

# A Comparison of the Promptness of Treatment of Pediatric Leukemia in Rural and Urban Alabama

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*Studies have shown that there is a disparity in cancer treatment in rural versus urban areas (Desch, Smith, Breindel, Simonson, & Kane, 1992; Tropman, Hatzell, Paskett, Ricketts, Cooper, & Aldrich, 1999). Past studies have focused on adult patients; the current study extends this line of research to children by comparing the promptness of treatment of pediatric acute lymphocytic leukemia in rural and urban Alabama patients. Data were obtained from the Alabama Statewide Cancer Registry. Results are discussed in terms of equity in time span between diagnosis and treatment in urban and rural patients.*

Leukemia, a cancer of the blood that starts in the bone marrow, is one of the most prevalent forms of cancer in children. It comprises 30% of all childhood cancers (Belson, Kingsley, & Holmes, 2007; Children's Hospital, 2007; Zahm & Devesa, 1995). The most common form of leukemia in children is acute lymphocytic leukemia (ALL), which accounts for 80% of childhood leukemias diagnosed in the United States (Schmidt, 1998).

ALL affects lymphocytes, which are a group of white blood cells that normally fight infection. The disease is characterized by a production of abnormal lymphocytes in the bone marrow, which are released into the bloodstream, where they multiply very quickly (Children's Hospital, 2007; Mayo Clinic Staff, 2006; National Cancer Institute, 2003). This causes problems because the abnormal cells crowd out the healthy blood cells and render those affected vulnerable to infection and easy bleeding. The abnormal cells, termed leukemic cells at this point, can also collect in the central nervous system, causing even more serious problems (Mayo Clinic Staff, 2006).

Diagnosis of leukemia in children is categorized into risk groups which are determined by a patient's white blood cell (WBC) count. The risk groups are distinguished as standard (low) risk, high risk, and recurrent. Standard risk includes children ages 1 to 9 who have WBC counts less than 50,000/microliter at diagnosis (Schoenstadt, 2006). High risk includes children younger than 1 and older than 9 years and children who have WBC counts of more than 50,000/microliter at diagnosis. Childhood ALL that has come back after treatment is labeled recurrent (Schoenstadt, 2006). As a point of reference: a normal child will have approximately 5,000 to 10,000 WBC per microliter (Keene, 1999).

Treatment for ALL includes one or all of the following: chemotherapy, radiation therapy, and bone marrow transplantation, as well as medications to prevent or treat damage caused by these treatment modalities (Children's Hospital, 2007). The type of treatment used is dependent upon the patient's risk group at diagnosis.

Treatment is broken down into the following stages: induction therapy, intensification or consolidation therapy, and maintenance therapy. During the first stage of treatment, induction therapy, most of the leukemic cells in the blood and bone marrow are killed by chemotherapy treatment (American Cancer Society, 2007; Mayo Clinic Staff, 2006). It lasts about one month. The second phase, intensification therapy, aims to kill any leukemic cells still present in the brain or spinal cord by increasing the dosage of drugs being used for treatment (American Cancer Society, 2007; Mayo Clinic Staff, 2006). It could consist of a single course of treatment over a month or up to three courses in three months. Maintenance therapy is then completed in an attempt to prevent leukemic cells from growing again. This phase of treatment is less intense than induction and intensification therapies and lasts about 2 years.

Beginning treatment soon after diagnosis is critical with ALL. The disease progresses very rapidly, and the more mature the cell, the more difficult it is to treat. Studies have shown that early high-dose treatment greatly increases the survival rate of children stricken with ALL (Marco et al., 2000; Ortega et al., 2001).

Studies have shown that there is a disparity in cancer treatment in rural versus urban areas (Desch, Smith, Breindel, Simonson, & Kane, 1992; Tropman, Hatzell, Paskett, Ricketts, Cooper, & Aldrich, 1999). Some rural patients are diagnosed in late stages of cancer (Liff, Chow, & Greenberg, 1991), and others receive primary treatment but do not receive adjuvant, or supplemental, treatment (Tropman et al., 1999). This poses a problem with recovery, especially for children with ALL, because of the disease's rapid progression.

The purpose of this study is to determine if there is a longer time span between diagnosis and treatment for rural Alabama pediatric and adolescent patients with ALL, compared to their urban counterparts. It was hypothesized that rural patients would have a longer time span than urban patients. This is a unique study in that no previous studies comparing the time span between diagnosis and treatment of ALL for urban and rural subjects have been found.

## Method

The population for this study (see Appendix A, Figure 1) included all pediatric and adolescent children in the state of Alabama who were diagnosed with acute lymphocytic leukemia between 1996 and 2005 whose information was stored in the Alabama Statewide Cancer Registry database (N=278). Rural/urban locale was determined from the 2000 U.S. Census Bureau tabulations on rural/urban population percentages for each county in the state of Alabama. A county was classified as rural if more than 50% of its population was considered rural. If 50% or fewer of the county's population were considered rural, then the county was classified as urban. Because of missing data and outliers in the data, some patients' data were excluded (N=22 for first treatment, N=25 for chemotherapy, N=249 for radiation therapy).

The data from the Alabama Statewide Cancer Registry included dates of diagnosis, dates of first treatment, dates of chemotherapy, dates of radiation therapy, dates of hormone therapy, and summaries of each therapy, as well as urban/rural locale, age, and gender. Dates for hormone therapy were excluded from this study because background information about the disease did not indicate it as a type of treatment for ALL. Dates for bone marrow transplantation were not available and, therefore, were excluded from this study. This study was approved by the Institutional Review Boards for the University of Alabama and by the Alabama Department of Public Health.

Statistical analyses were conducted using descriptive statistics and one way analysis of variance (ANOVA). Descriptive statistics were used to compile data for demographic information. ANOVA, a data analysis tool in SPSS statistical software (SPSS, 2005), was the best analysis for this study because there were two population groups, rural and urban, which were compared on time span between diagnosis and treatment.

## Results

The population studied (see Appendix A, Figure 1) consisted of 96 rural patients (34.5%) and 182 urban patients (65.5%). By gender, the breakdown was 150 male (54%) and 128 female (46%) patients. Once exclusions were made, the number of patients for each analysis changed. For the first-treatment analysis (see Appendix A, Figure 2), there were 173 urban patients (67.6% total, 54.9% male, 45.1% female) and 83 rural patients (32.4%, 54.2% male, 45.8% female). For the chemotherapy analysis (See Appendix A, Figure 3), there were 172 urban patients (68% total, 54.7 % male, 45.3% female) and 81 rural patients (32% total, 54.3% male, 45.7% female). For the radiation analysis (see Appendix A, Figure 4), there were 19 urban patients (65.5% total, 57.9% male, 42.1% female) and 10 rural patients (34.5% total, 70% male, 30% female). The one way ANOVA showed no significant difference in the time span between diagnosis and treatment dates for rural and urban populations in any of the sets of treatment dates analyzed. The results do not support the hypothesis.

## Discussion

The results of this study are significant because they show no difference in time lapsed before initiation of treatment after ALL has been diagnosed in urban and rural children in the state of Alabama. Therefore, for the variable examined in this study, there is no disparity in treatment of rural and urban Alabamians. The only variable of interest for this study was the time span between diagnosis and treatment initiation; however, there could be disparities between urban and rural ALL patients when other variables, such as risk status at the time of diagnosis or rate of adjuvant therapy (Tropman et al., 1999), are examined. These data were not available for examination in the current study.

Limitations of this study include lack of previous research examining the variable in question for this study, limited data for analysis, and the inevitably small population sample. ALL is a rare form of cancer nationally, although it is the most common in children, and there has not been much research done investigating the effectiveness of treatment in one group as compared with the effectiveness of treatment in another group. Since the cause of mutations in the DNA that lead to ALL is not known, researchers may be focusing more on that aspect of the disease (Mayo Clinic Staff, 2007).

It was believed that the null findings of this study could be a reflection of the impact of the All Kids insurance coverage on the citizens of the state

of Alabama. All Kids is a low-cost, comprehensive healthcare coverage program for children under the age of 19 (Alabama Department of Public Health, 2007). The income range for All Kids eligibility is higher than the income range for Medicaid, so many parents who make just above the Medicaid eligibility limit have been able to get affordable health insurance for their previously uninsured children since the program's initiation in Alabama in 1997. As of October 2007, over 69,000 children have been enrolled in the All Kids insurance program (Alabama Department of Public Health, 2007). The number of children who do not have access to health care (which may have been a key factor contributing to the promptness of treatment) has, therefore, been greatly reduced. To test this assumption, a series of ANOVAs were run comparing urban and rural time spans between diagnosis and treatment for some of the years in the data set, beginning with 1996, which was pre-All Kids. The purpose of doing these analyses was to see if the initiation and development of All Kids in the state had an effect on the time span between diagnosis and treatment; not all years included in the data set were analyzed. A linear graph of the mean time spans was created in Microsoft Excel (see Appendix B, Figures 1 and 2) for rural and urban patients. Results showed that there was no significant difference between time spans for urban versus rural for individual years and no direct relationship between initiation and development of All Kids and the length of the time span between treatment and diagnosis.

Since all the results show equal access to treatment after diagnosis, it is believed that rural patients are most likely diagnosed in urban areas just as their urban counterparts. Therefore, once the diagnosis has been made, treatment can be started promptly because the patient is already in a facility that is equipped to provide treatment.

The next variable that should be investigated is time span between onset of symptoms and diagnosis. This variable may show a difference in rural versus urban patients because patients will most likely be in their respective locales when symptoms begin and would be referred to a specialist if it was believed that ALL was present. This would mean rural patients would have to travel to an urban area to be diagnosed, whereas urban patients would already be in an urban area.

Such a study could also be expanded in the future to include a larger geographical region and to include data for bone marrow transplantation, adjuvant therapy, rate of relapse, and mortality rates of urban and rural ALL patients. Adding variables such as these would extend the analysis to the efficacy of the overall ALL course of treatment in rural versus urban areas. Expanding the geographical area of focus would provide a larger

population sample with which to work. Comparison of different areas within a region or nationally would also help identify other patterns that may be present.

While this study does have limitations, it is a first step in an area that has heretofore been unexplored. For that reason alone, we see this investigation as beneficial. Additionally, while null results, like those reported here, can be viewed as having not been able to detect differences, we must also remember that such results are a “good thing” in these circumstances. That is, children, regardless of rural or urban background, are getting the care they need equally quickly.

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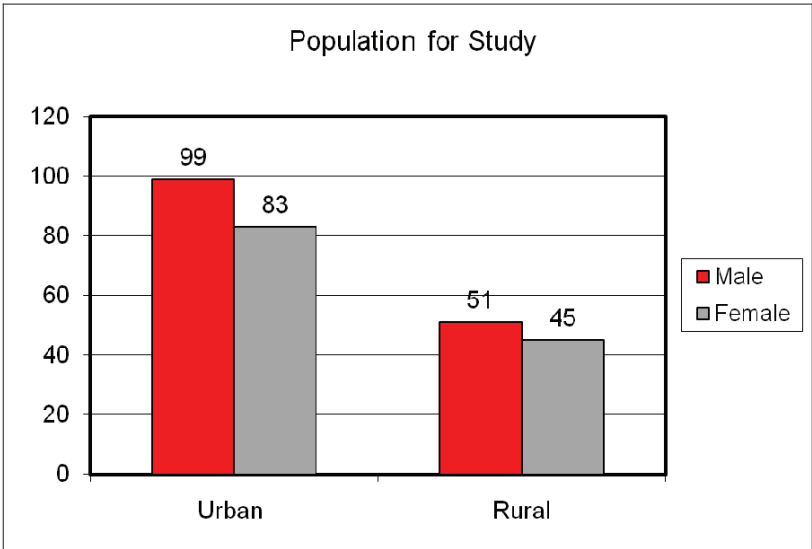
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**Appendix A:  
Results of Time Span Analyses**

**Figure 1.**



**Figure 2.**

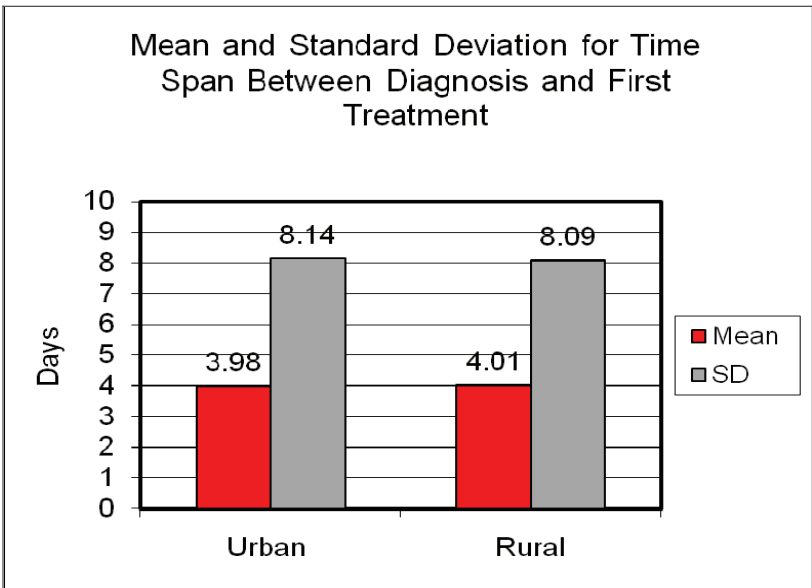


Figure 3.

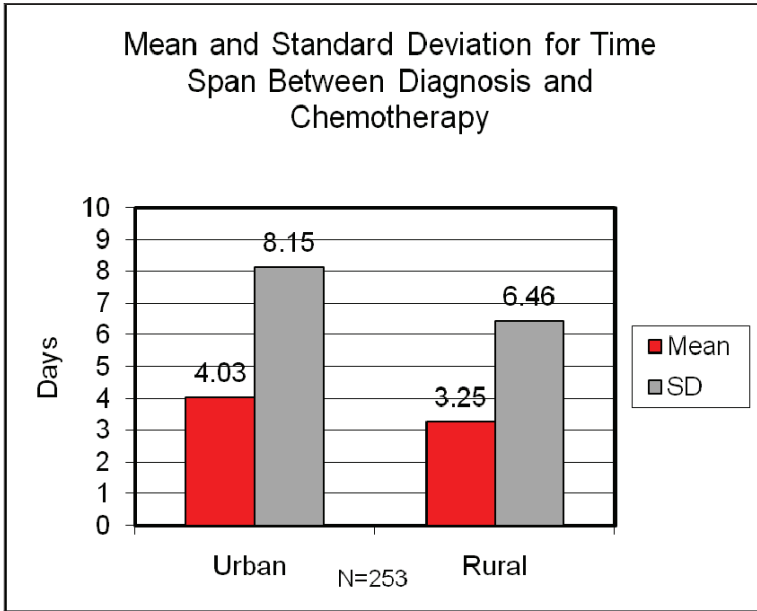
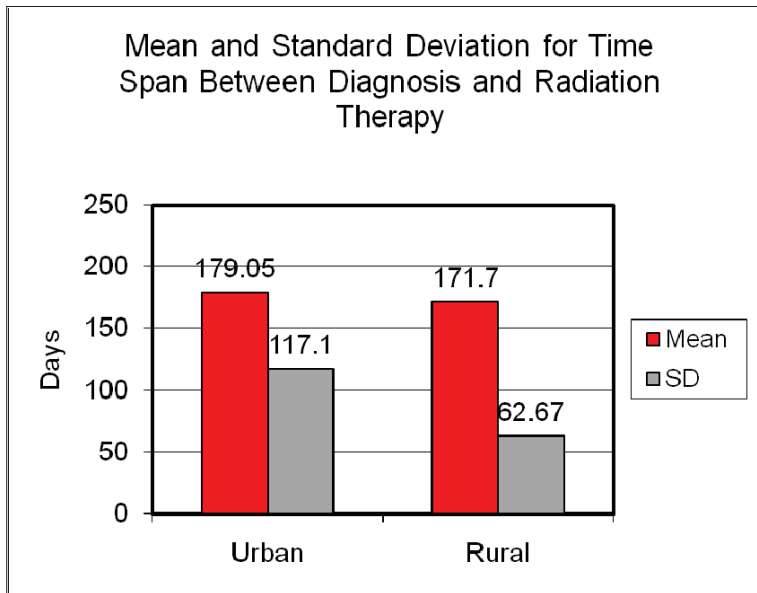
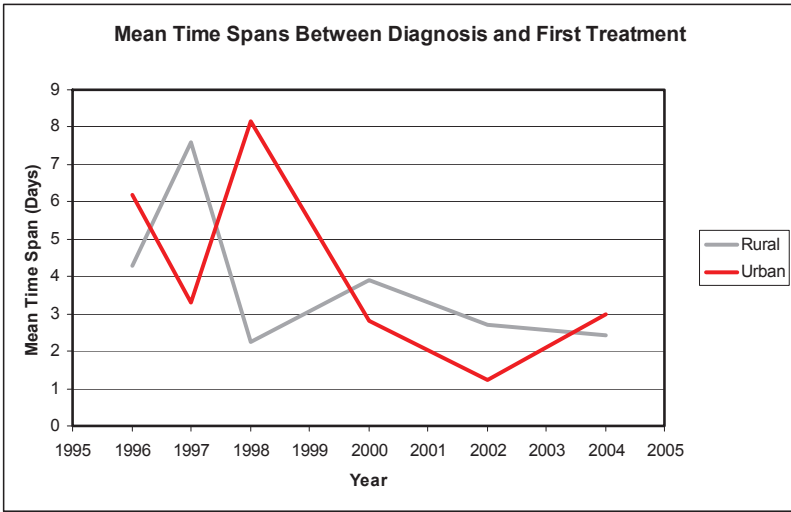


Figure 4.



**Appendix B:  
Post Hoc Analyses**

**Figure 1.**



**Figure 2.**

