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Healthcare Utilization in a Childhood and Adolescent Cancer Survivor Cohort

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Healthcare Utilization in a Childhood and Adolescent Cancer Survivor Cohort

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Abstract

Healthcare Utilization in a Childhood and Adolescent Cancer Survivor Cohort

By Lillian C. Boyer

Background: Due to late effects from receiving treatment for childhood cancer, childhood cancer survivors are at an increased risk for chronic conditions and mortality. Better preventative care can be provided by learning about their healthcare utilization through evaluating hospitalization, emergency room visits, doctors' visits and surgery among the childhood and adolescent cancer survivor cohort.

Methods: Baseline surveys from the Children's Healthcare of Atlanta Childhood, Adolescent, and Young Adult Cancer Survivor Study (CHOA-CAYACSS) completed by patient or parent proxy were merged with treatment history extracted from medical records. Eligible survivors were ≤ 22 years at the time of baseline survey and were ≥ 2 years off therapy. We used univariate analyses to identify factors to be included in the hospitalization, emergency room visits, doctors' visits and surgery multivariate analyses. Reasons for each of the outcomes were classified using ICD-9 codes.

Results: The sample included 867 survivors (51% male, 84% completed by parent proxy, and 68% white). 5% of the cohort was hospitalized, 20% of the cohort was seen in the emergency room, 52 % visited a doctor and 10% had surgery in the year before visiting the cancer survivor clinic. Self-reported rating of general health was predictive in all of the models. All multivariate models included sex and age at diagnosis. Using ICD-9 codes, injury (32%) followed by symptoms (20%) were listed as the reason for emergency room visit, external (17%) and infectious (13%) were the highest among doctors' visits, health services (17%), gastrointestinal (13%) and injury (12%) among surgery and health services (20%) and symptoms (17%) among hospital visits.

Conclusion: Further research is needed to understand the healthcare utilization of childhood cancer survivors to investigate factors leading to these outcomes and provide preventative care.

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Contents

I. Introduction 1

Childhood and Adolescent Cancer 1

Incidence 2

Survival Rates 3

Childhood Cancer Survivorship 3

II. Materials and Methods 7

Data Analysis 10

III. Results 12

Study Population 12

Demographic Characteristics 12

Clinical Characteristics and Treatment History 12

Characteristics of the Survivors Hospitalized 13

Characteristics of the Survivors Visiting the Emergency Room 15

Characteristics of the Survivors Visiting the Doctor 16

Characteristics of the Survivors Undergoing Surgery 17

ICD-9 codes for Hospitalization, Emergency Room, Doctor Visits and Surgery 18

Hospitalization 19

Emergency room visits 19

Doctor visits 20

Surgery 21

IV. Discussion 23

V. Summary, Public Health Implications, and Future Directions 27

VI. References 29

List of Tables

Table 1. Demographic Characteristics Childhood Cancer Survivors from the Children's Healthcare of Atlanta Childhood, Adolescent, and Young Adult Cancer Survivor Study (CHOA-CAYACSS)..... 32
Table 2. Clinical and Treatment Characteristics Childhood Cancer Survivors from the Children's Healthcare of Atlanta Childhood, Adolescent, and Young Adult Cancer Survivor Study (CHOA-CAYACSS) 34
Table 3. Demographic and Clinical Characteristics Childhood Cancer Survivors from the Children's Healthcare of Atlanta Childhood, Adolescent, and Young Adult Cancer Survivor Study (CHOA-CAYACSS) by Outcome..... 35
Table 4. ICD9 codes frequency for Emergency Room visits, Doctor Visits, Surgery and Hospital Visits..... 37
Table 5. Univariate Logistic Regression for Hospital Visits among Children's Healthcare of Atlanta Childhood, Adolescent, and Young Adult Cancer Survivor Study (CHOA-CAYACSS)..... 38
Table 6. Multivariate Logistic Regression for Hospital Visits among Children's Healthcare of Atlanta Childhood, Adolescent, and Young Adult Cancer Survivor Study (CHOA-CAYACSS)..... 40
Table 7. Univariate Logistic Regression for Emergency Room visits among Children's Healthcare of Atlanta Childhood, Adolescent, and Young Adult Cancer Survivor Study (CHOA-CAYACSS)..... 41
Table 8. Multivariate Logistic Regression for Emergency Room visits among Children's Healthcare of Atlanta Childhood, Adolescent, and Young Adult Cancer Survivor Study (CHOA-CAYACSS)..... 43
Table 9. Univariate Logistic Regression for Doctors' Visits among Children's Healthcare of Atlanta Childhood, Adolescent, and Young Adult Cancer Survivor Study (CHOA-CAYACSS)..... 44
Table 10. Multivariate Logistic Regression for Doctors' Visits among Children's Healthcare of Atlanta Childhood, Adolescent, and Young Adult Cancer Survivor Study (CHOA-CAYACSS)..... 46
Table 11. Univariate Logistic Regression for Surgery among Children's Healthcare of Atlanta Childhood, Adolescent, and Young Adult Cancer Survivor Study (CHOA-CAYACSS)..... 48
Table 12. Multivariate Logistic Regression for Surgery among Children's Healthcare of Atlanta Childhood, Adolescent, and Young Adult Cancer Survivor Study (CHOA-CAYACSS)..... 50

I. Introduction

Childhood and Adolescent Cancer

Childhood cancer survivorship rates have increased (1); however, survivors are at an increased risk for late effects including chronic conditions (2). The objective of this study is to quantify healthcare utilization of childhood cancer survivors by quantifying hospital visits, doctor's visits, emergency room (ER) visits and surgery among the CAYACCS patient population. We hypothesize that there will be a higher odds of hospitalization among the uninsured, those with less time since treatment completion, younger age at diagnosis, and those with higher cumulative doses of chemotherapy (3). We hypothesize that males, uninsured survivors, older survivors, and patients longer from cancer diagnosis are less likely to visit the doctor and that these visits will not be related to past cancer diagnosis(4). We expect the highest frequency of these outcomes among CNS survivors and females. We hypothesize the highest frequency of ER visits will be among CNS and bone tumor survivors, being treated with higher levels of chemotherapy and radiation, and not attending follow-up care (5). Higher levels of smoking and drinking should also be linked to higher rates of hospitalization (5).

The second aim of this study is to compare odds of hospital visits, doctor's visits, Emergency Room (ER) visits and surgery among this patient population and the general population. We hypothesize that the odds of hospital visits, doctor's visits, Emergency Room (ER) visits and surgery during the study period will be greater in the childhood cancer survivors than in children and adolescents in the general population.

Incidence

Cancer is the second leading cause of death among children (aged 0-14) and adolescents (15-19) in the United States (6) (7). The most common cancers in children are leukemia composing 28% of childhood cancers, 26% of childhood cancers were brain and central nervous system (CNS) tumors followed by lymphomas, nephroblastoma and reticuloendothelial neoplasms composing 13% of cancers (7). In adolescents, the most common forms of cancer are brain and CNS (20%), lymphoma (20%) and, leukemia (13%) (7). In 2017, an estimated 10,270 children were diagnosed with malignant cancer with 1,190 dying as a result. Incidence of cancer in children and adolescents has stabilized in recent years with an annual increase of 0.5% per year with 13,500 new cases per year (8),while the survival rate has increased. Current five-year survival rates for childhood cancer are greater than 83% (1).

According to Kurt et al, the overall age adjusted cancer incidence rate was 171.01 per million persons in children and adolescents between 2001 and 2009 (3). The groups with the highest incidence were boys, adolescents compared to children and white race having higher rates than other racial groups during this period. Leukemias were the most common occurring cancer in these groups. In the international community, the weighted age standardized rate of 155.8 per million person years for children and adolescents (aged 0-19). The cancers occurring most frequently were leukemia, CNS tumors and lymphomas (9).

Survival Rates

According to Smith et al, between 1975 and 2006, childhood cancer mortality rates declined by 50% (10). The smallest mortality declines of 35% to 45% were in CNS and bone cancer. Despite a 64% reduction in leukemia mortality, leukemia followed by bone and CNS tumors had the highest mortality of children diagnosis with cancer from 1975 to 2006 (10). Mortality rates have significantly decreased in the last several decades with survival from childhood cancer currently over 80% (1). Additionally, long term survival is likely for patients living 5 years past diagnosis (1). According to Robison and Hudson, based on the current incidence and rate of survival, the number of childhood cancer survivors in the population will approach 500,000 by 2020 (11). The current number of childhood cancer survivors is approximately 1 out of every 750 people (11).

Childhood Cancer Survivorship

Increase in the survival of childhood cancers has prompted and provided large enough numbers of patients to study the long-term implications of childhood cancer treatment, from chemotherapy, radiation or surgery exposure. There are three primary outcomes to consider in childhood cancer survivorship: health status, morbidity and mortality (2). Using the Childhood Cancer Survivor Study cohort, Mertens et al. found retrospectively that there was a 10.8 fold increase in mortality for 5-year survivors (12). Pediatric cancer survivors are at risk for late effects treatment such as secondary neoplasms and chronic conditions (13), (14). Oeffinger et al, found that 62.3% of survivors had at least one chronic condition and 27.5% had a condition classified as a grade 3 or 4 condition, making it severe or life threatening (2). An important piece to understanding the late effects among childhood cancer survivors requires understanding

re-hospitalization and healthcare utilization among this population. Cancer survivors spend significantly more on health care (15). Some survivors do not seek care due to barriers with cost. Using the 2009 Behavioral Risk Factor Surveillance System survey, the relative risk of survivors forgoing care was 1.67 times that of controls (16). The subgroups of cancer survivors most effected by the cost of care were those in their 20s and those with the poorest health. A continued concern with the preventative care recommended for childhood and adolescent survivors is how to administer services in a cost-effective manner, especially with the growing number of survivors (17).

Healthcare utilization likely varies among subpopulations of childhood and adolescent cancer survivors. A study using the Childhood Cancer Survivor Study (CCSS) of children from the United States and Canada found higher income areas were more likely to receive echocardiograms screening, and higher density of doctors in the area increased the likelihood of a recommended echocardiogram(18) . Providing preventative care allows for intervention to manage chronic conditions and limit the severity of symptoms.

The British Childhood Cancer Survivor Study found excess morbidity among childhood cancer survivors resulted in higher rates of health care utilization than the general population. Survivors went to the doctor more often (CI, 1.1 to 1.3), increased outpatient hospital visits (CI 2.3 to 2.8), day patient hospitalization (CI, 1.3 to 1.6) and inpatient hospitalization (CI, 1.7 to 2.2) (5). In Utah, the risk of hospitalization admission among survivors of childhood and adolescent cancer was 1.67 times as high as the rate among the noncancer controls, with the risk highest among neuroblastoma and bone tumor survivors (19). There is evidence that survivors of childhood cancer are

hospitalized at higher rates (3). In the Danish pediatric and adolescent survivor cohort matched with controls, the standardized hospitalization rate ratio among childhood and adolescent cancer survivors was 1.38 (95% CI, 1.37-1.39) as high as that of the non-survivor controls, with an overall absolute excess risk (AER) of 2803 (95% CI, 2712-2893) per 100,000 person-years (20). Further data was needed to understand the complexity of survivorship care.

Due to the facts two thirds of childhood cancer survivors diagnosed with chronic diseases and there are higher rates of hospitalization among this population, further work is needed to understand the healthcare utilization of ER visits, doctor's visits, surgery and hospitalization of childhood cancer survivors. By understanding the health care utilization of childhood cancer survivors, preventative services can be better tailored to this population and understanding the reasons for usage could further identify conditions present in this population.

The 2016 overall rate of hospitalization in the United States is 104.2 per 1,000 people, with a mean hospital stay of 4.6 days (21). The South Atlantic region, where the CAYACCS survey was administered, accounted for 20.6% of all stays in the United States (21). The rates of hospitalization during this time were 210.8 per 1,000 for patients less than 1 year old, 17.1 for patients aged 1-17, and 75.4 per 1,000 for patients aged 18-44 (21). The mean length of stay was 3.9 days for children under 1, 4.2 days for ages 1 to 17 and 3.8 days for people aged 18 to 44.

In the United States in 2015, under 18-year-old age group had 203 visits for 100 people visits to physician's offices (22). In 2015 in the United States under 18 years old averaged 43 visits per 100 people. Among under 18-year-old, there were 37 visits per 100

people in hospital outpatient departments in 2015. For children aged 0 to 17 years, the rate of stays was 7,928 per 100,000 population excluding neonatal and nonmaternal stays, the rate reduced to 2,505 per 100,000 population (23). For adults aged 18-44 had a lower rate of hospitalization of 7,888 per 100,000 population but when non-maternal and neonatal stays were removed there was a higher rate than among children of 4,334 per 100,000 population.

II. Materials and Methods

The study included a subset of patients from the Children's Healthcare of Atlanta-Childhood, Adolescent, and Young Adult Cancer Survivor Study (CHOA-CAYACSS) cohort. Patients were included in this cohort if they were at least 2 years from the end of their therapy and receiving preventative care and follow-up at CHOA through the Aflac Cancer Survivor program. The Aflac Cancer Survivor Program provides patients with a treatment summary and advises and educates patients and their families on any additional screenings that are recommended due to increased risk from their history of cancer, exposure to cancer treatment and current health status. The Aflac Cancer Survivor Program provides a variety of services to cancer patients and their families from pediatric oncology, endocrinology, psychology, and social work.

Inclusion criteria for this analysis, required pediatric cancer patients or parent proxy to complete a baseline survey 2 or more years after the end of cancer treatment. The initial dataset included 1,000 patients. Patients were excluded if they were over the age of 22 years old at the time of the baseline survey or 20 years old or greater at the time of diagnosis (n=27). Surveys that did not provide a response to the primary outcome question were considered incomplete and removed from the analysis (n=24). Patients who withdrew study consent (n=3) were removed from the dataset. Patients with brain tumors have limited numbers of patients in this survey, as they are followed in a separate multidisciplinary clinic due to the differences in treatment including establishing the date of end of treatment, general lack of cancer treatment summary and differences in survivor health due to cranial radiation and surgery. Patient surveys missing their corresponding cancer treatment summary were dropped from the dataset (n=28). All the patients who

completed the CHOA-CAYACSS survey but were not diagnosed with a cancer malignancy were dropped from the analysis (n=51).

After applying exclusions, 867 participants who were enrolled in the CAYACSS study between January 23, 2008 and June 29, 2013 were included in this analysis. Cancer diagnosis was classified into diagnosis categories. The diagnosis types were defined as leukemia, lymphoma, bone and soft tissue sarcoma, kidney, neuroblastoma, other solid tumors and central nervous system and brain tumors. Originally, the other solid tumors and central nervous system and brain tumors were separate categories but the number of patients in each category was not sufficient to run the logistic regression model.

Data was collected from two different sources: the baseline CHOA-CAYACSS survey and the patients' medical record in Epic. Surveys from CHOA-CAYACSS were completed by parent report of patients under 18 or patient report for those who were 18 years or older. Eligibility patients were approached at their first survivor clinic visit or via email. Patients did not have to receive their cancer treatment at CHOA to be part of the cohort. Over the evolution of the CHOA-CAYACSS, there were several different original sources for storing survey data including paper surveys entered into Redcap, an older portal, and data that had been entered by a student into Redcap as well as the surveys that were completed by the participant directly in Redcap. A 10% sample of the survey from each source was taken to ensure data entry quality, verify survey completion and establish missing data versus stopping the survey. It was concluded data was accurately and consistently recorded across the various survey formats.

Cancer diagnosis and treatment information was abstracted from the patients' medical record, and included if the patient received chemotherapy, radiation, and bone

marrow transplant, the date of cancer diagnosis, the date of the end of their cancer treatment, diagnosis and diagnosis type. The baseline survey was linked to the cancer treatment summary extracted from EPIC. The age at follow-up was calculated based off the date of survey completion and the date of birth. Time since diagnosis was calculated from the date of diagnosis to the date of survey completion.

The outcome variables of interest were obtained from a survey question: 'Have you had any of the following in the last year? Illness or injury requiring a doctors visit, Illness of injury requiring an emergency room (ER) visit, Illness or injury requiring hospitalization, Illness or injury requiring surgery'. The survey asked about the 1-year time frame proceeding the survey date. Patient or parent report who reported 'yes' to any of the questions above were also asked, the date, reason and if the outcome was due to cancer. SAS was used to code for a response of yes to any one of the outcome variables if the box for the outcome variable had been checked, or the write in section had been completed for any one of the fields for date, reason or event due to cancer. Any information provided for the four outcome variables of interest was used to code for ICD9 codes.

The covariates of interest from the survey included sex, race, parent's marital status, type of insurance, any chemotherapy, any radiation, bone marrow transplant, reported rating of general health, type of cancer diagnosis, age at follow-up survey, father's employment status, mother's employment status, exercise, household income, frequency of tobacco use, father's highest level of education, mother's highest level of education, and age at diagnosis. Due to smaller numbers in the Asian and pacific islander category, that group was combined with the other category. Parental status was

recategorized for a more robust sample to never married, married and not currently married. Likewise, type of insurance was simplified into categories based on type of insurance being public, private or having no insurance. Question, “How would you rate your overall general health status?” originally consisted of 5 categories being excellent, very good, good, poor and fair but poor and fair were combined to run the logistic regression.

Data Analysis

Univariate logistic regression models were run for each of the four outcomes: hospital visits (n=41), emergency room visits (n=182), doctors’ visits (n=452), and surgery (n=87). The univariate models contained sex, race, parent’s marital status, type of insurance, any chemotherapy, any radiation, bone marrow transplant, reported rating general health, type of cancer diagnosis, age at diagnosis, age at follow-up survey, father’s highest level of education, mother’s highest level of education, exercise, household income, tobacco frequency, father’s employment status and mother’s employment status. Univariate models that did not contain an odds ratio of 1 in the 95% confidence interval, meaning they had a p-value less than .05, were included in the final multivariate model. In order to compare to other studies, sex and age at diagnosis were included in all of the final multivariate models. The final multivariate model for hospital visits included sex, age at diagnosis, any chemotherapy, reported general health, type of cancer diagnosis, and household income. The final multivariate model for emergency room visits included sex, age at diagnosis, parent’s marital status, any radiation, reported rating of general health, exercise, household income and mother’s highest level of education. The final multivariate model for doctors’ visits included sex, age at diagnosis,

race, reported rating of general health, type of cancer diagnosis, father's employment status, household income, and mother's highest level of education. The final multivariate model for surgery included sex, age at diagnosis, race, any radiation, reported general health and type of cancer diagnosis.

III. Results

Study Population

Surveys were completed by parents and their survivors enrolled in the CAYACSS study between January 23, 2008 and June 29, 2013.

Demographic Characteristics

Provided in Table 1 are the demographic characteristics of childhood and adolescent survivors included in the analysis. Of these, 726 (83.7%) were completed by parent proxy. 446 (51.4%) survivors were male and 68.1% were non-Hispanic white with the second largest group being Black, non-Hispanic with 126 (14.53) survivors included in the analysis. The majority of patients or parent proxy reported the patients' health as excellent (42.0%) or very good (38%). Similarly, there were also high levels of the survivors' exercise, with 312 (36%) respondents reporting the survivor exercised every day and 259 (30%) respondents reporting the survivor exercised most days. The age at follow-up was fairly evenly divided between survivors aged 0 to 10 (30.1%), survivors aged 11 to 15 (33.7%) and survivors aged 16 to 22 (35.5%). The majority of patients had a father who was employed (72.7%) and about half of survivors in the analysis had a mother who was employed (55.3%).

Clinical Characteristics and Treatment History

Table *2* describes the clinical characteristics of patients included in the analysis. The majority of patients received Chemotherapy (97.6%) and about a third of survivors had any amount of radiation during their cancer treatment (34.4%). 116 (13.4%) of survivors had a bone marrow transplant as part of their treatment. The majority of cancer diagnoses 381 survivors (44%), were classified as type 1 in this study meaning it was a Leukemia diagnosis. The other two most common diagnoses were Lymphoma (12.2%) and Bone or soft tissue sarcomas (12.1%). The sample was divided into 4 categories for age at diagnosis with 301 (34.7%) survivors being diagnosed between the ages of zero and three years old. The majority of responders to the survey 736 (84.9%) did not answer the question on if the survivor used tobacco products. The lowest number of survivors categorized for age at diagnosis was among the fifteen to nineteen-year-olds which composed of 54 survivors (6.2%). The majority of respondents reported survivors having private insurance, with 596 (68.7%) survivors having private insurance. No insurance was the smallest category with only 14 patients or 1.61% of the sample falling into this category. There were also 15 respondents who did not answer the insurance question. In our study population of 867 survivors, 4.7% of the cohort was hospitalized, 16.2% of the cohort was seen in the emergency room, 52.1% visited a doctor and 8.4% had surgery in the year before visiting the cancer survivor clinic.

Characteristics of the Survivors Hospitalized

Table 3 describes the clinical and demographic characteristics of the cohort by outcome. Of those who were hospitalized, 80.5% of the surveys were completed by parent proxy. The majority of those hospitalized were male, composing of 56% of the

hospitalizations. White, non-Hispanic survivors accounted for 68% of the survivor population while Black, non-Hispanic survivors each composed 9.8% of the sample and Asian or Pacific Islander or Other made up 12% of those who were hospitalized. 41.5% of patients who were hospitalized had parents who were married, 14.6% had parents who were never married, 22% had parents who were not currently married and 22% were missing parental marital status. Very few patients who were hospitalized had no insurance 2.4%, while 56.2% had private insurance, and the remaining 41.6% had public insurance. 46.3% of those hospitalized were treated with chemotherapy only, 43% were treated with both chemotherapy and radiation. There were significantly less survivors who were hospitalized who received just radiation 4.9% or neither chemotherapy or radiation 4.9%. The majority of those hospitalized were not treated with a bone marrow transplant 85.4%. The largest frequency for overall rating of general health was among 46.3% of survivors reported to have very good general health, but a significant proportion, 22% of those hospitalized rated their health as fair and poor. The majority of those hospitalized were among Leukemia 29.3% and Bone and Soft tissue sarcoma survivors 24.4% while the smallest group was among kidney cancer survivors. Those who were hospitalized tended to be younger at age of diagnosis, with 31.7% of the sample between the ages of 0 to 3 at diagnosis, 43.9% between 4 and 9, 17.1% between the ages of 10 and 14 and 7.3% among 15 to 19 years. Age at follow-up was fairly evenly distributed with 29.3% of survivors aged 0 to 10, 29.3% aged 11-15 and 41.5% aged 16-22 years old at follow-up among those hospitalized. The largest frequency of the father's highest level of education was 34.2% for fathers who did not complete high school, received their GED or graduated high school, with the smallest group being 14.6%

among father's who did some college. The maternal highest level of education ranged from 26.8% of mothers completing high school or less, 26.8% completing some college, with the smallest group, 17.1% completing some level of post graduate education. Survivors were more likely to respond that they exercised more frequently with the largest frequency of exercise among survivors exercising everyday 31.7% and the smallest frequency 7.3% among "do not exercise". There was a wide range in household income with 22% of survivors in households with less than $19,999 and 22% of survivors in households making between $20,000 and $39,999 while 19.5% of the sample lived in a household making over $100,000. The majority of survivors hospitalized had a father who was employed 65.9% with only 4.9% having a father who was unemployed and 29.3% was missing. However, closer to half of the sample 43.9% had a mother who was employed with 29.3% of the sample missing.

Characteristics of the Survivors Visiting the Emergency Room

The majority of survivors who visited the emergency room 81.3% were completed by parent proxy. 52.2% of those were male. The largest group of survivors visiting the emergency room were White, non-Hispanic making up 65.4% of the sample while the smallest group was Asian, Pacific Islander or those identifying as Other making up 6.6% of those who visited the emergency room. 45.6% of survivors' parents were married with similar numbers of never married 13.2% and not currently married 18.7%. 62.6% of the sample had private insurance with very small numbers of uninsured patients 1.3% visiting the emergency room for care. Survivors were more likely to have received chemotherapy alone, making up 71.4% of the sample with the second largest group

26.37% receiving both chemotherapy and radiation. Only 11.5% of those visiting the emergency room received a bone marrow transplant. Close to a three-fourths of the sample rated their overall general health excellent 32.4% or very good 40.1%. The largest group, 47.3% of survivors was among leukemia survivors with the next largest groups among kidney 14.3% and 10.4% among bone or soft tissue sarcoma diagnoses. Less of the cohort had an older age at diagnosis with only 13.2% aged 10 to 14 and 5.5% aged 15 to 19. Age of follow-up was fairly evenly between 0 to 10, 11 to 15 and 16 to 22. Father's level of education and mother's level of education were fairly evenly divided between the categories. 33.5% of survivors reported exercising everyday with the proportion of the sample decreasing with decreasing exercise frequency. The largest group among those visiting the emergency room was survivors in homes making over $100,000. Over half of fathers were employed 68.7% while about half, 50.6% of mother's were employed.

Characteristics of the Survivors Visiting the Doctor

86.1% of survivors visiting the doctor had a survey completed by parent proxy. There were slightly more females 51.3% than males. 75% of the survivors visiting the doctor were White, non-Hispanic with the next largest group 11.8% being Black, non-Hispanic survivors. The largest partition, 56.7% of survivors had parents who were married whereas 8% had parents who were never married. Private insurance was most common for those who went to the doctor 74.6% whereas only 1.1% of the cohort going to the doctor was uninsured. Receiving chemotherapy alone has the largest group of the survivors 66.4% along with both chemotherapy and radiation 31.2%. Only 15.3% of the those going to the doctor had bone marrow transplants. The majority of survivors rated

their overall health as excellent 36.7% and very good 41.2%. Most survivors visiting the doctor were survivors of Leukemia 46.9% while all other groups ranged from 8.9% to 12.6%. Among those going to the doctor were younger, 42.9% were diagnosed between the ages of 4 to 9 and 37.4% were between the ages of 0 to 3. Age of follow-up was consistent across categories, ranging between 33% to 33.9%. There were not significant differences in the level of father's education between categories with a range of 19.0% 27.2% or among mother's level of highest education with a range between 18.6% to 36.5%. The majority of survivors who went to the doctor reported exercising frequently with 39.8% exercising everyday, and 30.3% exercising most days and only 2.9% of survivors reported that they "do not exercise". The largest group of survivors going to the doctor was 31.6% who had a household income of over $100,000 with the lowest frequency 8.2% among survivors with a household income of less than $19,999. The majority 77% of fathers were employed while over half, 57.5% of mother's were employed among survivors visiting the doctor.

Characteristics of the Survivors Undergoing Surgery

The majority 77% of patients reporting surgery were completed by parent proxy. 52.9% of survivors who were hospitalized, were female. 75.9% of those undergoing surgery were White, non-Hispanic with the next largest group 11.7% being Black, non-Hispanic. 47.1% had parents that were married but 25.3% of the sample was missing parent's marital status. Survivors who had surgery as an outcome either had public insurance 34.5% or private insurance 65.5%. 66.37% of those with surgery had chemotherapy alone while only 2.3% had radiation alone. 19.5% of those with surgery had a bone marrow transplant, which was higher than any of the other outcome variables. 10.4% of survivors

said that they had fair or poor health. The most common diagnosis among survivors with a surgical procedure was Leukemia at 31% followed by bone and soft tissue sarcoma at 21.8%. Survivors with a surgical procedure were more likely to be younger at time of diagnosis with 33.3% of the sample between the ages of 0 and 3 and 41.4% of the sample between the ages of 4 and 9 years old. However, the largest group for age at follow-up was 44.8% among the oldest group of survivors ages 16 to 22. 31% of paternal highest level of education was high school or less while the largest group of maternal education was 36.8% among college graduates. Compared to the other outcome variables, there was a greater frequency of those who reported they "do not exercise" 3.5% and "occasionally" 20.7% among survivors requiring a surgical procedure. 23% of survivors had a household income over $100,000 followed by the next largest group of a household income of $20,000 to $39,999. 66.7% of survivors had a father who was employed while 47.1% of mothers were employed.

ICD-9 codes for Hospitalization, Emergency Room, Doctor Visits and Surgery

Table 4 displays ICD-9 codes coded based on the reason provided for the health outcome. Since all study participants included a reason for a health event, not all patients are represented. When multiple reasons were provided for one health event, all codes were included. Of hospital visits, 19.6% were due to a need for health services, and the next most common, 17.4% were due to symptoms. Visits to the emergency room were greatest for injury 32.2%, pulmonary factors 14.4% and symptoms 20%. Survivors visited the doctor most frequently for pulmonary factors 28.2%, external 16.8%, symptoms 14% and neurologic factors 8.2%. Survivors undergoing surgery were most

likely to have a procedural code 26.9% followed by health services 17.1%, gastroenterology 12.7% and injury 12%.

Hospitalization

Table 5 contains the univariate analysis analyzing covariates with hospitalization among Children's Healthcare of Atlanta Childhood, Adolescent, and Young Adult Cancer Survivor Study (CHOA-CAYACSS). The final model in Table 5, included sex, age at diagnosis, reported overall general health, type of cancer diagnosis, and household income. Those reporting very good health (OR = 3.09, 95% CI: 1.23 , 7.73), and poor or fair health (OR = 12.97, 95% CI: 3.99 , 42.19), were at a statistically statically significant higher odds of hospitalization compared to those who reported excellent health. Although these were the hypothesized results, patients rating their overall health as good were not a significantly higher odds of hospitalization compared to patients who reported excellent health. Patients who were diagnosed with bone and soft tissue sarcoma had 3.83 (95% CI: 1.40, 10.51) times as high an odd of hospitalization compared to those who were diagnosed with leukemia. Patients diagnosed with CNS, brain and other solid tumors had 3.75 (95% CI: 1.27, 11.03) times as high an odd of hospitalization compared to those who were diagnosed with leukemia. There were no other statistically statically significant differences in hospitalization between different diagnosis types. Increasing household income appeared to have a protective effect on the patient being hospitalized although it was not linear. Among those with a household income of less than $19,999, there was 3.12 times the odds of hospitalization compared to patients with a household income of over $100,000 (95% CI: 1.07, 9.12).

Emergency room visits

In the univariate analysis in Table 7, parent's marital status, type of insurance, chemotherapy and radiation, general health, exercise, household income and maternal education were all significant and included in the final multivariate model. In the final model in Table 8, exercise had a statistically significant harmful effect with survivors reporting that they "do not exercise" having 7.58 (95% CI: 1.77, 32.40) times the odds of visiting emergency room as those who reported exercising everyday. Although it was not statistically significant, patients or parents who rated the patient as having poor or fair general health had an increased odd of 3.01 (95% CI: 0.98, 9.24) times as high as the odds of emergency room visits as those patients or parent proxies who identified the patient as having overall excellent health. As overall reported rating of general health decreased, the point estimate for the odds of visiting the emergency room increased. Patients or parent proxies who reported lower levels of exercise appeared to have an increased odd of visiting the emergency room compared to patients who exercise at all. Greater statistical power through a larger cohort is needed to determine if there is a statistically significance protective effect of improved ratings of overall general health and increased frequency of exercise.

Doctor visits

Table 9 contains the univariate analysis analyzing covariates with doctor's visits among Children's Healthcare of Atlanta Childhood, Adolescent, and Young Adult Cancer Survivor Study (CHOA-CAYACSS). The final model in Table 10, included sex, age at diagnosis, race, type of insurance, reported rating of general health, type of cancer diagnosis, father's employment status, exercise, household income, and maternal

education were included in the final model. Those who identified as Hispanic had 0.25 times the odds of those who were White and non-Hispanic of visiting the doctor 95% CI: (0.12, 0.52). Worse report of overall general health was statistically significant for increasing the odds visiting the doctor compared to those who reported excellent general health. Those who reported poor or fair general health were at a 6.60 times 95% CI: (1.58, 27.44) as high an odd of visiting the doctor compared to those who were in excellent health. Those who reported very good were at a 1.72 times 95% CI: (1.16, 2.55) as high an odd of visiting the doctor compared to those who were in excellent health. The lowest odds of visiting the doctor was among those with Other Solid Tumor or Central Nervous System and Brain Tumor diagnoses types (OR=0.37 , 95% CI: 0.21, 0.71) compared to the odds of visiting the doctor among the leukemia group. Only exercising some days was statistically significant when compared to the group exercising everyday (OR=0.45).

Surgery

Table 10 contains the univariate analysis analyzing covariates with surgery among Children's Healthcare of Atlanta Childhood, Adolescent, and Young Adult Cancer Survivor Study (CHOA-CAYACSS). The final model in Table 11 for surgery included sex, age at diagnosis, race, chemotherapy and radiation exposure, reported general health, and type of cancer diagnosis and exercise. The odds of surgery were statistically significantly lower among African Americans with an odds of .32 (95% CI: 0.13, 0.78) times that of the odds of surgery among white patients. Patients who reported good or poor or fair overall general health were statistically more likely to be surgery than patients who reported their general health as being excellent. The odds of surgery were

most significant among patients' whose health was poor or fair were 4.71 95% CI: (1.75, 12.67) times as high as the odds of surgery compared to patients reported to have excellent overall health. The odds of surgery among survivor with a good heath rating were 3.05 95% CI: (1.54, 6.04) times as high as the odds of surgery compared to patients reported to have excellent overall health. The odds of surgery were increased in bother the bone and soft tissue sarcoma and the neuroblastoma group when compared to leukemia survivors. The odds of surgery among bone and soft tissue sarcoma survivors was 2.93 (95% CI: 1.44, 5.98) times as high as the odds of surgery among Leukemia survivors. The odds of surgery among neuroblastoma survivors was 2.41 (95% CI: 1.07, 5.43) times as high as the odds of surgery among Leukemia survivors.

IV. Discussion

Across the models, our findings for general overall health were consistent for being predictive of healthcare utilization. Patients whose general overall health was rated in the worst categories, poor and fair, was predictive of all four outcomes. Several of the models, doctor visits and surgery, other levels of the general health question was shown to be predictive. Factors outside of chronic conditions could affect this rating such as stress, interpersonal relationships, and poor spiritual status (24). Another significant finding was that household income was significant in the model predicting hospital visits, with poorer individuals being more likely to be hospitalized. Survivors with less finical means may also be limited in their access to insurance and healthcare. Leyenaar et al., found across general and children's hospital's there was a higher frequency of hospitalization for the lowest median household income by zip (25). If they are unable to access preventative services, they may be more likely to be hospitalized.

Leukemia was the reference group for this analysis, hospitalization rates for childhood leukemia survivors were greater than that of their siblings or the general population (26). This study found bone and soft tissue sarcoma cancer survivors were at an increased odds of hospitalization which is supported by previous literature (27). These findings may be indicating of a greater likelihood of treatment consisting of receiving combinations of chemotherapies and radiations and the high risk for recurrence or metastatic disease. Secondary malignancies were among the highest risks for morbidity leading to hospitalization (28).

Despite a small sample size, our study found that African American survivors were at an increased odd of surgery compared to their White counterparts. This analysis

found that survivors identifying as Hispanic had a lower odds of seeing the doctor. This analysis found that survivors identifying as Hispanic had a lower odds of seeing the doctor. A study looking at the trends in access to health care in the United States from 2000 to 2014, found results consistent with this analysis. Hispanic children had the lowest frequency of any racial group in attending well-child visits, which decreased from 19.8% to 11.9% over the course of the study (29). Findings may reflect the barriers to accessing medical care these groups experience.

Regular exercise is thought to improve the health, quality of life and psychosocial well-being of cancer survivors (30). Our study found that exercise reduced the odds of hospitalization, particularly among survivors who exercised every day, most days or some days compared to those who did not exercise at all.

In this analysis, age at diagnosis was only predictive in the model for doctors' visits. Survivors diagnosed between the ages of 4-9 and 10-14 had a lower odd of visiting the doctor than patients aged 0 to 3 years old. By comparing these findings to similar statistics from the National Center for Health Statistics, we gain perspective on the healthcare utilization of childhood and adolescent survivors. According to the National Center for Health Statistics, 59.2% of children rate their health as excellent and 26.4% rate their health as very good. Among our cohort, 42% and 38% of survivors or parent proxies rated the survivors' health as excellent of very good. Of children under the age of 12, 5.7% visits the hospital once in the last 12 months in the United States in 2018 (31). Among adolescents aged 12 to 17, 1.3% had only one visit to the hospital in the last 12-months. Compared to our cohort, we might have expected less children to be hospitalized since the study had 4.7% of the study population hospitalized. For children aged zero to

four, 11.1% came into contact with a doctor in the last 6 months to a year whereas of children aged five to eleven years 17.6% came into contact with a doctor in the last year. Among adolescents aged twelve to seventeen 18.5% came into contact with a doctor in the last year, according to the National Health Interview Survey from 2018. Due to the limited size of the cohort, models in this analysis couldn't be run with the smaller groups of age at follow-up listed above. In our survivor population 52.1% of the population visited the doctor over the 1-year study which is much higher than what would be expected from the general population.

This study supports previous findings that general health is related to health outcomes (24). In the hospital, emergency room, doctor visits and surgery models, we found that patient or parent proxy reporting of general health was a statistically significant predictor. Reporting poor or fair health greatly increased the survivors' odds of experiencing the outcome. Exercise was also a statistically significant predictor in emergency room visits. These findings support results found by Freeman et al., in a British cancer survivors which found that survivors rated their physical health lower and perceived their physical health declining at a faster rate than the general population (21)

The study was limited by self-reported survey response which limited the information due to recall bias. Additionally, cancer patient may be more likely to report symptoms than the general population. Schwartz et al., found that when childhood and adolescent childhood cancer survivors were compared to healthy controls in the primary care setting, they listed significantly greater health problems 5.6 compared to 2.6 from controls (32).

This study was limited by the survivor cohort and biased included only survivors who visited the clinic. Patients who have health insurance or have a higher socioeconomic status may be more likely to be included in our sample. However, CHOA provides care to the majority of children in Georgia which provides a greater representation of minorities and other individuals that may not have been included in other areas. Cancer patients who return to the survivor clinic return in different proportions than the original population, slightly biasing our sample. A study from the same institution as this cohort found patients receiving chemotherapy alone, having private insurance, and identifying as the White, non-Hispanic race were more likely to attend a survivor visit (33). Another study found, overall white race, younger age at diagnosis and leukemia and lymphoma diagnoses were associated with better rates of follow-up through the multidisciplinary clinic (34). The study was limited by only looking at the odds of these outcomes during the 1-year time period.

V. Summary, Public Health Implications, and Future Directions

In summary, future studies are needed to provide a better picture of healthcare utilization among this population. Efforts to provide survivor follow-up care and treatment summaries at this institution, may have reduced the addressed differences between treatment status among the study population. Future research is needed to describe the healthcare utilization patterns of patients and economic impact. By providing access to services, the late effects can be mitigated and appropriately addressed as childhood cancer survivors move onto adult care.

Our results suggest that childhood and adolescent cancer survivors continue to need preventative care and targeted services. By improving their perception of their overall general health, some health events may be prevented. Since the frequency of doctor visits, hospitals, emergency rooms and surgeries seem to be higher among survivors, providing better preventative care, large finical expenditures can be avoided, and survivors' health can be improved. Our study further supported the importance of exercise and other health habits to maintain positive perception of overall health.

Future directions include a more robust cohort of patients to further analyze different categories of the covariates. Smaller categories had to be grouped together so providing a larger sample size would provide power for the analysis and provide narrower confidence intervals and possible statistical significance for some covariates. Also providing a time period of greater than one year would provide insight into the trends over time and the opportunity to conduct more complex analyzes. This analysis was limited by self-report particularly when it came to ICD-9 codes. Many outcomes did

not have a reason provided. By relying on self-report, survivors or their parents proxy may not understand or remember all the information the survey requests from them.

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Table 1. Demographic Characteristics Childhood Cancer Survivors from the Children's Healthcare of Atlanta Childhood, Adolescent, and Young Adult Cancer Survivor Study (CHOA-CAYACSS)

	Eligible Survivors (n=867)	
	No.	**%**
Person completing the survey		
Parent proxy	726	83.74
Patient (18 or older)	141	16.26
Sex		
Male	446	51.4
Female	421	48.6
Race		
White, non-Hispanic	590	68.05
Black, non-Hispanic	126	14.53
Hispanic	90	10.38
Asian or Pacific Islander	21	2.42
Other*	34	3.92
Missing	6	0.69
Parent's Marital Status		
Never married	82	9.46
Married	467	53.86
Not Currently Married	148	17.07
Missing/ other/ unknown	170	19.61
Reported Rating of General Health		
Excellent	364	41.98
Very Good	329	37.95
Good	134	15.46
Fair	34	3.92
Poor	4	0.46
Missing	2	0.23
Age at Follow-Up Survey		
0 - 10	267	30.80
11 - 15	292	33.68
16 - 22	308	35.52
Father's Highest Level of Education		
Did not finish high school	68	7.84
High school or GED	179	20.64
Some college	172	19.84
College graduate	226	26.07
Some graduate or professional school	34	3.92
Graduate or professional (medical, law) school graduate	141	16.26
Do not know	25	2.88
Missing	22	7.84
Mother's Highest Level of Education		
Did not finish high school	51	5.88

High school or GED	141	16.26
Some college	178	20.53
College graduate	306	35.29
Some graduate or professional school	42	4.84
Graduate or professional (medical, law) school graduate	138	15.92
Do not know	7	0.81
Missing	4	0.5
Exercise		
Do not exercise	29	3.34
Occasionally	97	11.19
Some Days	143	16.49
Most Days	259	29.87
Everyday	312	35.99
Missing	27	3.11
Household Income		
Less than $19,999	83	9.57
$20,000 - $39,999	143	16.49
$40,000 - $59,999	99	11.42
$60,000 - $79,999	104	12.00
$80,000 - $99,999	102	11.76
Over $100,000	251	28.95
Don't know	62	7.15
Missing	23	2.65
Father's Employment Status		
Yes	626	72.70
No	51	5.88
Missing	190	21.91
Mother's Employment Status		
Yes	479	55.25
No	239	27.57
Missing	149	17.19

*Other race includes Hispanics, Asian and Pacific Islanders, and American Indian/Alaska Natives.

Table 2. Clinical and Treatment Characteristics Childhood Cancer Survivors from the Children's Healthcare of Atlanta Childhood, Adolescent, and Young Adult Cancer Survivor Study (CHOA-CAYACSS)

	Eligible Survivors (n=867)	
	No.	**%**
Chemotherapy or Radiation		
Chemotherapy only	560	64.59
Radiation only	12	1.38
both chemotherapy and radiation	286	32.99
neither chemotherapy or radiation	9	1.04
Bone Marrow Transplant		
Yes	116	13.38
No	751	86.62
Type of Cancer Diagnosis		
Leukemia	381	43.94
Lymphoma	106	12.23
Bone/Soft tissue Sarcoma	105	12.11
Kidney	98	11.30
Neuroblastoma	82	9.46
Other Solid Tumor CNS/Brain Tumor	95	11.00
Age at Diagnosis		
0 - 3	301	34.71
4 - 9	383	44.18
10 - 14	129	14.88
15 - 19	54	6.23
Visited the Emergency Room		
Yes	182	20.99
No	685	79.01
Visited the Doctor		
Yes	452	52.13
No	415	47.87
Hospitalization		
Yes	41	4.73
No	826	95.27
Surgery		
Yes	87	10.03
No	780	89.97
Type of Insurance		
Public	242	27.91
Private	596	68.74
No insurance	14	1.61
missing	15	1.73

Table 3. Demographic and Clinical Characteristics Childhood Cancer Survivors from the Children's Healthcare of Atlanta Childhood, Adolescent, and Young Adult Cancer Survivor Study (CHOA-CAYACSS) by Outcome

	Hospitalized (n=41)		ER (n=182)		Doctor's Visit (n=452)		Surgery (n=87)	
	No.	%	No.	%	No.	%	No.	%
Person completing the survey								
Parent proxy	33	80.49	148	81.32	389	86.06	67	77.01
Patient (18 or older)	8	19.51	34	18.68	63	13.94	20	22.99
Sex								
Male	23	56.10	95	52.20	220	48.67	41	47.13
Female	18	43.90	87	47.80	232	51.33	46	52.87
Race								
White, non-Hispanic	28	68.29	119	65.38	339	75.00	66	75.86
Black, non-Hispanic	4	9.76	31	17.03	53	11.73	6	6.90
Hispanic	4	9.76	20	10.99	27	5.97	8	9.20
Asian or Pacific Islander or Other	5	12.2	12	6.6	30	6.64	7	8.05
Missing					3	0.66		
Parent's Marital Status								
Never married	6	14.63	24	13.19	36	7.96	10	11.49
Married	17	41.46	83	45.60	256	56.67	41	47.13
Not Currently Married	9	21.95	34	18.68	83	18.36	14	16.09
Missing/ other/ unknown	9	21.95	41	22.53	77	17.04	22	25.29
Type of Insurance								
Public	17	41.46	65	35.71	102	22.57	30	34.48
Private	23	56.1	114	62.64	337	74.56	57	65.52
No insurance	1	2.44	2	1.10	6	1.33		
Missing			1	0.55	7	1.55		
Chemotherapy or Radiation								
Both Chemotherapy and Radiation	18	42.9	48	26.37	141	31.19	37	42.53
Chemotherapy only	19	46.34	130	71.43	300	66.37	47	54.02
Radiation only	2	4.88	2	1.10	7	1.55	2	2.30
Neither Chemotherapy and Radiation	2	4.88	2	1.1	4	0.88	1	1.15
Bone Marrow Transplant								
Yes	6	14.63	21	11.54	69	15.27	17	19.54
No	35	85.37	161	88.46	383	84.73	70	80.46
Reported Rating of General Health								
Excellent	7	17.07	59	32.42	166	36.73	25	28.74
Very Good	19	46.34	73	40.11	186	41.15	29	33.33
Good	6	14.63	32	17.58	74	16.37	24	27.59
Fair & Poor	9	21.95	18	9.89	26	5.75	9	10.35
Type of Cancer Diagnosis								
Leukemia	12	29.27	86	47.25	212	46.90	27	31.03
Lymphoma	3	7.32	16	8.79	46	10.18	10	11.49
Bone/Soft tissue Sarcoma	10	24.39	19	10.44	57	12.61	19	21.84
Kidney	3	7.32	26	14.29	47	10.40	9	10.34
Neuroblastoma	6	14.63	17	9.34	50	11.06	13	14.94
Other *	7	17.08	18	9.9	40	8.85	9	10.35

Age at Diagnosis								
0 - 3	13	31.72	67	36.81	169	37.39	29	33.33
4 - 9	18	43.9	81	44.51	194	42.92	36	41.38
10 - 14	7	17.07	24	13.19	62	13.72	13	14.94
15 - 19	3	7.32	10	5.49	27	5.97	9	10.34
Age at Follow-Up Survey								
0 - 10	12	29.27	53	29.12	149	32.96	28	32.18
11 - 15	12	29.27	63	34.62	150	33.19	20	22.99
16 - 22	17	41.46	66	36.26	153	33.85	39	44.83
Father's Highest Level of Education								
High school or less**	14	34.15	62	34.07	121	26.77	27	31.03
Some college	6	14.63	36	19.78	86	19.03	13	14.94
College graduate	9	21.95	42	23.08	123	27.21	18	20.69
Post Graduate***	8	19.51	30	16.48	102	22.57	23	26.44
Missing and don't know	4	9.76	12	6.59	20	4.42	6	6.9
Mother's Highest Level of Education								
High school or less*	11	26.83	51	28.02	84	18.58	24	27.59
Some college	11	26.83	43	23.63	96	21.24	15	17.24
College graduate	10	24.39	54	29.67	165	36.5	32	36.78
Post Graduate**	7	17.07	32	17.58	104	23.01	14	16.09
Missing and don't know	2	4.88	2	1.1	3	0.66	2	2.3
Exercise								
Do not exercise	3	7.32	10	5.49	13	2.88	3	3.45
Occasionally	6	14.63	28	15.38	53	11.73	18	20.69
Some Days	9	21.95	23	12.64	58	12.83	16	18.39
Most Days	9	21.95	53	29.12	137	30.31	19	21.84
Everyday	13	31.71	61	33.52	180	39.82	30	34.38
Missing	1	2.44	7	3.85	11	2.43	1	1.15
Household Income								
Less than $19,999	9	21.95	30	16.48	37	8.19	10	11.49
$20,000 - $39,999	12	29.27	35	19.23	65	14.38	17	19.54
$40,000 - $59,999	5	12.2	25	13.74	50	11.06	11	12.64
$60,000 - $79,999	2	4.88	18	9.89	61	13.50	10	11.49
$80,000 - $99,999	2	4.88	19	10.44	65	14.38	12	13.79
Over $100,000	8	19.51	41	22.53	143	31.64	20	22.99
Don't know	3	7.32	12	6.59	26	5.75	7	8.05
Missing			2	1.10	5	1.11		
Father's Employment Status								
Yes	27	65.85	125	68.68	348	76.99	58	66.67
No	2	4.88	9	4.95	21	4.65	2	2.3
Missing			48	26.37	83	18.36	27	31.03
Mother's Employment Status								
Yes	18	43.90	92	50.55	260	57.52	41	47.13
No	14	34.15	55	30.22	125	27.65	24	27.59
Missing	9	21.95	35	19.23	67	14.82	22	25.29

*Other Solid Tumor, Central Nervous System (CNS) & Brain Tumor

**Did not complete high school, GED, or completition of high school

***Post Graduate included any amount of graduate or professional school

Table 4. ICD9 codes frequency for Emergency Room visits, Doctor Visits, Surgery and Hospital Visits

Type of category	Hospital Visits Counts (%)	Emergency Room Counts (%)	Doctor Visits Counts (%)	Surgery Counts (%)
Infectious (001-139)	3 (6.52)	9 (5)	79 (13.27)	7 (5.22)
Neoplasms (140-239)	4 (8.70)	3 (1.67)	1 (0.17)	6 (4.48)
Endocrine (240-279)	4 (8.70)	5 (2.78)	6 (1.01)	15 (4.48)
Blood Disorder (280-289)		1 (0.6)	3 (0.5)	
Psychological (290-319)		3 (1.67)	10 (1.68)	
Neurologic (320-389)	1 (2.17)	6 (3.33)	49 (8.23)	15 (11.12)
Cardiovascular (390-459)	2 (4.35)	1 (0.6)	1 (0.17)	
Pulmonary (460-519)	3 (6.52)	26 (14.44)	168 (28.23)	3 (2.24)
Gastrointestinal (520-579)	1 (2.17)	5 (2.78)	11 (1.85)	17 (12.69)
Genitourinary (580-629)	2 (4.35)	8 (4.44)	9 (1.51)	4 (2.99)
Obstetrics (630-679)				
Skin (680-709)	1 (2.17)	1 (1.67)	10 (1.68)	1 (0.746)
Musculoskeletal (710-739)	1 (2.17)	4 (2.22)	22 (3.70)	4 (2.99)
Congenital Anomalies (740-759)	1 (2.17)	1 (1.67)	2 (0.34)	1 (0.746)
Symptoms (780-799)	8 (17.39)	36 (20.0)	83 (13.95)	1 (0.746)
Injury (800-999)	6 (13.04)	58 (32.3)	35 (5.88)	16 (11.94)
Health Services (V01 - V91)	9 (19.56)	9 (5)	4 (0.67)	23 (17.16)
External (E000-E999)		2 (1.11)	100 (16.81)	
Z00.00			2 (0.33)	
Procedure Codes				36 (26.87)

Table 5. Univariate Logistic Regression for Hospital Visits among Children's Healthcare of Atlanta Childhood, Adolescent, and Young Adult Cancer Survivor Study (CHOA-CAYACSS)

Variables in the Model	OR	95% CI	p-value
Sex			
Male	1.22	0.65, 2.29	0.54
Female	**reference (1.0)**		
Race			
White	**reference (1.0)**		
Black	1.52	0.52, 4.41	0.44
Hispanic	1.07	0.37, 3.13	0.9
Asian/ pacific islander and other	0.5	0.18, 1.35	0.17
Parent's Marital Status			
Never married	**reference (1.0)**		
Married	2.09	0.80, 5.47	0.13
Not Currently Married	1.22	0.42, 3.56	0.72
Type of Insurance			
Public	0.53	0.28, 1.01	0.05
Private	**reference (1.0)**		
No	0.52	0.07, 4.16	0.54
Chemotherapy or Radiation			
Both Chemotherapy and Radiation	**reference (1.0)**		
Chemotherapy only	0.52	0.27, 1.01	0.05
Radiation only	2.98	0.60, 14.62	0.18
Neither Chemotherapy or Radiation	4.25	0.82, 21.98	0.08
Bone Marrow Transplant			
Bone Marrow Transplant	1.12	0.46 2.71	0.81
No Bone Marrow Transplant	**reference (1.0)**		
Reported Rating of General Health			
Excellent	**reference (1.0)**		
Very Good	3.13	1.30, 7.53	0.01
Good	2.39	0.79, 7.25	0.12
Poor and Fair	15.83	5.50, 45.57	<.01
Type of Cancer Diagnosis			
Leukemia	**reference (1.0)**		
Lymphoma	0.90	0.25, 3.23	0.87
Bone/Soft tissue Sarcoma	3.24	1.36, 7.72	0.01
Kidney	0.97	0.27, 3.51	0.96
Neuroblastoma	2.43	0.88, 6.67	0.09
Other Solid Tumor CNS/Brain Tumor	2.45	0.94, 6.39	0.07
Age at Follow-Up Survey			
0 - 10	**reference (1.0)**		
11 - 15	0.91	0.40, 2.06	0.82
16 - 22	1.24	0.58, 2.65	0.58
Father's Employment Status			
Father employed	1.10	0.26, 4.78	0.89
Father unemployed	**reference (1.0)**		
Mother's Employment Status			
Mother employed	0.63	0.31, 1.29	0.20
Mother unemployed	**reference (1.0)**		

Exercise			
Everyday	**reference (1.0)**		
Most Days	0.83	0.35, 1.97	0.67
Some days	1.55	0.65, 3.70	0.33
Occasionally	1.52	0.56, 4.10	0.41
Do not exercise	2.65	0.71, 9.91	0.15
Household Income			
Less than $19,999	3.69	1.38, 9.92	0.01
$20,000 - $39,999	2.78	1.11, 6.98	0.03
$40,000 - $59,999	1.62	0.52, 5.06	0.41
$60,000 - $79,999	0.60	0.12, 2.85	0.52
$80,000 - $99,999	0.61	0.13, 2.91	0.53
Over $100,000	**reference (1.0)**		
Father's Highest Level of Education			
High school or GED or less	**reference (1.0)**		
Some college	0.60	0.23, 1.60	0.31
College graduate	0.69	0.29, 1.63	0.40
Any graduate school	0.80	0.33, 1.94	0.62
Mother's Highest Level of Education			
High school or GED or less	**reference (1.0)**		
Some college	1.08	0.46, 2.57	0.85
College graduate	0.56	0.23, 1.34	0.19
Any graduate school	0.67	0.25, 1.76	0.41
Age at Diagnosis			
0 - 3	**reference (1.0)**		
4 - 9	1.09	0.53, 2.27	0.81
10 - 14	1.27	0.50, 3.26	0.62
15 - 19	1.30	0.36, 4.74	0.69

Table 6. Multivariate Logistic Regression for Hospital Visits among Children's Healthcare of Atlanta Childhood, Adolescent, and Young Adult Cancer Survivor Study (CHOA-CAYACSS)

Variables in the Model	OR	95% CI	p-value
Sex			
Male	1.53	0.75, 3.12	0.24
Female	**reference (1.0)**		
Age at Diagnosis			
0 - 3	**reference (1.0)**		
4 - 9	1.16	0.50, 2.71	0.73
10 - 14	0.26	0.06, 1.16	0.08
15 - 19	1.07	0.22, 5.19	0.93
Reported Rating of General Health			
Excellent	**reference (1.0)**		
Very Good	3.09	1.23, 7.73	0.02
Good	1.68	0.50, 5.60	0.40
Poor and Fair	12.97	3.99, 42.19	<.01
Type of Cancer Diagnosis			
Leukemia	**reference (1.0)**		
Lymphoma	0.34	0.04, 2.89	0.32
Bone/Soft tissue Sarcoma	3.84	1.40, 10.51	0.01
Kidney	1.07	0.28, 4.09	0.92
Neuroblastoma	2.66	0.86, 8.22	0.09
Other Solid Tumor CNS/Brain Tumor	3.75	1.27, 11.03	0.02
Household Income			
Less than $19,999	3.12	1.07, 9.12	0.04
$20,000 - $39,999	2.11	0.79, 5.65	0.14
$40,000 - $59,999	1.17	0.35, 3.87	0.80
$60,000 - $79,999	0.51	0.10, 2.52	0.41
$80,000 - $99,999	0.48	0.09, 2.38	0.36
Over $100,000	**reference (1.0)**		

Table 7. Univariate Logistic Regression for Emergency Room visits among Children's Healthcare of Atlanta Childhood, Adolescent, and Young Adult Cancer Survivor Study (CHOA-CAYACSS)

Variable in the Model	OR	95% CI	p-value
Sex			
Male	1.04	0.75, 1.44	0.82
Female	**reference (1.0)**		
Race			
White	**reference (1.0)**		
Black	0.77	0.49, 1.22	0.27
Hispanic	0.88	0.52, 1.51	0.65
Asian/ Pacific Islander and Other	0.91	0.46, 1.77	0.77
Parent's Marital Status			
Never married	**reference (1.0)**		
Married	1.91	1.13, 3.26	0.02
Not Currently Married	1.39	0.75, 2.56	0.29
Type of Insurance			
Public	0.644	0.45, 0.91	0.01
Private	**reference (1.0)**		
No	1.419	0.31, 6.43	0.65
Chemotherapy or Radiation			
Both Chemotherapy and Radiation	**reference (1.0)**		
Chemotherapy only	1.50	1.04, 2.16	0.03
Radiation only	0.99	0.21, 4.67	0.99
Neither Chemotherapy or Radiation	1.42	0.29, 7.03	0.67
Bone Marrow Transplant			
Bone Marrow Transplant	0.81	0.49, 1.34	0.41
No Bone Marrow Transplant	**reference (1.0)**		
Reported Rating of General Health			
Excellent	**reference (1.0)**		
Very Good	1.47	1.01, 2.16	0.05
Good	1.62	1.00, 2.64	0.05
Poor and Fair	4.65	2.32, 9.32	<0.01
Type of Cancer Diagnosis			
Leukemia	**reference (1.0)**		
Lymphoma	0.61	0.34, 1.09	0.10
Bone/Soft tissue Sarcoma	0.76	0.44, 1.32	0.32
Kidney	1.24	0.75, 2.06	0.41
Neuroblastoma	0.90	0.50, 1.61	0.72
Other Solid Tumor CNS/Brain Tumor	0.80	0.46, 1.41	0.45
Age at Follow-Up Survey			
0 - 10	**reference (1.0)**		
11 - 15	1.11	0.74, 1.67	0.62
16 - 22	1.10	0.73, 1.65	0.64
Father's Employment Status			
Father employed	1.16	0.55, 2.46	0.69
Father unemployed	**reference (1.0)**		
Mother's Employment Status			

Mother employed	0.80	0.54, 1.54	0.23
Mother unemployed	**reference (1.0)**		
Exercise			
Everyday	**reference (1.0)**		
Most Days	1.06	0.70, 1.60	0.79
Some days	0.79	0.47, 1.34	0.38
Occasionally	1.67	0.99, 2.81	0.05
Do not exercise	2.17	0.96, 4.89	0.06
Household Income			
Less than $19,999	2.90	1.66, 5.07	0.00
$20,000 - $39,999	1.66	1.00, 2.76	0.05
$40,000 - $59,999	1.73	0.99, 3.04	0.06
$60,000 - $79,999	1.07	0.58, 1.97	0.82
$80,000 - $99,999	1.17	0.64, 2.14	0.60
Over $100,000	**reference (1.0)**		
Father's Highest Level of Education			
High school or GED or less	**reference (1.0)**		
Some college	0.79	0.50, 1.26	0.32
College graduate	0.68	0.44, 1.06	0.09
Any graduate school	0.62	0.38, 1.01	0.05
Mother's Highest Level of Education			
High school or GED or less	**reference (1.0)**		
Some college	0.88	0.55, 1.41	0.60
College graduate	0.59	0.38, 0.92	0.02
Any graduate school	0.60	0.36, 0.98	0.04
Age at Diagnosis			
0 - 3	**reference (1.0)**		
4 - 9	0.94	0.65, 1.35	0.73
10 - 14	0.80	0.48, 1.34	0.40
15 - 19	0.79	0.38, 1.66	0.54

Table 8. Multivariate Logistic Regression for Emergency Room visits among Children's Healthcare of Atlanta Childhood, Adolescent, and Young Adult Cancer Survivor Study (CHOA-CAYACSS)

Variables in the Model	OR	95% CI	p-value
Sex			
Male	1.21	0.80, 1.84	0.37
Female	**reference (1.0)**		
Age at Diagnosis			
0-3	**reference (1.0)**		
4 through 9	0.82	0.52, 1.29	0.40
10 through 14	0.35	0.15, 0.78	0.01
15 through 19	0.00	0, Infinity	0.99
Parent's Marital Status			
Never married	**reference (1.0)**		
Married	0.56	0.28, 1.12	0.10
Not Currently Married	0.73	0.36, 1.48	0.38
Chemotherapy or Radiation			
Both Chemotherapy and Radiation	**reference (1.0)**		
Chemotherapy only	1.57	0.99, 2.49	0.05
Radiation only	0.00	0, Infinity	0.99
Neither Chemotherapy or Radiation	0.00	0, Infinity	0.99
Reported Rating of General Health			
Excellent	**reference (1.0)**		
Very Good	1.37	0.85, 2.20	0.19
Good	1.32	0.70, 2.50	0.40
Poor and Fair	3.01	0.98, 9.24	0.05
Exercise			
Everyday	**reference (1.0)**		
Most Days	1.20	0.72, 1.98	0.48
Some days	1.00	0.52, 1.95	0.99
Occasionally	1.37	0.63, 2.98	0.43
Do not exercise	7.58	1.77, 32.40	0.01
Household Income			
Less than $19,999	1.41	0.54, 3.64	0.48
$20,000 - $39,999	0.93	0.42, 2.03	0.85
$40,000 - $59,999	1.20	0.58, 2.52	0.62
$60,000 - $79,999	0.68	0.31, 1.45	0.32
$80,000 - $99,999	1.13	0.57, 2.26	0.72
Over $100,000	**reference (1.0)**		
Mother's Highest Level of Education			
High school or GED or less	**reference (1.0)**		
Some college	0.82	0.44, 1.50	0.52
College graduate	0.51	0.28, 0.96	0.04
Any graduate school	0.56	0.27, 1.17	0.12

Table 9. Univariate Logistic Regression for Doctors' Visits among Children's Healthcare of Atlanta Childhood, Adolescent, and Young Adult Cancer Survivor Study (CHOA-CAYACSS)

Variables in the Model	OR	95% CI	p-value
Sex			
Male	0.79	0.61, 1.04	0.09
Female	**reference (1.0)**		
Race			
White	**reference (1.0)**		
Black	1.86	1.26, 2.75	0.00
Hispanic	3.15	1.95, 5.09	<.01
Asian/ pacific islander and other	1.13	0.65, 1.96	0.68
Parent's Marital Status			
Never married	**reference (1.0)**		
Married	0.65	0.40, 1.04	0.07
Not Currently Married	0.61	0.36, 1.06	0.08
Type of Insurance			
Public	1.79	1.32, 2.42	0.00
Private	**reference (1.0)**		
No	1.74	0.60, 5.06	0.31
Chemotherapy or Radiation			
Both Chemotherapy and Radiation	**reference (1.0)**		
Chemotherapy only	1.19	0.89, 1.58	0.24
Radiation only	1.44	0.45, 4.64	0.54
Neither Chemotherapy or Radiation	0.82	0.22, 3.13	0.77
Bone Marrow Transplant			
Bone Marrow Transplant	1.41	0.95, 2.10	0.09
No Bone Marrow Transplant	**reference (1.0)**		
Reported Rating of General Health			
Excellent	**reference (1.0)**		
Very Good	1.55	1.15, 2.09	0.00
Good	1.47	0.99, 2.19	0.06
Poor and Fair	2.58	1.27, 5.28	0.01
Type of Cancer Diagnosis			
Leukemia	**reference (1.0)**		
Lymphoma	0.61	0.40, 0.94	0.03
Bone/Soft tissue Sarcoma	0.95	0.61, 1.46	0.80
Kidney	0.74	0.47, 1.15	0.17
Neuroblastoma	1.25	0.77, 2.03	0.38
Other Solid Tumor CNS/Brain Tumor	0.58	0.37, 0.91	0.02
Age at Follow-Up Survey			
0-10	**reference (1.0)**		
11 - 15	0.84	0.60, 1.17	0.29
16 - 22	0.78	0.56, 1.09	0.14
Father's Employment Status			
Father employed	1.79	1.00, 3.19	0.05
Father unemployed	**reference (1.0)**		
Mother's Employment Status			
Mother employed	1.08	0.79, 1.48	0.62

Mother unemployed	**reference (1.0)**		
Exercise			
Everyday	**reference (1.0)**		
Most Days	0.82	0.59, 1.15	0.25
Some days	0.50	0.34, 0.75	0.00
Occasionally	0.88	0.56, 1.40	0.60
Do not exercise	0.60	0.28, 1.28	0.18
Household Income			
Less than $19,999	0.61	0.37, 1.00	0.05
$20,000 - $39,999	0.63	0.42, 0.95	0.03
$40,000 - $59,999	0.77	0.48, 1.23	0.27
$60,000 - $79,999	1.07	0.67, 1.70	0.77
$80,000 - $99,999	1.33	0.83, 2.13	0.24
Over $100,000	**reference (1.0)**		
Father's Highest Level of Education			
High school or GED or less	**reference (1.0)**		
Some college	1.04	0.71, 1.54	0.84
College graduate	1.24	0.87, 1.79	0.24
Any graduate school	1.46	0.99, 2.15	0.06
Mother's Highest Level of Education			
High school or GED or less	**reference (1.0)**		
Some college	1.51	1.00, 2.27	0.05
College graduate	1.51	1.05, 2.16	0.03
Any graduate school	1.76	1.17, 2.65	0.01
Age at diagnosis			
0 - 3	**reference (1.0)**		
4 - 9	0.80	0.59, 1.09	0.15
10 - 14	0.72	0.48, 1.09	0.12
15 - 19	0.78	0.44, 1.40	0.40

Table 10. Multivariate Logistic Regression for Doctors' Visits among Children's Healthcare of Atlanta Childhood, Adolescent, and Young Adult Cancer Survivor Study (CHOA-CAYACSS)

Variables in the Model	OR	95% CI	p-value
Sex			
Male	0.79	0.55, 1.12	0.19
Female	**reference (1.0)**		
Age at Diagnosis			
0 - 3	**reference (1.0)**		
4 - 9	0.76	0.50, 1.14	0.18
10 - 14	0.64	0.35, 1.17	0.15
15 - 19	0.35	0.03, 4.59	0.42
Race			
White	**reference (1.0)**		
Black	0.69	0.40, 1.20	0.19
Hispanic	0.25	0.12, 0.52	0.00
Asian/ Pacific Islander and Other	0.82	0.41, 1.63	0.57
Reported Rating of General Health			
Excellent	**reference (1.0)**		
Very Good	1.72	1.16, 2.55	0.01
Good	2.11	1.19, 3.72	0.01
Poor and Fair	6.60	1.59, 27.44	0.01
Type of Cancer Diagnosis			
Leukemia	**reference (1.0)**		
Lymphoma	1.07	0.56, 2.04	0.84
Bone/Soft tissue Sarcoma	0.95	0.53, 1.70	0.86
Kidney	0.82	0.46, 1.46	0.50
Neuroblastoma	0.83	0.44, 1.54	0.55
Other Solid Tumor CNS/Brain Tumor	0.37	0.20, 0.69	0.00
Father's Employment Status			
Father employed	1.62	0.78, 3.35	0.19
Father unemployed	**reference (1.0)**		
Household Income			
Less than $19,999	0.78	0.33, 1.85	0.58
$20,000 - $39,999	0.82	0.42, 1.60	0.56
$40,000 - $59,999	0.87	0.47, 1.62	0.66
$60,000 - $79,999	1.01	0.56, 1.81	0.98
$80,000 - $99,999	1.19	0.68, 2.09	0.54
Over $100,000	**reference (1.0)**		
Mother's Highest Level of Education			
High school or GED or less	**reference (1.0)**		
Some college	0.89	0.50, 1.58	0.68
College graduate	1.02	0.58, 1.80	0.94
Any graduate school	0.93	0.49, 1.75	0.82
Type of Insurance			
Public	0.78	0.45, 1.35	0.38
Private	**reference (1.0)**		

No	1.19	0.21, 6.67	0.84
Exercise			
Everyday	**reference (1.0)**		
Most Days	0.70	0.46, 1.07	0.10
Some days	0.45	0.26, 0.78	0.00
Occasionally	0.69	0.34, 1.39	0.30
Do not exercise	1.30	0.34, 4.96	0.70

Table 11. Univariate Logistic Regression for Surgery among Children's Healthcare of Atlanta Childhood, Adolescent, and Young Adult Cancer Survivor Study (CHOA-CAYACSS)

Variable	OR	95% CI	p-value
Sex			
Male	0.825	0.53, 1.29	0.40
Female	**reference (1.0)**		
Race			
White	**reference (1.0)**		
Black	2.519	1.07, 5.95	0.04
Hispanic	1.291	0.60, 2.79	0.52
Asian/ Pacific Islander and Other	0.864	0.38, 1.99	0.73
Parent's Marital Status			
Never married	**reference (1.0)**		
Married	1.443	0.69, 3.01	0.33
Not Currently Married	1.329	0.56, 3.14	0.52
Type of Insurance			
Public	0.747	0.47, 1.20	
Private	**reference (1.0)**		
No	>999.999	<0.01, >999.99	
Chemotherapy or Radiation			
Both Chemotherapy and Radiation	**reference (1.0)**		
Chemotherapy only	**0.617**	0.39, 0.97	0.04
Radiation only	1.346	0.28, 6.39	0.71
Neither Chemotherapy or Radiation	0.841	0.10, 6.92	0.87
Bone Marrow Transplant			
Bone Marrow Transplant	1.671	.94, 2.96	0.08
No Bone Marrow Transplant	**reference (1.0)**		
Reported Rating of General Health			
Excellent	**reference (1.0)**		
Very Good	1.311	0.75, 2.29	0.34
Good	2.959	1.62, 5.39	0.00
Poor and Fair	4.21	1.80, 9.86	0.00
Type of Cancer Diagnosis			
Leukemia	**reference (1.0)**		
Lymphoma	1.366	0.64, 2.92	0.42
Bone/Soft tissue Sarcoma	2.897	1.54, 5.45	0.00
Kidney	1.326	0.60, 2.92	0.48
Neuroblastoma	2.47	1.21, 5.03	0.01
Other Solid Tumor CNS/Brain Tumor	1.372	0.62, 3.02	0.43
Age at Follow-Up Survey			
0-10	**reference (1.0)**		
11 - 15	0.628	0.35, 1.14	0.13
16 - 22	1.238	0.74, 2.07	0.42
Father's Employment Status			
Father employed	2.501	0.59, 10.55	0.21
Father unemployed	**reference (1.0)**		
Mother's Employment Status			
Mother employed	0.839	0.49, 1.42	0.51

Mother unemployed	**reference (1.0)**		
Exercise			
Everyday	**reference (1.0)**		
Most Days	0.744	0.41, 1.36	0.33
Some days	1.184	0.62, 2.25	0.61
Occasionally	2.142	1.14, 4.04	0.02
Do not exercise	1.085	0.31, 3.80	0.90
Household Income			
Less than $19,999	1.582	0.71, 3.53	0.26
$20,000 - $39,999	1.558	0.79, 3.081	0.20
$40,000 - $59,999	1.443	0.67, 3.14	0.35
$60,000 - $79,999	1.228	0.55, 2.72	0.61
$80,000 - $99,999	1.54	0.72, 3.28	0.26
Over $100,000	**reference (1.0)**		
Father's Highest Level of Education			
High school or GED or less	**reference (1.0)**		
Some college	0.666	0.33, 1.33	0.25
College graduate	0.705	0.37, 1.32	0.27
Any graduate school	1.233	0.68, 2.23	0.49
Mother's Highest Level of Education			
High school or GED or less	**reference (1.0)**		
Some college	0.644	0.33, 1.27	0.21
College graduate	0.818	0.47, 1.44	0.48
Any graduate school	0.59	0.30, 1.18	0.14
Age at Diagnosis			
0 - 3	**reference (1.0)**		
4 - 9	0.973	0.58, 1.63	0.92
10 - 14	1.051	0.53, 2.09	0.89
15 - 19	1.876	0.83, 4.22	0.13

Table 12. Multivariate Logistic Regression for Surgery among Children's Healthcare of Atlanta Childhood, Adolescent, and Young Adult Cancer Survivor Study (CHOA-CAYACSS)

Variables in the Model	OR	95% CI	p-value
Sex			
Male	0.85	0.53, 1.36	0.49
Female	**reference (1.0)**		
Age at Diagnosis			
0 - 3	**reference (1.0)**		
4 through 9	1.13	0.63, 2.03	0.69
10 through 14	0.88	0.38, 2.04	0.77
15 through 19	1.56	0.55, 4.42	0.40
Race			
White	**reference (1.0)**		
Black	0.32	0.13, 0.78	0.01
Hispanic	0.59	0.25, 1.44	0.25
Asian/ Pacific Islander and Other	1.03	0.42, 2.56	0.94
Chemotherapy or Radiation			
Both Chemotherapy and Radiation	**reference (1.0)**		
Chemotherapy only	0.82	0.48, 1.38	0.45
Radiation only	1.63	0.29, 9.22	0.58
Neither Chemotherapy and Radiation	0.85	0.09, 8.34	0.89
Reported Rating of General Health			
Excellent	**reference (1.0)**		
Very Good	1.42	0.80, 2.56	0.24
Good	3.05	1.54, 6.04	0.00
Poor and Fair	4.71	1.75, 12.67	0.00
Type of Cancer Diagnosis			
Leukemia	**reference (1.0)**		
Lymphoma	1.32	0.55, 3.15	0.54
Bone/Soft tissue Sarcoma	2.93	1.44, 5.98	0.00
Kidney	1.48	0.62, 3.54	0.37
Neuroblastoma	2.41	1.07, 5.43	0.03
Other Solid Tumor CNS/Brain Tumor	1.16	0.48, 2.81	0.75
Exercise			
Everyday	**reference (1.0)**		
Most Days	0.61	0.32, 1.16	0.13
Some days	0.97	0.47, 1.98	0.93
Occasionally	1.18	0.55, 2.55	0.67
Do not exercise	0.70	0.18, 2.80	0.61