NIMH, 2015).

A teenage individual's depression may stem from physical or hormonal changes, social or academic stress, or the intense emotions that a person often experiences as they grow up (NIMH, 2015; Flynn et al., 2020). There are high levels of comorbidity in adolescents with depression; teens with depression often also suffer from anxiety disorders, attention deficit disorders, or eating disorders (Garber and Weersing, 2010; Rohde, 2009). Teens struggling with depression may also turn to different coping mechanisms including alcohol and drug usage, which can lead to substance abuse disorders (Rohde, 2009). Regardless of age, treatment for depression typically consists of medication and/or psychotherapy (Karrouri et al., 2021).

The ninth chapter of *Reviving Ophelia: Saving the Selves of Adolescent Girls* by Dr. Mary Pipher and Sara Pipher Gilliam discusses the topics of depression and self-harm. The chapter chronicles the experiences of multiple teenage girls in order to show different causes and perspectives on depression. For example, one girl's depression stemmed mainly from the fact that she was not conventionally beautiful and was thus rejected by her peers, while a second girl, who *was* considered pretty, desired self-harm in order to cope with her abusive relationship. Pipher notes that "All girls experience pain at this point in their development. If that pain is blamed on themselves, on their own failures, and manifests itself as depression" (Pipher and Gilliam, 2019). The chapter emphasizes that depression can display itself in many different ways, such as through anger, apathy, starvation, cutting, or pills. However, "whatever the outward form of the depression, the inward form is the grieving for the lost self, the authentic girl has disappeared with adolescence" (Pipher and Gilliam, 2019).

Cancer

Put in the most simple of terms, cancer is the abnormal and uncontrolled growth of cells (American Cancer Society, 2022; National Cancer Institute (NCI), 2021). In his Pulitzer Prize

winning book *The Emperor of All Maladies: A Biography of Cancer*, Siddhartha Mukherjee states that the growth of cancer "is unleashed by mutations– changes in DNA that specifically affect genes that incite unlimited cell growth. In a normal cell, powerful genetic circuits regulate cell division and cell death. In a cancer cell, these circuits have been broken, unleashing a cell that cannot stop growing" (as cited in Mukherjee, 2011). This genetic change is illustrated in Figure 2. Once these circuits are broken, cell division, which is essential for growth, repair, and reproduction, becomes a terrifying thing that allows cancer cells to flourish virtually unchecked (American Cancer Society, 2022; NCI, 2021).

Depending on how these cells develop, they fall into one of two categories: hematologic cancers (cancers of the blood cells) or solid tumor cancers (cancers of any other organs or tissues) (American Cancer Society, 2022). Tumors are solid clumps/masses that are formed by the abnormal growth of cells. It is important to note that not all cancer cells become tumors, and not all tumors are cancerous. If a tumor is not cancerous it is referred to as "benign," and if it is cancerous it is called "malignant" (American Cancer Society, 2022; NCI, 2021).

There are over 100 types of cancer, the most common of which are breast cancer, lung and bronchus cancer, prostate cancer, colon and rectum cancer, melanoma of the skin, bladder cancer, non-Hodgkin lymphoma, kidney and renal pelvis cancer, endometrial cancer, leukemia, pancreatic cancer, thyroid cancer, and liver cancer (NCI, 2020). There are many different ways to categorize and classify the different types of cancer. Typically, a cancer is named after the part of the body from which it originates (American Cancer Society, 2022). Even if the cancer becomes metastatic, meaning that it spreads to a different part of the body, it is still referred to by the name of the primary cancer. For example, if a person has pancreatic cancer that spreads to the liver, the cancer is called metastatic pancreatic cancer, not liver cancer. Figure 3 demonstrates

how cancer cells enter the bloodstream or lymphatic system and travel to the rest of the body (NCI, 2020).

Another way to classify different types of cancer is based on the type of cells from which they originate. There are many categories, but the four main groups are carcinomas, sarcomas, leukemias, and lymphomas, shown in Figure 4. The first type, carcinomas, are cancers that start in the skin or in the tissues that cover the surface of a person's internal organs and glands (NCI, 2021; Cancer.net, 2019; Cancer Research UK, 2021). This type of cancer is the most common, makes up around 80%-90% of adult cancer diagnoses, and usually forms solid tumors. Examples of carcinoma subtypes are adenocarcinoma, basal cell carcinoma, squamous cell carcinoma, and transitional cell carcinoma (NCI, 2021; Cancer.net, 2019; Cancer Research UK, 2021). The next type of cancer, sarcomas, are cancers that begin in bones and the soft tissues that connect the body, including muscles, fat, tendons, cartilage, and blood vessels. Sarcomas are much more rare than carcinomas, making up around 1% of cancer diagnoses (Cancer Research UK, 2021), and are mostly found in the arms, legs, abdomen, and chest (NCI, 2021; Cancer.net, 2019). Some subtypes are liposarcoma, leiomyosarcoma, and osteosarcoma (NCI, 2021; Memorial Sloan Kettering Cancer Center, no date). The third category is leukemias, which are cancers of the blood that usually form in bone marrow (NCI, 2021; Cancer.net, 2019; Cancer Research UK, 2021). They make up around 3% of cancer diagnoses, but are the most common type of cancer found in children and teens (Cancer Research UK, 2021). Leukemias do not grow into solid tumors, and instead remain in the bloodstream. A person's blood typically consists of white blood cells, red blood cells, and platelets, but if a person suffers from leukemia, they have an abnormal production of white blood cells, and an insufficient amount of red blood cells and platelets (Memorial Sloan Kettering Cancer Center, no date). This prevents oxygen from

properly flowing through the body, makes it harder to control bleeding, and more difficult to fight infections (NCI, 2021). According to the National Cancer Institute, "there are four common types of leukemia, which are grouped based on how quickly the disease gets worse (acute or chronic) and on the type of blood cell the cancer starts in (lymphoblastic or myeloid)" (NCI, 2021). Chronic leukemia progresses at a slower rate, while acute leukemia develops more quickly (NCI, 2021). The last category is lymphomas, which are cancers that begin in the immune system, specifically in white blood cells known as lymphocytes (NCI, 2021; Cancer.net, 2019; Cancer Research UK, 2021; Memorial Sloan Kettering Cancer Center, no date). Because lymphatic tissue is present throughout the body, lymphoma can start almost anywhere (NCI, 2021). The two broad groups of lymphoma are Hodgkin lymphoma and non-Hodgkin lymphoma, which together make up around 4%-5% of all cancer diagnoses (Memorial Sloan Kettering Cancer Center, no date; Cancer Research UK, 2021).

Solid tumor cancers are also categorized by stage, which refers to the cancer's size, development, and whether or not it has spread to other parts of the body (NCI, 2021; Cancer.net, 2021; American Cancer Society, 2022). Cancer staging is necessary to figure out the extent of the cancer, what type of treatment is best, and to predict the course the cancer might take. Cancer is staged on a scale of I-IV, with higher numbers referring to more advanced cancers. Stage I cancer, also called early-stage cancer, is cancer that has not spread to other parts of the body and has not grown deeply into nearby tissue (Cancer.net, 2021; Cancer Research UK, 2020). This type of cancer has the best prognosis. Stage II and Stage III are cancers that have spread into the surrounding tissues, and may have spread to the surrounding lymph nodes (Cancer.net, 2021; Cancer Research UK, 2020). Stage IV cancer refers to metastatic cancer and is the most aggressive and hardest to treat (Cancer.net, 2021; Cancer Research UK, 2020).

Women have a one in three chance of developing cancer in their lifetime and men have a one in two chance (NCI, 2022). The National Cancer Institute reported that "prostate, lung, and colorectal cancers account for an estimated 43% of all cancers diagnosed in men in 2020. For women, the three most common cancers are breast, lung, and colorectal, and they will account for an estimated 50% of all new cancer diagnoses in women in 2020" (NCI, 2020). In 2020, the World Health Organization's International Agency for Research on Cancer reported 19.2 million new cases of cancer and 9.9 million cancer related deaths worldwide (World Health Organization (WHO, 2020). Additionally, the International Agency for Research on Cancer predicts that by 2040, the number of new cancer cases per year will rise to 29.6 million and the number of cancer related deaths will reach 16.3 million (WHO, 2020, American Cancer Society, 2022). There are many different ways to treat cancer. These treatment options include chemotherapy, radiation therapy, surgery, hormone therapy, immunotherapy, clinical trials, and more (NCI, 2020).

The Psychological Side of Cancer: Depression in Cancer Patients

In addition to treating the physical illness of cancer, it is just as important to treat the psychological hardships that come with the disease. According to the American Psychosocial Oncology Society, psychosocial oncology (also called psycho-oncology) is "a cancer specialty that addresses the variety of psychological, behavioral, emotional and social issues that arise for cancer patients and their loved ones" at all stages of disease (Maytal, 2020). It also includes "the psychological, social and behavioral factors that may influence cancer morbidity and mortality" (Holland, 2018). The formal rise of psycho-oncology began in the 1970s, since the stigma around cancer had lessened to the point where people could comfortably talk about their diagnoses, and the stigma around mental health had lessened enough for psychological issues to become a normalized discussion (Holland, 2002; Lang-Rollin and Berberich, 2018). In 1984, the

International Psycho-Oncology Society (IPOS) was created with the goal of integrating psychosocial care into mainstream cancer care around the world and to "foster international multidisciplinary communication about clinical, educational and research issues that relate to the subspecialty of psycho-oncology" (IPOS, no date).

Depression occurs in approximately one in every four cancer patients, but is often neglected or ignored in favor of focusing on the cancer itself (Krebber et al., 2014; Walker et al., 2014; Mitchell et al., 2011; Pitman et al., 2018; American Cancer Society, 2020). Unlike the prevalence of depression among the general population, the prevalence of depression is equal among male and female cancer patients (Miller et al., 2011). Interestingly, the prevalence of depression is the same among patients receiving end of life care and patients actively living with their cancer diagnoses (Pitman et al., 2018).

When diagnosed with cancer, individuals are faced with the uncertainty of the future, intense physical side effects, a change in appearance, and the need to pause their lives to undergo treatment. They are also confronted with the uncertainty of survival, and often feel lonely and as though their cancer is all encompassing. All of these things contribute to mental health deterioration among cancer patients (American Cancer Society, 2020). In addition to these difficult emotions, possible contributors to depressive symptoms in cancer patients are also physical. This includes poorly controlled pain, metabolic and/or endocrine abnormalities, and side effects of medications and certain treatments such as chemotherapy and corticosteroids (Pitman et al., 2018; NCI, 2020). Commentary on the article "Cancer Pain, Anxiety and Depression in Admitted Patients in a Tertiary Care Hospital – A Prospective Observational Study" also notes that certain cancers like pancreatic and lung cancers release chemicals that are thought to contribute to depression (Ghoshal, 2020).

While depression in cancer patients is very prevalent, it comes with specific diagnostic challenges (Park & Rosenstein, 2015). Somatic symptoms related to cancer and its treatment, including fatigue, anorexia, and sleep disruption, are common symptoms of MDD, and thus complicate accurately diagnosing depression (Park & Rosenstein, 2015). A systematic literature review published in the *Journal of Pain and Symptom Management* found that in metastatic cancer patients, the most common reported symptoms were fatigue, pain, lack of energy, loss of appetite, and feelings of weakness, all of which are also symptoms of depression (Teunissen et al., 2007). There continues to be a debate on how these physical symptoms should be considered in the diagnostic process, with some researchers arguing for their inclusion and others insisting that they be largely attributed to cancer and its treatment (Park & Rosenstein, 2015). Additionally, the perception among healthcare providers and patients that depression is a normal response to a cancer diagnosis further complicates accurately measuring the prevalence of depression (Park & Rosenstein, 2015).

It may not seem as important to treat depression when compared to the necessity of treating the cancer diagnosis, but the comorbidity of depression and cancer have been proven to worsen cancer symptoms and increase rates of mortality (Colleoni et al., 2000; Pinquart & Duberstein, 2010). Untreated depression in cancer patients can lead to extreme psychological suffering, impairments in quality of life, refusal of treatment, more time needed in hospitals, and worsened adherence to prescribed treatment regimens (Park & Rosenstein, 2015). A meta-analysis from 2009 "revealed that minor or major depression increases mortality rates by up to 39%, and that patients displaying even few depressive symptoms may be at a 25% increased risk of mortality" (Satin et al., 2009). Additionally, a study from 2003 showed that

>70% of oncologists and 85% of patients believe that mood affects the progression of cancer (Lemon et al., 2003).

The recognition that depression and other mental health problems complicate the management of cancer has led to an increase in the field of psycho-oncology, but only an estimated 5% of cancer patients actually see a mental health professional during their treatment (Walker et al., 2014). This shockingly low number can be attributed to various factors including a lack of understanding regarding the impact of depression on cancer treatment, challenges in the diagnostic process, and the limited availability of fitting mental health services (Walker & Sharpe, 2014; Kadan-Lottick et al., 2005).

Depression in oncology patients is not treated significantly differently from depression in the general population, but it is important to note that certain antidepressants can interact with chemotherapy agents and worsen existing cancer symptoms (Lang-Rollin & Berberich, 2018; Pitman et al., 2018). Successful interventions must take treatment setting, stage of the cancer, physical symptoms, and existential stress into account (Lang-Rollin & Berberich, 2018). A systematic review of randomized controlled trials suggests that psychotherapy is useful for treating depression in advanced cancer patients (Akechi et al., 2008). Additionally a meta-analysis on psychosocial interventions for depression, anxiety, and quality of life in cancer survivors found that cognitive behavioral therapy (CBT) was successful in managing depression amongst cancer survivors (Osborn et al., 2006).

Cancer in Adolescents

According to the CDC, “malignant neoplasms” (another term for cancer) are the fourth leading cause of death in adolescents aged 15-19 (CDC, 2021). The American Cancer Society reports that in the United States among adolescents aged 15-19 there are an estimated 5,000 to

6,000 new cases of cancer every year and approximately 500-600 cancer related deaths (American Cancer Society, 2022). The most common cancers for individuals in this age group are leukemia, lymphoma, brain and other central nervous system cancers, thyroid cancer, gonadal germ cell tumors, and sarcomas (Miller et al., 2021). The incidence rates of different cancers among adolescents ages 15-19 are detailed in Figure 5 (American Cancer Society, 2023). Depending on the type of cancer, the prognosis for adolescents with cancer ranges. The National Cancer Institute reported that from 2011-2017, 85.9% of adolescents diagnosed with cancer had survived at least five years (NCI, 2021). The relative survival rates among adolescents ages 15-19 with different cancers are detailed in Figure 6 (American Cancer Society, 2023). However, it is important to note that while five year survival rates are generally positive, they are still inferior when compared to the five year survival rates of non-adolescent cancer patients, particularly when comparing breast cancer and leukemia (Lewis et al., 2014; Berkman et al., 2020).

Depression in Adolescents with Cancer

There are many issues that show up specifically when it comes to teenagers with cancer, including late diagnosis and whether the patient should be given an adult or child treatment plan (American Cancer Society, 2019; Hughes & Stark, 2018). Another substantial issue that comes up is preserving the mental health of these patients. As previously discussed, the adolescent period is an incredibly difficult one, full of stresses and emotional turmoil for even the healthiest of children. It makes sense that these feelings would be exacerbated by a cancer diagnosis. In fact, “rates of depression and other psychological disorders are substantially higher in AYAs (adolescents and young adults) with cancer when compared with older adults” (Park & Rosenstein, 2015). This is theorized to be due to the fact that AYAs are specifically vulnerable to

psychological distress due to the intersection of disease and young age, disruptions in their developmental trajectory, greater physical symptom burden, social isolation from their peers, and increased likelihood of developing aggressive disease (Park & Rosenstein, 2015; Duan et al., 2021; Li et al., 2022). Adolescents with cancer also reported more concerns about body image, fertility, and sexuality, when compared to older adults with cancer (Park & Rosenstein, 2015). Numerous studies have also shown that the younger a cancer patient is, the greater the pain they are likely to feel (Walsh et al., 2000; Mao et al., 2007; Poleshuck et al., 2006; Macdonald et al., 2005). Pain, in turn, has been linked to depression, allowing for the idea that adolescent cancer patients experience more pain and are thus more likely to display symptoms of depression (Kroenke et al., 2010; Li et al., 2022).

The Psychological Effects of Informal Animal Interaction

Interactions with animals, both formal (prescribed by a professional or in a supervised setting) and informal (pet ownership/interaction), have been shown to have positive effects on depression. In recent years, many studies have detailed the benefits of owning a pet (Sharpley et al., 2020; Batty et al., 2017; Cheung & Kam, 2017; Stanley et al., 2014; Taniguchi et al., 2018). Pets are defined as domesticated and cared for non-human companion animals (Cheung & Kam, 2017). Research has suggested that pet ownership is associated with positive physical and psychological outcomes (Batty et al., 2017; Bennett et al., 2015; Branson et al., 2016; Cheung & Kam, 2017; Dall et al., 2017; Feng et al., 2014; Hajek & König, 2020; Krause-Parello & Gulick, 2013; McNicholas & Collis, 2000; Oka & Shibata, 2009; Shibata et al., 2012; Stanley et al., 2014; Taniguchi et al., 2018; Wood et al., 2005; Wood et al., 2017; Yabroff et al., 2008; Sharpley et al., 2020). This can likely be attributed to the human-animal bond, “a well-documented phenomenon that has been around since humans began domesticating animals” (Fine, 2019).

Pets provide companionship and stimulation, and have been found to increase oxytocin levels and foster positive emotions, which in turn promote self-efficacy, self-affirmation, sociability, positive attitude, coping skills, responsibility, and a reduction in loneliness (Bennett et al., 2015; Cheung & Kam, 2017; Krause-Parello & Gulick, 2013; Moretti et al., 2011; Slattery & Neumann, 2010; Wells, 2009; Yang et al., 2017). Dog ownership has specifically been found to ease loneliness and increase physical activity in older individuals (Sharpley et al., 2020; Banks & Banks, 2002, Feng et al., 2014; Garcia et al., 2015; Westgarth et al., 2017; Hajek & König, 2020).

Many studies have been conducted to test the connection between pet ownership and depression, and a range of conflicting results exist (Batty et al., 2017; Branson et al., 2016; Enmarker, et al., 2015; Parslow et al., 2005). Some studies show that pets help lessen symptoms of depression (Batty et al., 2017; Branson et al., 2016; Krause-Parello & Gulick, 2013), while others show that they have no significant effect (Enmarker, et al., 2015; Parslow et al., 2005). Results in support of pet-ownership for depressed individuals have shown that older adults who engaged more frequently with pets were less depressed, regardless of the adult's age, gender, education, and other characteristics (Cheung & Kam, 2017). Female dog owners were found to be less socially isolated and more lonely than individuals without pets, making the preventive function of pets higher for females (Cheung & Kam, 2017; Hajek & König, 2020). This is opposed to studies that suggest that people with more depressive symptoms are more likely to seek dogs as pets, but that owning a pet does not have any statistically significant benefits for depressive symptoms over time (Sharpley, et al. 2020).

The few qualitative and speculative works that exist on the contributions of pets to lower depression in adults have presented conflicted findings (Branson et al., 2016; Yang et al., 2017).

A recent systematic review of 54 studies on pet ownership and mental health deduced that no firm conclusions can be made on the association between pets and mental health (Scoresby et al., 2021). The review makes note of the fact that depression is multifactorial, with human-animal interactions being only a single factor; other contributors to mental health must be considered in future research (Scoresby et al., 2021).

To date, there is limited knowledge regarding the association between owning a pet and depressive symptoms among adolescents. It is important that the differences between an adult pet owner and an adolescent pet owner are taken into account in future research, as certain positive effects that older people are found to have from owning a pet may not apply to teens.

The Psychological Effects of Formal Animal Interaction: Animal Assisted Therapy

Animal therapy, also referred to as pet therapy, animal-assisted therapy (AAT) or animal-assisted interventions (AAI), is the planned and guided inclusion of a trained animal in a patient's treatment plan (The International Association of Human–Animal Interaction Organizations (IAHAIO), 2018). AAT and other common terminology used in the field are outlined in Table 1. AAT can involve domesticated pets, farm animals, or marine animals, and may be used in a one on one or group setting (Connor & Miller, 2000). The purpose of AAT is to further an established therapeutic goal, such as helping someone recover from or cope with a health problem or mental disorder. It is goal oriented, planned, formal, structured, and documented, and is delivered and/or directed by a professional health or human service provider who demonstrates skill and expertise regarding the clinical applications of human-animal interactions (IAHAIO, 2018). Both the animal and the handler must be properly trained and licensed to practice (IAHAIO, 2018). Therapy animals can provide physical, psychological, and emotional benefits to those they interact with, typically in facility settings such as healthcare,

assisted living, and schools (IAHAIO, 2018). AAT should not be confused with animal-assisted activities (AAA), which present similarly, but are not explicitly involved in an individual's treatment plan (Souter & Miller, 2007).

The first formal research into animal assisted therapy occurred in the 1960s by Boris Levinson. He accidentally discovered it when seeing that one of his young patients was more comfortable and likely to socialize with his dog than with other humans (Fine, 2017). In 1961 he wrote "The dog as a co-therapist," which was met with extreme ridicule (Levinson, 1961). However, over the past 60 years, the public and professional opinions of AAT have substantially evolved (Fine et al., 2019). The majority of support for AAT and AAA is anecdotal, with countless individuals reporting that spending time with animals has beneficial effects; in recent years there have been many studies that have helped legitimize the field and show the efficacy of AAT in working with trauma victims, children with autism, individuals with executive functioning disorders, and in various settings such as foster care, residential programs, nursing homes, and juvenile detention facilities (O'Haire et al., 2015; O'Haire, 2017; Fine et al., 2010.; Gabriels et al., 2017; Schuck et al., 2018; Bernabei et al., 2019).

There have been many studies on the effects of AAT on depression specifically. A meta-analysis from 2007 found empirical support that AAA and AAT have a moderate positive effect on depression, but stressed that further research is necessary to fully understand these effects (Souter & Miller, 2007). A study conducted over the course of 10 weeks involving a randomized sample of institutionalized patients aged 65+ had participants engage in individual 30-minute sessions of AAT (Ambrosi, et al., 2018). The study found that AAT, specifically with dogs, was effective in reducing depression symptoms amongst participants (Ambrosi, et al., 2018). There was a marked increase in verbal interactions between the elderly and the dog

handlers throughout the study, suggesting that the animals acted as facilitators for social interaction, which in turn elicited positive emotional responses and lessened feelings of depression (Ambrosi, et al., 2018). Another study analyzing the effects of farm animals on psychiatric disorders found that measured depression was significantly lower when tested at a six month follow-up (Berget et al., 2011). While researchers and clinicians agree that more research is necessary to fully understand the effects of AAT on depression, it is widely agreed that the effects are positive and significant when used as a complementary therapy. Most of the existent research is specifically with dogs and uses relatively small sample sizes, so it would be beneficial to test other types of animals on a larger scale.

Animal Assisted Therapy in Hospitals

Despite the fact that it is incredibly important to minimize the emotional suffering of those going through the hospital system, very few non pharmacological strategies have been developed to support the mental wellbeing of patients. Distraction is the most commonly found strategy, with distraction being defined as "a simple and economical technique based on the modification of the environment, consisting in shifting the child's focus from distress-triggering negative stimuli related to the illness and the medical procedures to non-medical elements that are more attractive and pleasant" (Ávila-Álvarez et al., 2020). A 2017 study on the effectiveness of distraction to manage procedural pain in pediatric cancer patients found that distraction had a significant effect on self-reported pain (Bukola & Paula, 2017). A 2007 study found that virtual reality successfully distracted adult oncology patients, making chemotherapy sessions feel shorter in duration when compared to sessions with no distraction techniques (Schneider & Hood, 2007).

The presence of animals, both formally and informally, is used as a distraction tool for children and adults. Most existent research on animals as distraction in hospital settings focuses on the pediatric population, and suggests that animals successfully distract, cause a reduction in stress and pain, and lead to an increase in positive mood amongst patients. A systematic review and meta-analysis on the effects of AAT on hospitalized children and teenagers found that AAT had a significant positive effect on controlling both pain and blood pressure amongst patients (Feng et al., 2021) Multiple randomized controlled studies aiming to compare the effects of AAT with standard treatment protocol in children and adolescents admitted to psychiatric facilities found that interactions with the animals lessened the depression symptoms of the patients (Berget et al., 2011; Stefanini et al., 2015). Furthermore, when tested with pediatric oncology patients, an animal therapy program called "A Magical Dream" was found to "alleviate psychological distress in children and parents, facilitate their adaptation to the therapeutic process, and promote their wellbeing while hospitalized" (Gagnon et al., 2004). This research suggests that AAT could have positive effects on patients of other ages as well, and on cancer patients specifically.

A systematic review of the risks and benefits of AAT in hospitals found the risks to be incredibly low and the potential benefits to be substantial in patients with various diseases (Bert et al., 2016). It was found that "animal-intervention programs suggested various benefits such as reducing stress, pain and anxiety," with the main risk being "zoonosis," the transmission of infection from animal to human (Bert et al., 2016). This risk is easily manageable with proper hygiene protocols and careful selection of patients to participate in AAT programs (Bert et al., 2016). Consequently, it can be inferred that the potential benefits of AAT far outweigh the

potential risks, even though the need for further research is still necessary to further corroborate its benefits.

Limited Research on AAT to Treat Depression in Adolescent Oncology Patients

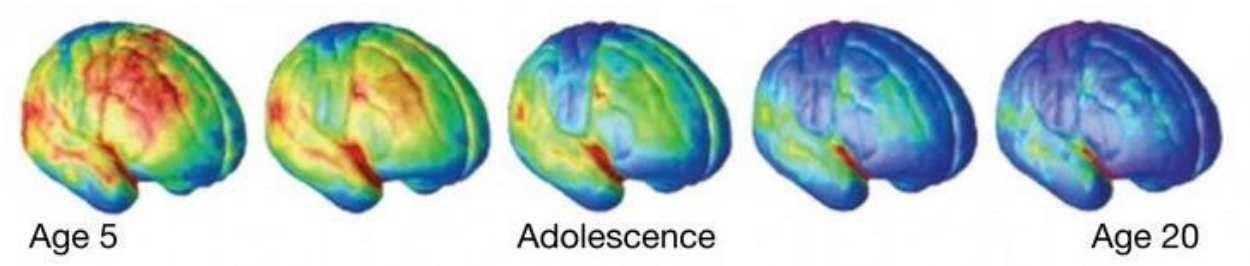
Despite the growing popularity of AAT and the increase in research studies analyzing the positive effects it can have on various psychological disorders, more research is necessary on AAT in the specific area of adolescents with depression. The majority of current research focuses on the elderly and on children, but adolescence is its own distinct life stage that must be studied and tested separately. This is especially true when taking into consideration the prevalence of adolescent depression.

Furthermore, there is available research on AAT as a complementary therapy for hospital patients, but this research is predominantly on pediatric patients, not adolescents. More specifically, AAT as an intervention for adolescent oncology patients remains unexplored. This population is incredibly vulnerable to depression and other psychiatric disorders, and has the potential to benefit greatly from non-pharmacological interventions like AAT. Specific and direct studies are required in order to see the benefits of AAT on this uniquely challenged population.

Future research must take into account the special circumstances of adolescents with cancer in order to properly evaluate AAT's effectiveness on depression symptoms, psychological well-being, and overall quality of life. This means that in addition to taking into account the developmental stage, emotional maturity, and physical capabilities of the patients, researchers must also consider treatment plans, prognosis, and treatment-related symptoms. Expanding research in this area has the potential to positively affect the mental health of countless adolescents oncology patients through the development of targeted, effective, and evidence based interventions.

Figure 1

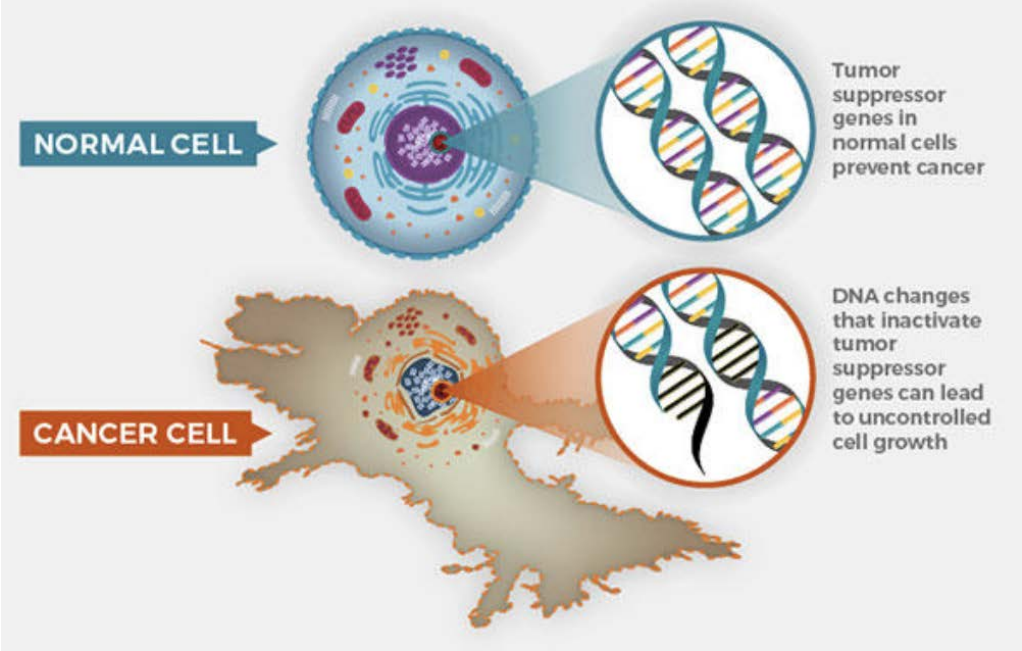
Dynamic mapping of human cortical development



Note. The red areas correspond to less developed areas of the brain and the blue areas correspond to more developed areas of the brain (Gogtay et al., 2004).

Figure 2

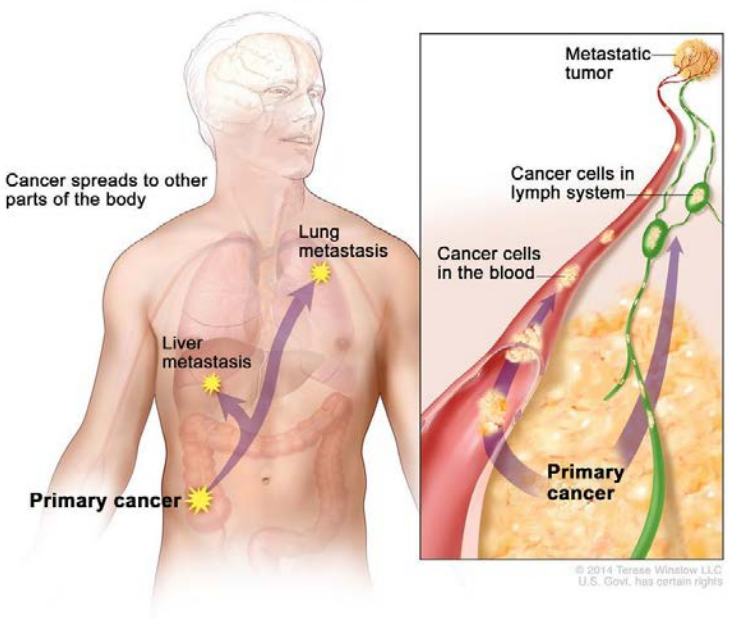
Normal Cell vs Cancer Cell



Note. From the National Cancer Institute (NCI, 2021)

Figure 3

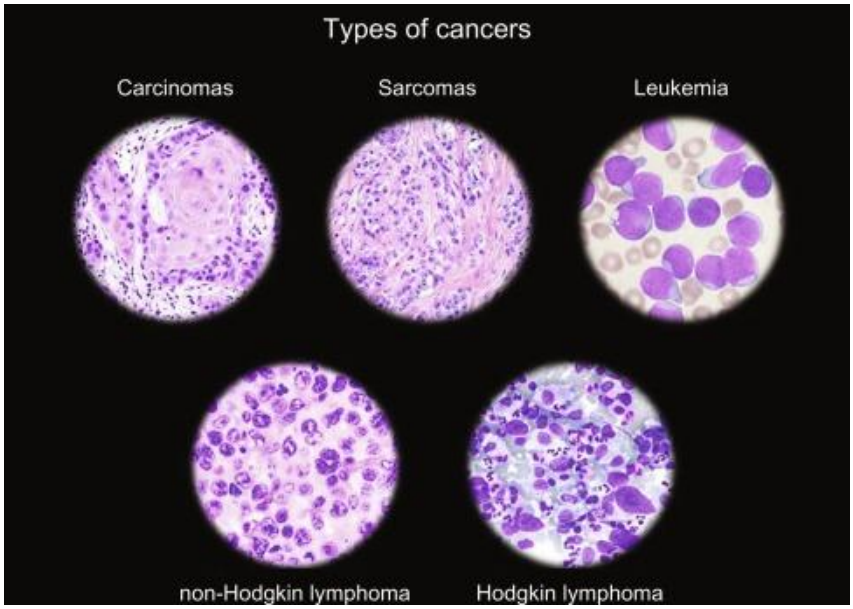
Cancer Metastasizing



Note. Copyright Therese Winslow (NCI, 2020)

Figure 4

Types of cancers



Note. (Lin et al., 2019)

Figure 5

Adolescent cancer incidence rates (2015-2019) among 15-19 year olds, by cancer type

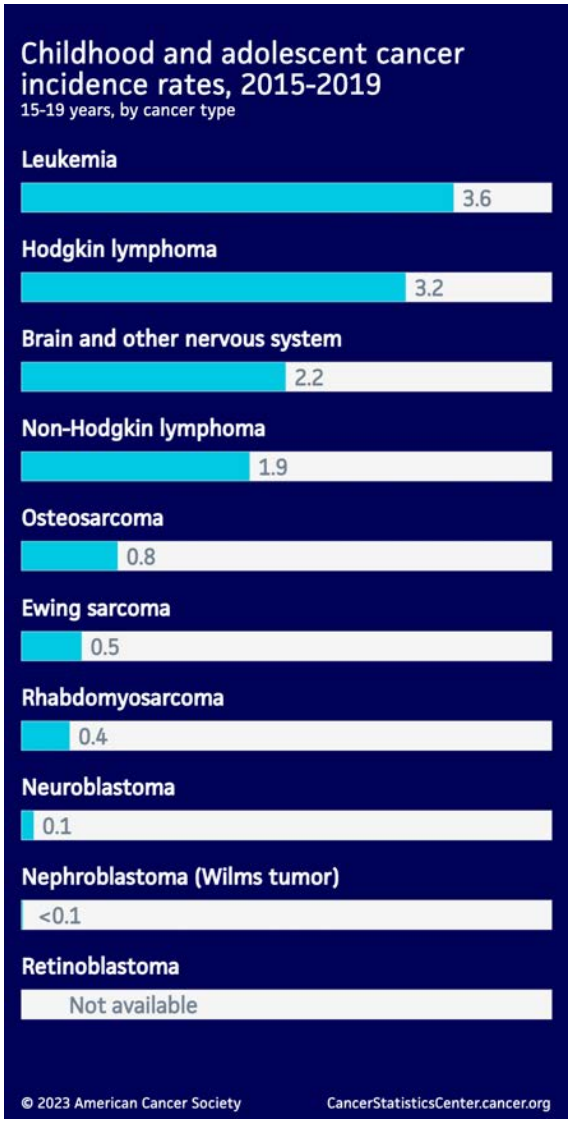


Figure 6

Adolescent cancer survival rates (2012- 2018) among 15-19 year olds, by cancer type

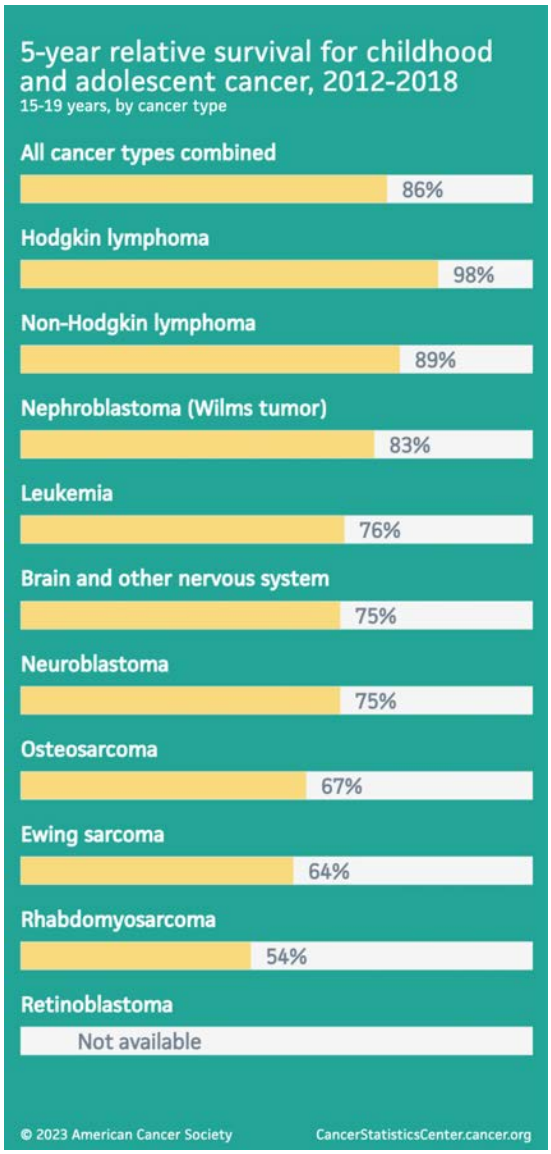


Table 1

Common terminology in animal assisted therapy

Term	Definition
Animal-Assisted Activity	"Use of a trained animal for the therapeutic, motivational, or educational benefit of patients"
Animal-Assisted Therapy	"Use of a trained animal by health professionals to facilitate specific, measurable goals for individual patients for whom there is a documentation of progress"
Pet Therapy	Pet therapy is an older, generic term that may be used to designate a visit from a patient's own, typically untrained, pet. This terminology is being used with less frequency over time.
Emotional Support Animal	"Use of a non-trained animal to provide companionship, relieve loneliness, and sometimes help with depression, anxiety, and specific phobias in an individual."
Service Animal	"Use of a trained animal to assist an individual in managing activities of daily living or monitoring health status."

Note. Definitions adapted from the American Disabilities Act National Network

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