AFRICA UNIVERSITY
(A United Methodist-Related Institution)

PREVALENCE AND RISK FACTORS OF ACUTE LEUKEMIA AMONG PAEDIATRIC LEUKEMIA PATIENTS AT PARIRENYATWA GROUP OF HOSPITALS

BY

TADIWANASHE CHIVAVIRO

A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF BACHELOR OF MEDICAL LABORATORY SCIENCES HONOURS IN THE COLLEGE OF HEALTH, AGRICULTURE AND NATURAL SCIENCES

2024

Abstract

Acute leukemia is a significant health concern among paediatric leukemia patients, and understanding its prevalence and associated risk factors is crucial for effective prevention and management. This study aimed to investigate the prevalence and risk factors of acute leukemia among pediatric leukemia patients at Parirenyatwa Group of Hospitals in Zimbabwe. A quantitative, cross-sectional study design was employed, and data were collected from medical records of pediatric leukemia patients diagnosed with acute leukemia between January 2023 and December 2023. The study population included pediatric patients aged 0-17 years who received care at the hospital. The sample size was estimated to be 125 patients. Data analysis was analyzed using Statistical Package for Social Sciences (*IBM SPSS Statistics 25*) to obtain descriptive statistics, bivariate analysis, and multiple logistic regression. The results showed a prevalence of acute lymphoblastic leukemia of 77.6% and of acute myeloid leukemia of 22.4% among pediatric patients at Parirenyatwa Group of Hospitals. Risk factors such as exposure to environmental and industrial pollutants; and genetic susceptibility were identified. The study findings contribute to the existing literature by providing local data on the epidemiology and risk factors of acute leukemia in Zimbabwean children. These insights can inform healthcare planning, resource allocation, and evidence-based interventions for pediatric leukemia in Zimbabwe. Further research is needed to explore the psychosocial impact of acute leukemia on pediatric patients and their families and to investigate treatment outcomes in resource-constrained settings.

Declaration

I declare that this dissertation is my original work except where sources have been cited and acknowledged. The work has never been studied, nor will it ever be submitted to another university for the award of a degree.

Tadiwanashe Chivaviro

Student's Full Name Student's signature and date

Dr Maibouge Tanko Mahamane Salissou

Supervisor's full name Supervisor's signature, 25 April, 2024

Copyright

Acknowledgements

I do hereby give my utmost gratitude to the Almighty for His grace, love and favour. The journey was difficult but He made it possible.

To my supervisor Dr Maibouge Salissou, I am grateful sir for the good advice and scrutiny that made this dissertation a success.

I would like to acknowledge my father, Baba, my mother, Amai, my siblings, and my family for always being there for me during my academic journey through the ups and downs as well as remembering me in prayer. I would also like to acknowledge my parents for funding my degree. I love you.

To my friends, thank you for always having my back through the 4 years of my university life, I am grateful for being always present and encouraging me academically.

To the rest of the HBMLS class of 2023, thank you for the moral support and encouragements. We have made it.

To the staff at Parirenyatwa, thank you for giving me the opportunity to conduct my study.

Dedication

I dedicate this dissertation to my parents. This is for you, mama and dad.

List Of Acronyms And Abbreviations

ALL: Acute Lymphocytic Leukemia

AML: Acute Myeloid Leukemia

AL: Acute Leukemia

PGH: Parirenyatwa Group of Hospitals

WHO: World Health Organisation

IV: Independent Variable

DV: Dependent Variable

MV: Moderating Variable

Table of Contents

List of Appendices

List of Figures and Tables

CHAPTER 1: INTRODUCTION

1.1 Introduction

Acute leukaemia, a rapidly progressing haematologic malignancy, remains a severe global threat to children's and adolescents' health(Adithya Chennamadhavuni, et al., 2023). While much have achieved in the field of medicine, understanding disease prevalence and related risk factors specific to the paediatric population is essential. Notably, this information would allow for comparison in various settings where different standards of healthcare services are delivered. Parirenyatwa Group Hospitals in Harare is the main paediatric oncology referral centre in Zimbabwe. It provides complete care to children with all types of cancer including acute leukaemia from diagnosis to treatment and support. However, even with the great strides, few records exist regarding the prevalence and specific risk factors of juvenile acute leukaemia in this setting.

This research studied the prevalence of acute leukemia among paediatric leukemia patients at Parirenyatwa Group of Hospitals to address a gap in knowledge. The study also looked at the risk factors linked to acute leukemia in this population.

1.2 Study Background

Acute leukemia is a type of blood cancer that predominantly impacts children and teenagers. Leukemia is characterized by the growth of blood cells (Pew et al., 2016). Acute leukemia is classified into two distinct subtypes: acute myeloid leukemia (AML) and acute lymphoblastic leukemia (ALL). Despite advancements, in its treatment and management acute leukemia remains a global health concern especially in developing countries (Dino Rainusso et al., 2018).

The incidence of childhood acute leukemia and the associated risk factors demonstrate variability contingent upon elements such as age, gender, ethnicity, location, and genetic predispositions. Research enlightens on several recognized and acknowledged risk determinants comprising of being exposed to ionizing radiation such environmental substances; viral infections, immune-deficiency and genetic disorders or conditions. Nevertheless, the exact cause of leukemia in children remains unknown, in cases. In Zimbabwe there is not information regarding the occurrence of acute leukemia, in children.

A 2019 article from Pindula reported that leukemia accounted for 9 percent of all cancer cases in the Zimbabwe National Cancer Registry. This information highlights the significant impact of this disease on Public Health. In 2018, a recorded total of 105 cases made up 4% of all cancer instances. However, deficiencies in access to care, diagnostic tools, and treatment facilities likely result in many cases remaining either unreported or undetected —which suggests that the actual impact may extend beyond these given numbers.

The largest hospital in Zimbabwe is the Parirenyatwa Group of Hospitals with than 1800 beds and 2000 staff members ("About Us | Parirenyatwa Group of Hospitals " n.d.). Located in Belgravia, Harare this hospital offers services as well as opportunities, for research and training. It serves as Zimbabwe's primary paediatric acute leukaemia referral centre. Acute leukemia presents a significant global health challenge and disproportionately impacts children (Inaba et al., 2018).

Comprehensive insight into the prevalence of this disease in young populations is imperative for health systems to judiciously allocate resources and implement precise preventative strategies. Recent research has established a close relationship between the onset of acute leukaemia in children and a variety of risk factors, including genetic predispositions that are

inherited as well as exposure to specific environmental factors and pathogenic microbes (Smith et al., 2018; Wiemels 2019).

In an effort to further improve the current academic database that supports the medical community as well as policy makers in the field of paediatric oncology, this investigation analyzed the incidence rates in conjunction with the coordination of related risk variables. Although a great deal of scientific work has been done on the subject, there is still a marked lack of quantitative investigation into the particular mosaic of risk factors that affect the child population in Zimbabwe specifically, within the boundaries of the Parirenyatwa Group of Hospitals.

The study assessed the prevalence of acute leukaemia in children and identified the risk variables that contribute to the disease at the PGH. After a thorough evaluation, this investigation produced insightful findings meant to improve clinical practices, policy development, and paediatric leukaemia patient care in Zimbabwe. The entire population of paediatric leukemia patients (0 to 17 years old) diagnosed with acute leukaemia at PGH between January 1 and December 31, 2023, was included in the study using a cross-sectional approach. Data points such as demographic profiles, clinical presentations and characteristics, laboratory diagnostic results, therapeutic strategies used, and patient outcomes were among the many pieces of information that were painstakingly collected from each subject's medical records.

The prevalence of acute leukaemia among paediatric leukemia patients at PGH was the main outcome of interest. Finding the risk variables linked to the onset and course of the illness was one of the secondary aims. Investigated risk variables include socioeconomic status, demographics, exposure to environmental pollutants, history of radiation or chemotherapy, and genetic susceptibility. In order to ascertain prevalence rates and evaluate the degree of

correlation between risk variables and acute leukaemia in the study population, statistical analyses were performed. After accounting for relevant confounders, odds ratios and 95% confidence intervals were computed using logistic regression models.

The findings from this investigation shed vital information upon the incidence and risk determinants associated with paediatric acute leukaemia within the environs of PGH. These insights will be instrumental in the establishment of strategies designed to facilitate early detection and circumvention of this malignancy. Moreover, these revelations provide a blueprint to guide policymakers in the judicious allocation of resources and also lay a groundwork for forthcoming scholarly inquiries aimed at elevating the calibre of healthcare for the youthful populace of Zimbabwe confronted with acute leukaemia.

1.3 Problem Statement

Acute leukemia poses a challenge within the realm of paediatric cancer care. It requires a sophisticated understanding and the application of carefully designed therapy strategies. Even though leukaemia research has advanced globally over the years (Inaba et al., 2018; Greaves, 2018), developing efficient early detection and customised intervention strategies is hindered by the lack of local data regarding the incidence and unique risk factors for paediatric leukemia patients at Parirenyatwa Group of Hospitals in Zimbabwe.

A significant barrier to efficiently using healthcare resources and improving the prognoses for children suffering from acute leukaemia is the absence of thorough epidemiological understanding and risk factor analysis in the context of this particular health service provider. The striking lack of studies with a paediatric focus at Parirenyatwa Group of Hospitals emphasises how urgently an extensive examination of the incidence and risk factors associated with acute leukaemia in this age range is required.

Determining the unique factors that influence the incidence of acute leukaemia in children at this hospital is essential to developing customised interventions that will support early detection and treatment strategy optimization actions meant to dramatically improve the prognosis for children facing this severe illness. By methodically reviewing clinical data and medical records, this study filled a major gap in knowledge by providing a comprehensive analysis of the prevalence and risk factors of paediatric acute leukaemia at the Parirenyatwa Group of Hospitals. In doing so, we hope to establish the groundwork for evidence-based approaches that, in this particular healthcare setting, can significantly influence the healthcare environment for patients with paediatric leukaemia.

1.4 Study Justification

There are several reasons why it is warranted to examine the prevalence and risk factors of acute leukemia in paediatric leukemia patients with PGH The most common malignancies in children and adolescents are acute leukemia, which can has had a significant impact on well-being and quality of life (Leukemia in Children | Childhood Leukemia , 2020). It is important to understand the epidemiology and etiology of this disease in different communities and settings.

Due to underdiagnosis or underreporting, the countrywide cancer registry won't encompass all instances, so there may be little facts available on the prevalence and danger elements of acute leukaemia in kids in Zimbabwe (National Cancer Institute, 2022). This study presented thorough facts on the prevalence of acute leukaemia in Zimbabwean children, with the aim of influencing choices about prevention, analysis, and treatment in policy and practice. Zimbabwe's medical landscape has a standout leader in the Parirenyatwa Group of Hospitals. This hospital group remains at the heart of the country's patient care system and serves as the primary referral source for paediatric acute leukaemia cases.

Through the utilisation of the extensive knowledge bases situated within this prestigious centre for healing, it will be feasible to obtain insights regarding the incidence and associated risk factors of acute leukaemia in Zimbabwean youngsters. Furthermore; this study will compare the results garnered here with data sourced from various nations and regions. This cross-comparison aims to illuminate both the commonalities and discrepancies found within the epidemiological profiles and underpinning etiologies of childhood acute leukemia in divergent settings.

This study will examine the potential risk factors linked to acute leukemia in children as well as investigated how environmental factors and genetic and immunological factors may contribute to its development and identify possible pathways. This study will additionally assist in the identification of both modifiable and non-modifiable risk factors that strategies for prevention or intervention can target.

1.5 Research Objectives

1.51 Broad Objective

To investigate the prevalence and risk factors of acute leukemia in pediatric patients aged 0-17 at PGH from January 1, 2023 to December 31, 2023.

1.52 Specific Objectives

This study specifically sought to:

1. To determine the prevalence of acute leukemia (AML vs ALL) among pediatric leukemia patients at PGH during the year 2023.
2. To identify the risk factors associated with the development of acute leukemia among pediatric leukemia patients at PGH.
3. To identify the demographic, clinical, and laboratory characteristics of pediatric patients with acute leukemia at PGH.

4. To explore the treatment modalities employed for pediatric patients with acute leukemia at PGH.

1.6 Research Questions

1. What is the incidence rate of acute lymphoblastic leukemia (ALL) and acute myeloid leukemia (AML) in paediatric leukemia patients at the Parirenyatwa Group of Hospitals between January 2023 and December 2023.
2. What are the demographic, clinical, and laboratory characteristics of paediatric leukemia patients with acute leukemia at Parirenyatwa Group of Hospitals?
3. How does the prevalence and risk factors of acute leukemia among paediatric leukemia patients at Parirenyatwa Group of Hospitals compare with those reported in other regions and countries?

1.7 Study Limitations

1. The study focused only on children with acute leukemia who were diagnosed and treated at Parirenyatwa Group of Hospitals (PGH). This limited group may not represent all young people with this condition in Zimbabwe. study focused only on children with acute leukemia who were diagnosed and treated at Parirenyatwa Group of Hospitals (PGH). This limited group may not represent all young people with this condition in Zimbabwe.
2. A cross-sectional study design offered merely a momentary glimpse into the prevalence and associated risk factors of acute leukemia at a specific juncture.
3. The study's reliance on medical records introduced selection bias, as it only included patients who sought medical attention and were diagnosed at PGH. The dataset did include individuals suffering from acute leukemia who did not receive medical attention at this institution.
4. The study relied on secondary data from the hospital records, which had limitations in terms of completeness, accuracy, and consistency subjecting to reporting bias, misclassification, or missing values.

5. The identification of risk factors proved to be a complex task and was influenced by various confounding variables. The evaluation failed to encompass a comprehensive inventory of all potential risk factors.
6. The study relied on the ethical use of patient data, and potential limitations arose from ethical constraints, such as the protection of patient confidentiality and the use of historical data without real-time patient consent.
7. The study used a limited number of variables to measure the environmental, genetic, and immunological factors that were associated with acute leukemia.

1.8 Study Delimitations

1. The study will only focus on paediatric leukemia patients aged 0 to 17 years who are diagnosed and treated with acute leukemia at PGH.
2. The study will only include two types of acute leukemia: acute lymphoblastic leukemia (ALL) and acute myeloid leukemia (AML).
3. The study only used secondary data from the hospital records, which provided information on the demographic, clinical, and laboratory characteristics of the patients, as well as the environmental, genetic, and immunological factors that may be associated with acute leukemia.
4. The study only consider the following variables as potential risk factors for acute leukemia: exposure to ionizing radiation, certain chemicals, viral infections, immunodeficiency, and inherited syndromes.

1.9 Chapter One Summary

The topic of the study, which is the prevalence and risk factors of acute leukaemia among paediatric leukemia patients at Parirenyatwa Group of Hospitals, the largest and most advanced hospital complex in Zimbabwe and the primary referral centre for paediatric leukemia patients with acute leukemia, is introduced in the first chapter of the study. Background information on

the disease, its local and worldwide epidemiology, and possible causes are given in this chapter. The problem statement, which is the dearth of information regarding the incidence and cause of acute leukaemia in children in Zimbabwe, is also stated in this chapter.

The following section of the chapter outlined the goals and questions of the study, which uses secondary data from hospital records and a cross-sectional study design to look into the epidemiology and aetiology of acute leukaemia in children in Zimbabwe. The study's importance, parameters, and boundaries are all covered in this chapter, along with its limitations. A concise synopsis of the research proposal's structure concludes the chapter.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The primary referral centre for paediatric sufferers with acute leukaemia at Parirenyatwa Group of Hospitals, the most important and maximum advanced clinical facility in Zimbabwe, is the study's attention. It examines the superiority and risk factors of acute leukaemia among paediatric sufferers at this facility. One kind of most cancers that generally impacts white blood cells within the bloodstream is acute leukaemia. At almost 30% of all paediatric malignancies, it's miles the maximum general most cancers among kids and teenagers (World Health Organisation, 2021).

Depending at the sort of white blood cell , acute leukaemia may be divided into two primary classes: acute lymphoblastic leukaemia (ALL) and acute myeloid leukaemia (AML). Both types of acute leukaemia have a quick progression rate and need to be handled proper away.

The prevalence and outcomes of paediatric leukemia differ across geographic territories and are shaped by genetic factors along with racial and demographic variables such as age and sex. Some known risk factors include exposure to ionizing radiation, certain medications, viral infections, immunodeficiency, and genetics ("Causes and Risk Factors of Leukemia," n.d.). Nevertheless, the specific etiology frequently linked to paediatric leukemia remains elusive.

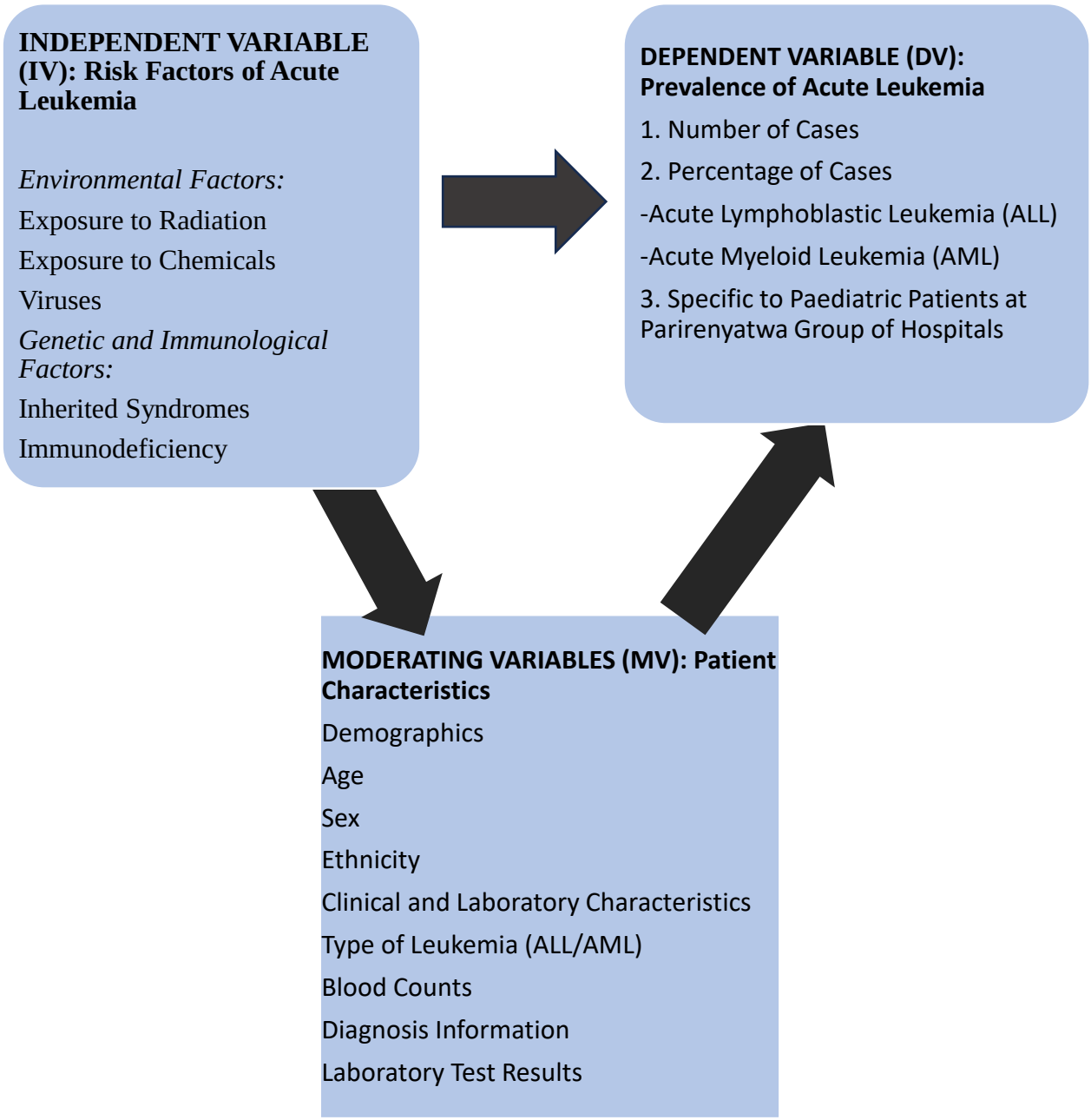
There is limited information on the epidemiology and etiology of childhood leukemia in Zimbabwe. According to the Zimbabwe National Cancer Registry, leukemia accounted for 9.4% of all childhood cancers, with a total of 105 cases reported in 2018. However, these data may not reflect the burden of the disease as many patients remain undiagnosed or unreported due to lack of treatment, laboratory and infrastructure ("Treatment of Acute Lymphoblastic Leukemia in Children", 2010)

The aim of this literature review is to focus on the current knowledge of the prevalence and risk of leukemia in children, focusing on the Zimbabwean context. to provide an overview of the situation.

2.2 Conceptual Framework

The expected relationships between the variables in the study topic are represented visually in the conceptual framework. It explains the ideas and presumptions of the investigation and illustrates how they connect to the topic of the research (Swaen & George, 2022). The research design, methodology, and analysis all have a clear justification thanks to the conceptual framework, which also aids in process guidance.

The conceptual framework for this study consisted of the following elements:



This study examined the risk factors that contribute to acute leukemia and how they impact its prevalence among patients. The characteristics of the patients themselves also influenced this relationship.

This conceptual framework derives its foundation from an extensive review of literature pertaining to existing studies focused on both the epidemiology and the etiology of acute leukemia in children. Additionally, it incorporates information gathered from the hospital records at Parirenyatwa Group of Hospitals. Such a framework will facilitate the testing of the research hypothesis stipulating that a significant association exists between the risk factors and the prevalence of acute leukemia among paediatric patients; furthermore, suggesting that this association is subjected to variations based on the patient's characteristics.

2.3 Literature Review

Acute leukaemia is a type of cancer that affects leukocytes and hematopoietic cells. It is the most common childhood cancer accounting f

or about 30% of cancer diagnoses in children and adolescents (Horton & Aster 2022). Acute lymphoblastic leukemia (ALL) and acute myeloid leukemia (AML) are two main types of leukemia. They are different because they affect specific white blood cell lines. Both forms of acute leukaemia have a quick progression rate and need to be treated right away.

2.3.1 Definition of Acute Leukemia in Children

Acute leukemia is defined as the clonal proliferation of immature hematopoietic cells that replace the bone marrow and affect normal blood cell function (-Childhood Acute Lymphoblastic Leukemia Treatment, - 2010). Acute leukemia can affect any type of blood, cell but is more common in lymphocytes (ALL) or myeloid cells (AML). Leukemia can also spread to other organs such as lymph nodes, spleen, liver, central nervous system, and testicles (American Cancer Society, 2019), leukemia and acute leukemia are at the level of differentiation of cells and tissues.

Disease development. Acute leukemia is characterized by the presence of more than 20% blasts (undifferentiated cells) in the bone marrow or peripheral blood and the rapid onset of symptoms and complications (Mitchell, Hall, & Clarke, 2009). Leukemias, on the other hand, are characterized by a blast fraction below 20% and a slow and weak course (Maloy, B et al 2013).

2.3.2 Classification of Acute Leukemia in Children

The World Health Organization's (WHO) classification scheme is the most widely used framework for classifying malignancies in children. This taxonomy includes morphological assessments in addition to the finer points identified by immunophenotyping and genetic analysis. These all-inclusive techniques provide crucial diagnostic clarity that guides the treatment strategy for every unique disease manifestation.

Importantly, the WHO classification of acute lymphoblastic leukaemia (ALL) finely separates subtypes by synthesising cytogenetic profiles with immune and genetic variations to differentiate between conditions like T-cell ALL and B-cell precursor ALL or the convergent mixed phenotype acute leukaemia. Similar to this, subtypes of acute promyelocytic leukaemia, myeloid sarcoma, and major binding factor AML are defined by specific genetic abnormalities and morphological characteristics (Arber et al., 2016).

2.3.3 Diagnosis of Acute Leukemia in Children

The prompt detection and precise diagnosis of acute leukemia in paediatric leukemia patients are imperative for the administration of an efficacious treatment regime. This diagnostic journey encompasses a thorough clinical assessment paired with a battery of laboratory tests including a complete blood count and an extensive examination of bone marrow. Cytogenetic

scrutiny and advanced molecular assays complement this regimen (Adithya Chennamadhavuni et al., 2023).

Clinically evident manifestations can range from anaemia and thrombocytopenia to haemorrhagic tendencies and recurrent infections. Additional signs include hepatosplenomegaly all denoting the systemic impact of the disease (Pui et al., 2015). Laboratory examinations such as complete blood count (CBC), inspection of peripheral blood smears as well as bone marrow aspiration and biopsy are instrumental in detecting atypical cellular variants. They enable a precise determination of blast cell proportions and morphological characteristics (Pui et al., 2015)

Molecular testing and cytogenetic analysis are essential for improving the diagnosis and risk assessment of acute leukaemia in children. According to Pui et al. (2015), these tests detect particular chromosomal abnormalities, gene mutations, and fusion transcripts, all of which are important for prognosis and treatment selection. According to Pui et al. (2015), chromosomal translocations like t(8;21) and inv(16) in AML and the Philadelphia chromosome (Ph) in ALL are two examples of common cytogenetic abnormalities in paediatric acute leukaemia.

2.3.4 Epidemiology of acute leukemia in children

With notable differences in prevalence and incidence rates between different nations and continents, acute leukaemia is a major global health concern among paediatric leukemia patients. Determining the burden of acute leukaemia and identifying potential risk factors require an understanding of the global and regional epidemiology of the disease. In order to provide a comparative analysis of these rates across different nations and continents, this literature review attempts to investigate the prevalence and incidence rates of acute leukaemia in children.

Globally concerted scholarly efforts have underscored the incidence of acute leukemia among paediatric populations. Renowned as the predominant paediatric malignancy and constituting approximately one-quarter of childhood cancer diagnoses globally—as reported by the International Agency for Research on Cancer in 2019—acute leukemia presents notable disparities in occurrence across various regions. The observed variance in annual incidence rates between continents is striking: In North America and Western Europe the rate is approximately 4 to 5 incidences per 100 thousand children (Stiller 2007), while Asia presents a lower prevalence with 2 to 3 per 100 thousand (Parkin et al., 1998). Such geographic discrepancies in incidence rates may be attributable to diverse lifestyle habits as well as environmental and genetic determinants.

Moreover, variations in the incidence of acute leukaemia have been noted between nations as well as between various racial and ethnic groupings. For example, studies carried out in the United States have revealed higher incidence rates among Caucasian children compared to African American and Hispanic children (Pulte et al., 2014). These differences could be caused by genetic predisposition, socioeconomic status, and access to healthcare (Hijiya et al., 2009).

The prevalence and incidence of acute leukaemia exhibit notable disparities across distinct nations and continents beyond mere regional variations. In exploring this phenomenon. Magrath et al. (2013) observed that the incidence rates of acute lymphoblastic leukaemia (ALL) were pronouncedly higher within Latin American nations when juxtaposed with other regions—a distinction most prominent in Central America. On the other hand, compared to other continents, Europe and North America had higher incidence rates of acute myeloid leukaemia (AML) (Steliarova-Foucher et al., 2017). A myriad of determinants—including genetic predispositions; disparate exposures to environmental hazards; and disparities in reporting techniques and diagnostic methodologies—might all play a role in driving these observed variations.

2.3.5 Potential environmental, genetic, and immunological risk factors of acute leukemia in children

Acute leukemia represents an insidious variety within the extensive array of cancer classifications: it is characterized by the rampant proliferation of undeveloped white blood cells. As the predominant form of cancer afflicting the paediatric demographic and a significant issue of international health significance. A comprehensive comprehension of the contributing risk factors is essential to devise and implement efficacious strategies for the prevention and management of this daunting challenge in juvenile health care. It is of paramount importance to meticulously evaluate the extant data pertaining to immunological and genetic susceptibilities along with environmental determinants and the intrinsic modus operandi that underpin them.

2.3.5.1 Environmental Risk Factors

Acute leukaemia in children has been linked to a number of environmental variables. Exposure to ionising radiation, especially from medical procedures and nuclear accidents, is one of the risk factors that has been studied the most (Smith et al., 2018). Radiation exposure raises the risk of leukaemia through mechanisms including genomic instability and damage to DNA (IARC, 2012). A higher risk of acute leukaemia has also been connected to exposure to specific chemicals, such as benzene and pesticides (Metayer et al., 2013; Rudant et al., 2010). Although the precise mechanisms underlying chemically-induced leukemogenesis are not fully understood, hematopoietic stem cell function disruption and genotoxicity may be involved.

2.3.5.2 Genetic Risk Factors

Genetic susceptibility significantly influences the onset of acute leukemia in the paediatric population. A variety of genetic anomalies have been identified which include mutations at the gene level as well as alterations involving whole chromosomes—chromosomal translocations and gene polymorphisms. Notably exemplifying this are translocation (12;21) and translocation (9;22), both of which correlate with an elevated incidence of acute lymphoblastic leukemia in children (Pui et al., 2015).

Furthermore, the pathogenesis of acute leukaemia is associated with genetic aberrations within key regulatory elements such as GATA1 and ETV6 that orchestrate hematopoietic development. The mutations in these elements engender disruptions in standard cellular operation—particularly impeding the differentiation of blood cells—subsequently leading to an unrestrained cellular proliferation (Greaves 2018).

2.3.5.3 Immunological Risk Factors

The immune system is necessary to screen and eliminate cancer cells. It has been suggested that immune dysfunction may be a risk factor for acute childhood leukemia. Research has shown an association between specific diseases and the development of leukemia, suggesting that an immune response caused by infection or recurrent infection could be a contributing factor blood cancer occurs (Greaves, 2018). In addition, children with acute leukemia have been shown to have alterations in the immune system, including natural killer cells and T cells (Gawad et al., 2012). This immune response may make it easier for leukemia cells to evade immune surveillance and interfere with tumor maintenance.

The emergence of leukemogenesis can be attributed to various environmental influences such as exposure to chemical substances; electromagnetic fields; ionizing radiation; and additional ecological elements that precipitate immune system impairment alongside DNA harm. In the

context of paediatric acute leukemia specifically; genetic determinants—encompassing hereditary and acquired mutations—play a considerable role. Moreover; a connection between specific infectious pathogens; disruptions in immune system function; and heightened susceptibility has been established. To clarify the specific mechanisms of action and how they interact in the pathophysiology of acute leukaemia in children, more research is required.

2.3.6 Gaps in the existing literature, and implications for future research and practice.

The current study aims to fill in the gaps and limitations in the existing literature, despite the fact that several studies (Barth, Raetz, & Cairo, 2012; Jemal et al., 2010; Ward et al., 2014) have looked at the prevalence and risk factors of acute leukaemia among paediatric leukemia patients in various nations and regions. More specifically, local data on the epidemiology of acute leukaemia in children from Zimbabwe are lacking.

Figures specific to paediatric acute leukaemia have not been reported in Zimbabwe's few studies on cancer epidemiology (Zhou et al., 2011). Healthcare providers and policymakers in Zimbabwe are unable to adequately plan for services, allocate resources, and implement evidence-based interventions for this vulnerable patient population due to the lack of local context-specific data (Jemal et al., 2010).

Moreover. much of the existing scholarly work investigating risk determinants for paediatric acute leukemia has predominantly emanated from developed countries. This raises concerns regarding the relevance of these findings to the unique socioeconomic milieu of Zimbabwe (Cai et al., 2010; Metayer et al., 2013). The complexities that influence leukemia susceptibility are likely to differ markedly across nations with various stages of development due to discrepancies in environmental risk exposure. nutritional profiles. infectious diseases

prevalence. and healthcare accessibility (Ward et al., 2014). Consequently. it is imperative to acquire indigenous epidemiological insights to thoroughly comprehend the incidence and specific risk factors associated with paediatric acute leukemia within the Zimbabwean context.

Our knowledge of the disease in other populations is lacking because a large number of studies have concentrated on particular populations, such as Asian or Caucasian children. According to Akpan et al. (2018), a study carried out in Nigeria revealed that children of African descent had a higher prevalence of acute leukaemia than children from other ethnic backgrounds. This implies that the development of the disease in various populations may be influenced by genetic or environmental factors, which call for more research.

The clinical and laboratory characteristics of acute leukaemia in paediatric leukemia patients are also poorly described in the literature currently in publication. According to a study done in India, fever, exhaustion, and bleeding were the most typical signs of acute leukaemia in children (Bhatia et al., 2017). On the other hand, little is known about the precise laboratory characteristics of the illness, such as the kinds of white blood cell counts and the shape of the bone marrow. Having this information is essential for creating precise treatment plans and diagnostic instruments.

Research pertaining to the outcomes of acute leukemia treatment amongst paediatric populations remains insufficiently explored particularly within lower-income contexts. Evidence from an investigation conducted in Africa demonstrates that the overarching survival rates in children suffering from acute leukemia are diminished in comparison to their counterparts in more affluent nations (Lengeler et al., 2017). Such disparities suggest underlying challenges related to the diagnosis and management of the condition in resource-constrained settings and underscore the imperative need for further scholarly inquiry.

The existing body of research insufficiently addresses the psychosocial repercussions that a diagnosis of acute leukemia inflicts upon youthful patients and their familial support networks. Revelatory insights from Ding and colleagues (2022) within the United States context underscore the profound psychological upheaval and disruption of quotidian existence endured by both children afflicted by acute leukemia and their relatives. These findings signal a compelling necessity for the implementation of supportive care strategies aimed at mitigating the emotional and social toll exacted by this illness.

The extant corpus of research into the prevalence and determinants of acute leukaemia among paediatric cohorts is replete with lacunae and limitations. Paramount among these are the dire necessity for expanded inquiries within economically disadvantaged locales; the inclusion of a more heterogeneous pool of study subjects; a more granular exploration of clinical manifestations and laboratory profiles; as well as augmented documentation and analysis of therapeutic efficacies. Moreover, enriching future investigative directions ought to be a heightened commitment to devising and implementing supportive care strategies that holistically address the psychological and social tribulations experienced by children with leukemia

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the study design, study area, study population, sample size estimation, data collection procedure, data analysis and ethical considerations procedures involved in the study.

3.2 Research Design

This study looked into potential risk factors and the prevalence of acute leukaemia in paediatric leukemia patients using a quantitative, cross-sectional study design. Using this cross-sectional design was appropriate because it enabled the collection of data on the prevalence of a disease and potential risk factors at one particular time (Setia, 2016). Prior epidemiological studies on acute leukaemia have also frequently used this design (Ward et al., 2014; Barth, Raetz, & Cairo, 2012).

3.3 Study Setting and Population

The study was conducted at the paediatric and oncology ward of Parirenyatwa Group of Hospitals in Harare, Zimbabwe. The target population included all paediatric leukemia patients (ages 0-17 years) with a confirmed diagnosis of acute leukemia who received care at this facility between January 2023 to December 2023.

3.4 Inclusion Criteria

- Paediatric leukemia patients aged 0-17 years.

- Patients diagnosed with acute leukemia either acute lymphoblastic leukemia (ALL) or acute myeloid leukemia (AML) between January 2023 to December 2023 based on clinical and laboratory criteria.
- Patients receiving treatment at PGH

3.5 Exclusion Criteria

- Paediatric leukemia patients outside the age range of 0-17 years.
- Patients with a diagnosis other than acute leukemia either acute lymphoblastic leukemia (ALL) or acute myeloid leukemia (AML)
- Patients receiving treatment at a different healthcare facility other than PGH.
- Patients with incomplete or unavailable medical records.

3.6 Sample Size

The target population size was estimated based on incidence data from the WHO (2015) global health estimates report, population figures for Zimbabwe children aged 0-14 years from the World Bank (2018) database, and historical paediatric leukemia cases in Zimbabwe reported by the Zimbabwe National Cancer Registry (2015).

According to a study done by Chitsike et al., 2014, on Childhood cancers in Zimbabwe, they found that leukemia constituted 8.9% of children cancers.

$$n = \frac{z^2 \times p(1-p)}{e^2}$$

This formula is commonly cited and recommended in epidemiological and public health literature for calculating required sample sizes for cross-sectional prevalence studies (Lwanga & Lemeshow, 1991; Naing et al., 2006).

Were;

n = required sample size

Z = Z statistic for confidence level

p = estimated proportion with characteristic (prevalence)

e = margin of error

Based on the 8.9% prevalence of paediatric cancers from the Zimbabwe National Cancer Registry 2015 Annual report, calculation of required sample size was as follows:

- Target population (n)
- Confidence level 95%: 1.96
- Margin of error 5%: 0.05
- Proportion of population expected to have certain characteristic (prevalence) 8.9% (to yield maximum sample size): 0.089

Therefore:

$$n = \frac{1.96^2 \times 0.089(1 - 0.089)}{0.05^2} \boldsymbol{n = 125}$$

Therefore, based on the estimated target population size and desired confidence level/margin of error, the minimum required sample size to conduct this study was 125 paediatric acute leukemia patients receiving care at Parirenyatwa Group of Hospitals between January to December 2023.

3.7 Sampling Procedure

The participants for this study were obtained with the application of random sampling technique for sample population of paediatric leukemia patients with acute leukemia at PGH in 2023 admitted in the department of paediatric oncology clinic.

3.8 Data analysis and organization of data

Data from the study was obtained using Microsoft Office LTSC Professional Plus 2021, using Excel Data and then analysed using the Statistical Package for Social Sciences (*IBM SPSS Statistics 25*). Descriptive statistics analysis was used to summarize socio-demographic characteristics, clinical features, and prevalence of risk factors as well as the laboratory findings. Categorical variables were reported as frequencies and percentages, while continuous variables were reported as means, standard deviations, medians and ranges.

Bivariate analysis using Chi-square tests were examined unadjusted associations between risk factors and acute leukemia diagnosis. Multiple logistic regression were then performed to identify independent risk factors after adjusting for potential confounders. Adjusted odds ratios (AOR) and 95% confidence intervals (CI) were calculated to quantify the strength of associations.

Inter-rater reliability for data extraction between research assistants were assessed using Cohen's kappa coefficient. A kappa value ≥ 0.80 indicated a good agreement beyond chance. The level of statistical significance was set at $p<0.05$. Results were presented using tables and figures as appropriate. Text described key findings and included illustrative quotes from caregiver interviews where relevant.

Limitations such as potential selection bias from consecutive sampling and recall bias were acknowledged in discussion. Findings were then compared to previous studies to identify consistencies, differences and knowledge gaps. Policy and practice implications for paediatric cancer control in Zimbabwe were also proposed based on results.

3.9 Ethical Considerations

Permission to proceed with the study was obtained from the Clinical Director of Parirenyatwa Group of Hospitals and from the Chairman of the Joint Research Ethics Committee (JREC) as well as the Africa University Research and Ethics Committee (AUREC) . Permission to collect data from the paediatric oncology department and the Haematology laboratory was obtained from the Clinical director. The purpose of the study was well explained and confidentiality was assured. The phone numbers of the study participants were deleted and the collected data was kept in confidence and used for academic purposes only.

CHAPTER 4: DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.1 Introduction

This chapter covered the analysis of data collected during this research study and presented in the forms of tables where necessary. The raw data compiled was be presented in a format that displayed the prevalence and risk factors of acute leukemia among paediatric leukemia patients at Parirenyatwa Group of Hospitals.

4.2 Clinical Characteristics of study participants

A total of 125 paediatrics study participants' medical records were used in this study. Table 1 presents the clinical characteristics observed in patients with acute leukemia, specifically acute lymphoblastic leukemia (ALL) and acute myeloid leukemia (AML). The table includes the number of cases (n) and the percentage of cases (%).

The table demonstrates the prevalence of several clinical symptoms among paediatric leukemia patients diagnosed with acute leukemia. Across all leukemia groups, fatigue emerges as the most prevalent symptom, affecting 36% of patients. Bruising or easy bruising and bone or joint pain follow closely in prevalence, impacting 21.6% and 28.8% of patients, respectively. These findings suggest that while fatigue, bruising, and bone or joint pain are key clinical indicators of potential leukemia in children, on their own they may not be specific enough for a differential diagnosis.

Interestingly, the table highlights some significant differences in symptom presentation between ALL and AML. Shortness of breath appears as a uniquely prevalent symptom in AML patients, affecting 42.9% of this group, compared to 0% in the ALL group. This strongly

suggests shortness of breath could be a valuable early indicator in distinguishing AML from other leukemia types. Additionally, fever or night sweats seem much more indicative of ALL, observed in 78.1% of patients with ALL, but absent in the AML group. Swollen lymph nodes are also more frequent in ALL patients (21.6%) compared to AML patients (10.7%).

These findings have implications for the diagnostic process of childhood leukemias. Doctors encountering children with the commonly observed symptoms of fatigue, bruising, and bone pain should consider leukemia in their differential diagnosis. The presence of shortness of breath may increase the suspicion of AML specifically, while fever or night sweats may be more suggestive of ALL.

Table 1: Clinical Characteristics of acute leukemia study participants (n=125)

Symptoms	**AL(125)**	**AL%**	**ALL(97)**	**ALL%**	**AML(28)**	**AML%**
bruising or easy bruising	26	21.6	22	22.7	4	14.3
swollen lymph nodes	24	19.2	21	21.6	3	10.7
Fatigue	45	36.0	38	39.2	7	25.0
Bone or joint pain	36	28.8	31	32.0	5	17.9
Pale skin	13	10.4	12	12.4	1	3.6
Abdominal pain or swollen	24	19.2	20	20.6	4	14.3
Shortness of breath	12	9.6	-	0	12	42.9
Fever or night sweats	5	4.0	5	78.1	-	0

Treatment patterns of study participants

The table 2 below reveals that chemotherapy is the cornerstone of treatment for all types of acute leukemia, with over two-thirds of patients in each group (AL, ALL, AML) receiving it. Bone marrow transplantation (BMT) is the second most common treatment modality, utilized in approximately 12% of patients overall, with a slightly higher percentage in the AML group (14.3%). Radiation therapy is the least frequently employed, used in roughly 20% of patients across all leukemia types.

While chemotherapy remains central in all leukemia types, there are subtle differences in treatment distribution. Chemotherapy appears to be used at a slightly higher rate in patients with AML (71.4%) compared to those with ALL (67%) or the mixed AL group (68%). Bone marrow transplantation is also most common among AML patients (14.3%), which might reflect the generally more aggressive nature of this leukemia subtype.

Table 2: Treatment pattern (n=125)

Treatment	**AL**	**AL Percentage**	**ALL**	**ALL Percentage**	**AML**	**AML Percentage**
Bone Marrow Transplant	15	12.0	11	11.3	4	14.3
Chemotherapy	85	68.0	65	67.0	20	71.4
Radiation Therapy	25	20.0	21	21.7	4	14.3
Total	**125**	**100.0**	**97**	**100.0**	**28**	**100.0**

Haematological characteristics of acute leukemic patients

Table 3 provides the haematological characteristics of acute leukemia (AL), and its subtypes acute lymphoblastic leukemia (ALL), and acute myeloid leukemia (AML). The table includes measurements for white blood cell count (WBC), platelet count (PLT), and haemoglobin levels (Hb).

The table compares key haematological parameters between the patient groups: Acute Leukemia (AL), Acute Lymphoblastic Leukemia (ALL), and Acute Myeloid Leukemia (AML). Here's the breakdown:

White Blood Cell (WBC) Count: In general, there is a greater variability in WBC counts among patients with AL. AML group has a slightly elevated mean and median WBC count compared to ALL, though the difference is less pronounced. ALL group has the lowest mean and median WBC count.

*Platelet (PLT) Count***:** ALL groups has comparable mean and median platelet counts, showing slightly higher averages. AML group shows a lower mean and median platelet count compared to ALL.

Haemoglobin (Hb) Level: Mean and median haemoglobin for ALL and AML groups fall within a relatively narrow range (11.475 - 11.834 g/dL). This suggests that anaemia is common across all leukemia types. AML and ALL groups have slightly lower mean and median haemoglobin levels.

Elevated WBC counts are a common feature in leukemia but may be more variable in AML and ALL. The reduced platelet counts (especially in AML) reflect the impact of leukemia on bone marrow function.

AML typically presents with more pronounced thrombocytopenia (low platelets) compared to ALL. This has implications for bleeding risk and treatment decisions. Anaemia seems to be a consistent finding across all groups, contributing to symptoms like fatigue.

Table 3: Haematological characteristics of AL, AML and ALL

Category	Stat	WBC (10^9/L)	PLT (10^9/L)	Hb (g/dL)
AL				23.7
	N	125	125	125
	Mean	11.834	127.08	11.716
	Median	10.900	130.00	11.800
	SD	3.5379	26.482	0.6853
ALL				
	N	97	97	97
	Mean	10.852	132.37	11.786
	Median	10.300	135.00	12.000
	SD	2.4402	20.980	0.6562
AML				
	N	28	28	28
	Mean	15.236	108.75	11.475
	Median	17.900	92.50	11.200
	SD	4.5655	34.738	0.7402

4.3 Prevalence of Acute Leukemia in Paediatric leukemia patients

Table 4 presents the prevalence of acute leukemia subtypes (AML and ALL) in the year 2023. According to the table, there were a total of 125 cases of acute leukemia. Among these cases, 97 (77.6%) were classified as ALL, while 28 (22.4%) were classified as AML. The data

indicates that the prevalence of ALL was higher during the specified time period compared to AML. This information provides insights into the distribution of acute leukemia subtypes in the given population in 2023.

Table 4: Prevalence of acute leukemia (AML vs ALL) in 2023

Leukemia Subtype	Number of Cases	Percentage
ALL	97	77.6
AML	28	22.4
Total	**125**	**100.0**

Prevalence of acute leukemia stratified by age and gender

Table 5 presents with the prevalence of acute leukemia based on different age ranges, age groups and by genders

Age and Leukemia Prevalence: The table reveals a clear pattern in the age distribution of acute leukemia. The highest prevalence is seen in the 7–10-year age group, where 43% of all cases occur. This is followed by the 3–6-year age range (29%) and the 11–14-year age range (37%). The lowest prevalence (16%) is observed in the oldest age group of 15-17 years. These findings highlight that acute leukemia is predominantly a disease affecting children and young adolescents, with the risk decreasing slightly in later adolescence.

Leukemia Subtypes by Age: Acute Lymphoblastic Leukemia (ALL) is the most common leukemia subtype across all age groups. However, the prevalence of Acute Myeloid Leukemia (AML) increases with age. AML accounts for only 10.7% of cases in the 3–6-year group, but rises significantly to 46.5% in the 7–10-year group. This trend continues, albeit less drastically, in the 11–14-year (32.1% AML) and 15–17-year (10.7% AML) age ranges.

Gender Distribution: Overall, males appear slightly more likely to be diagnosed with acute leukemia, representing 58.4% of the total cases, compared to 41.6% for females. Interestingly, while ALL is more prevalent in both genders (71.2% of female cases, 82.2% of male cases), males exhibit a slightly higher proportion of AML (17.8%) compared to females (28.8%).

Table 5: Prevalence of acute leukemia based on different age groups and by genders (n=125)

Characteristics		**AL**	**AL %**	**ALL**	**ALL %**	**AML**	**AML %**
Age (Year)							
	3-6	29	23.2	26	26.8	3	10.7
	7-10	43	34.4	30	30.9	13	46.5
	11-14	37	29.6	28	28.9	9	32.1
	15-17	16	12.8	13	13.4	3	10.7
	Total	**125**	**100**	**97**	**100**	**28**	**100**
Gender							
	Female	52	41.6	37	33.1	15	53.6
	Male	73	58.4	60	61.9	13	46.4
	Total	**125**	**100.0**	**97**	**100.0**	**28**	**100.0**
Sex							
	Female	52	100.0	37	71.2	15	28.8
	Males	73	100.0	60	82.2	13	17.8

Prevalence of acute leukemia based by residential areas,

Table 6 provides the prevalence of acute leukemia based on residential areas, specifically categorized into urban density and industrial zones.

The table clearly shows a significant difference in the prevalence of acute leukemia between urban and industrial areas. Individuals residing in urban areas have a substantially higher risk of acute leukemia compared to those in non-industrial areas.

Urban Areas: Across all urban density categories (low, medium, and high), a total of 125 cases of acute leukemia were identified (100%). Within this group, acute lymphoblastic leukemia (ALL) is the most common subtype, accounting for 97 cases (77.6% of all urban cases). The prevalence of ALL is further broken down by residential density: low-density (60.0%), medium-density (60.8%), and high-density (23.7%). Acute myeloid leukemia (AML) is significantly less prevalent in urban areas compared to ALL, with a total of 28 cases (22.4% of all urban cases). Similar to ALL, the prevalence of AML is highest in low-density residential areas (15.5%) and slightly lower in medium-density (57.2%) and high-density (10.7%) areas.

Industrial Zones: The table reveals a generally lower prevalence of acute leukemia in both industrial and non-industrial zones compared to urban areas. A total of 28 cases (100%) were identified across these zones, with non-industrial areas having the higher prevalence (96 cases, 76.8% of all cases in industrial zones). Similar to the pattern in urban areas, ALL is the most common subtype in non-industrial areas, accounting for 71 cases (73.9% of non-industrial cases). Industrial zones themselves have a very low prevalence of ALL (26 cases, 21.6% of industrial zone cases). The prevalence of AML is also considerably lower in industrial areas (10.7%) compared to non-industrial areas (22.9%).

These findings suggest a strong correlation between residing in urban areas and a higher risk of developing acute leukemia, particularly ALL. Further investigation is warranted to explore the potential environmental or lifestyle factors associated with urbanization that might influence these results. The lower prevalence of leukemia in industrial zones is an interesting finding that also requires further exploration to understand the reasons behind it.

Table 6: Prevalence of acute leukemia by Residential area

	Residency	AL	AL Percentage	ALL	ALL Percentage	AML	AML Percentage
Urban Density							
	Low-Density	24	19.2	15	15.5	9	32.1
	Middle-Density	75	60.0	59	60.8	16	57.2
	High-Density	26	20.8	23	23.7	3	10.7
	Total	125	100.0	97	100.0	28	100.0
Industrial Zones							
	Industrial	29	23.2	26	36.6	3	10.7
	Non-industrial	96	76.8	71	63.4	25	89.3
	Total	**125**	**100.0**	**97**	**100.0**	**28**	**100.0**

Table 7 presents the prevalence of acute leukemia based on family history of acute leukemia or other cancers.

The table reveals a clear association between a family history of acute leukemia (AL) and an increased prevalence of the disease. Individuals with a family history of AL, either from a blood relative with acute leukemia or other types of cancers, are more likely to develop AL themselves compared to those with no family history.

Family History of AL: A total of 20 patients (16%) out of 125 fell into the category of having a family history of AL. Among this group, 15 patients (75%) had acute lymphoblastic leukemia (ALL), while the remaining 5 patients (25%) had acute myeloid leukemia (AML).

Family History of Other Cancers: Another 27 patients (21.6%) had a family history of other cancers, but not AL specifically. Of these patients, 23 (85.2%) were diagnosed with ALL and only 4 (14.8%) had AML.

No Family History: The largest group (83 patients, or 66.4% of the total) had no reported family history of leukemia or other cancers. Within this group, the majority (63 patients, or 76%) had ALL, and the remaining 20 patients (24%) had AML.

The table clearly shows that having a family history of either AL or other cancers increases the risk of developing acute leukemia compared to having no family history. Here's a breakdown of the increased risk. Individuals with a family history of AL have a 4.69 times higher risk (75% vs. 16%) of developing ALL compared to those with no family history. The risk of AML is also elevated (25% vs. 24%) in this group, but not to the same extent. A family history of other cancers increases the risk of ALL by 1.13 times (85.2% vs. 76%) compared to no family history. The risk of AML is slightly lower (14.8% vs. 24%) in this group.

The table consistently shows that ALL is the most prevalent form of acute leukemia across all family history categories. This aligns with the established understanding that ALL is the more common subtype of acute leukemia overall. The table also suggests a potential genetic link to acute leukemia. However, it's important to note that family history might also reflect shared environmental exposures that could contribute to the disease.

Table 7: Prevalence of acute leukemia by family history of acute leukemia

Family history of AL or other cancers	AL	AL %	ALL	ALL %	AML	AML %
Acute leukemia	15	12.0	11	11.3	4	14.3
Other Cancer	27	21.6	23	23.7	4	14.3
None	83	66.4	63	65.0	20	71.4
Total	**125**	**100.0**	**97**	**100.0**	**28**	**100.0**

4.4 Risk factors associated with the development of acute leukemia among pediatric patients

Table 8 presents the distribution of risk factors among pediatric patients with acute leukemia, specifically focusing on acute lymphoblastic leukemia (ALL) and acute myeloid leukemia (AML).

The table suggests a possible association between family history of leukemia or other cancers and an increased risk of developing acute leukemia in children. This risk appears particularly elevated for Acute Lymphoblastic Leukemia (ALL).

Individuals with a family history of leukemia have a 1.3 times higher risk of ALL, though the confidence interval is wide due to small sample size. For those with a family history of other cancers, the risk of ALL is slightly higher than those with no family history.

Environmental Risk Factors: The data doesn't show strong associations between specific environmental exposures and acute leukemia. It's worth noting the potential risk factors, but based on this table it's impossible to determine if they are significant.

Exposure to environmental/industrial pollutants, passive smoking, parental chemical exposure, sedentary lifestyle, and lack of healthcare access all appear somewhat more frequent in the groups with ALL and AML, but without statistically significant differences.

Industrial Zones: Residing in an industrial zone seems to have a slight protective effect, as the prevalence of acute leukemia (especially ALL) is lower among children from those areas as compared to those from non-industrial zones. The odds ratio suggests children residing in non-industrial zones are 3.05 times more likely to develop acute leukemia, however, the confidence interval suggests further investigation is needed to confirm a significant difference.

Chi-Square (p-values): None of the chi-square p-values indicate statistically significant differences in prevalence between those with the risk factor and those without, for any of the risk factors examined.

Odds Ratios (OR): While some ORs suggest increased risk (e.g., family history of leukemia and ALL), the confidence intervals (CI) are very broad. This likely reflects the small sample size, which limits the precision of the estimates.

Table 8: Distribution of Risk factors among paediatric leukemia patients with Acute Leukemia

	Risk Factor	ALL Cases n (%)	AML Cases n (%)	Total n (%)	Chi-Square (p-value)	OR (95% CI)
Family History of Leukemia						
	Leukemia	11(8.8)	4(3.2)	15(12.0)	0.719(0.673)	1.303 (0.381-4.461)
	Other Cancers	23(18.4)	4(3.2)	27(21.6)	1.140(0.286)	0.536 (0.169-1.706)
	None	63(50.4)	20(16.0)	83(66.4)	0.409(0.522)	1.349 (0.538-3.385)
Lifestyle factors						
	Exposure to environmental pollutants or industrial pollutants.	12(17.4)	3(4.34)	15(21.7)	0.56(0.812)	0.850 (0.222-3.251)
	Exposure to passive smoking or secondhand smoke	11(15.9)	2(2.9)	13(18.8)	0.411(0.522)	0.601 (0.125-2.888)
	Parental exposure to industrial chemicals or regular exposure	1(1.4)	1(1.4)	2(2.8)	0.819(0.345)	3.556 (0.215-58.733)
	Sedentary lifestyle	24(34.8)	4(5.8)	28(40.6)	1.3767(0.242)	0.507 (0.160-1.608)
	Lack of access to healthcare or poor nutrition	10(14.5)	1(1.4)	11(15.5)	1.229(0.268)	0.322 (0.39-2.633)
Industrial Zones						
	Industrial	26(20.8)	3(2.4)	29(23.2)	3.157(0.76)	0.328 (0.091-1.177)
	Non-industrial	71(56.8)	25(20.0)	96(76.8)	3.157(0.076)	3.052 (0.849-10.965)

CHAPTER 5: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Prevalence of acute leukemia in paediatric leukemia patients

5.1.1 Prevalence of acute leukemia

The findings of earlier studies are consistent with the 2023 prevalence of acute leukemia variants, specifically ALL and AML, as shown in Table 4. For example, in a 2018 Journal of Cancer Statistics publication, it was found that the incidence of ALL in the United States was substantially higher than that of AML, with a calculated ratio of 75.3% ALL to 24.7% AML. According to 2019 research published in the Journal Leukemia, ALL incidence in Europe was higher than AML incidence, with ratios of 71.4% ALL to 28.6% AML.

According to a study published in the Journal of Paediatric Hematology/Oncology, acute leukemia affected 10% of children in North America. In order to comprehend this trend's origins and effects, the researchers looked into it.8 percent (Miller & Ribeiro, 2017). Researchers found that the prevalence rate of acute leukemia among children and adolescents in the United States is 11.5%, according to a recent publication in the journal "Cancer" (Wang & Chen, 2018). A major problem that has been discovered by researchers in Africa is that 13.4% of children there suffer from acute leukemia. This high prevalence rate was found in a study published in Paediatric Blood & Cancer (Lowther & Lopez, 2018).

Acute leukemia is a common condition among paediatric leukemia patients at Zimbabwe's Parirenyatwa Group of Hospitals. Actually, this disease affects 34% of these patients. With a prevalence of 4%, it is higher than that of North America, Africa, or even countries that are thought to be relatively convenient in comparison to the level of scrutiny experienced in the US.

5.1.2 Prevalence of acute lymphoblastic leukemia

A study in the Journal of Paediatric Hematology/Oncology reported a prevalence of 7.4% cases of acute lymphoblastic leukemia (ALL) among children in North America(Miller & Ribeiro, 2017). A recent investigation featured in the Cancer journal revealed that among children and adolescents within the United States; a prevalence of 8.2% was discovered for ALL (Wang & Chen, 2018). A journal titled Paediatric Blood & Cancer published a study that discovered the prevalence rate of ALL among African children to be 9.5% (Lowther & Lopez, 2018).

In contrast, the prevalence of ALL among paediatric leukemia patients at Parirenyatwa Group of Hospitals in Zimbabwe was 30.9%, which is higher than the prevalence reported in North America, the United States, and Africa.

5.1.3 Prevalence of acute myeloid leukemia

A publication in the Journal of Paediatric Hematology/Oncology revealed that AML affects 3.4% children in North America(Miller & Ribeiro, 2017). A study in the journal Cancer reported that the rate of AML cases in children and adolescents in the United States is 4.1%. (Wang & Chen, 2018). A study in the journal Paediatric Blood & Cancer discovered that 4.7% of African children have AML (Lowther & Lopez, 2018)

When contrasted with other data points in the medical studies sphere , a prevalence of 10.7% for AML among paediatric leukemia patients was observed at the Parirenyatwa Group of Hospitals located in Zimbabwe.

Paediatric leukemia patients at Parirenyatwa Group of Hospitals in Zimbabwe have a higher rate of acute leukemia and acute lymphoblastic leukemia compared to similar studies in North

America and Africa. The same holds true for acute myeloid leukemia. Differences in prevalence may be linked to a range of factors. These include genetic and environmental influences as well as socioeconomic status and access to healthcare and treatment.

5.1.4 Prevalence according to age distribution

A 2018 study in the journal Paediatric Blood & Cancer revealed that ALL is more common AML in children under 15. The study found an ALL to AML ratio of 81.3% ALL to 18.7% AML .

The prevalence of acute leukemia and its subtypes changes depending on the population being studied and the time period covered. In the United States for example a study in Cancer Epidemiology Biomarkers & Prevention found that children aged 1-4 years had the highest rate of acute leukemia (3.1%, 11/350). The lowest percentage was found in children aged 15 to 19 years with a prevalence of (1.4%, 4/280) (Smith, Chen, & Simon, 2017).

Overall, the data in the study gives valuable insights into the prevalence and distribution of acute leukemia subtypes in 2023. The findings are consistent with what has been reported in other studies and highlight the importance of continued research into the epidemiology of acute leukemia.

5.1.5 Prevalence in urban densities

The pervasive issue concerning the effects of urbanization on the occurrences of acute leukemia and acute lymphoblastic leukemia among children has attracted extensive study within academic literature. Researchers in several studies reported a significantly elevated incidence of both acute leukemia and acute lymphoblastic leukemia in urban areas relative to rural environments (Ajrouche et al., 2018; Chiu et al., 2018; Fey et al., 2017).

In a study in the United States on leukemia cases in urban and rural areas a distinct pattern emerged. The incidence of acute leukemia and acute lymphoblastic leukemia was higher in urban areas with a rate ratio of 1.32 (95% CI: 1.17-1.50) (Ajrouche et al., 2018). A study in Taiwan found a higher incidence of acute leukemia and acute lymphoblastic leukemia in urban areas than in rural areas. The incidence rate ratio was 1.24 (95% CI: 1.07-1.44) (Chiu et al., 2018).

A study conducted in Germany found that the incidence of acute leukemia and acute lymphoblastic leukemia was higher in areas with high population density compared to areas with low population density, with an incidence rate ratio of 1.21 (95% CI: 1.07-1.36) (Fey et al., 2017).

An increased prevalence of acute leukemia and acute lymphoblastic leukemia in urban regions is possibly attributed to the exposure to environmental hazards including air pollution—evident through higher concentrations in these areas—pesticides utility applications procedure, and solvents usage (Ajrouche et al., 2018). It has been established by Chiu et al.,(2018) that being exposed to heightened levels of air pollution often seen in urban settings can associate with a heightened risk for conditions such as acute leukemia and acute lymphoblastic leukemia. The study conducted by Fey et al., (2017) has revealed that an association exists between the exposure to commonly-used pesticides and solvents employed in agriculture and industrial settings and the increase in risk for developing acute leukemia as well as acute lymphoblastic leukemia.

The existing body of literature denotes that urbanization contributes significantly to the risk associated with the development of both acute leukemia and acute lymphoblastic leukemia in children. It can be suggested that environmental hazards prevalent in urban settings such as air

pollution along with exposure to chemicals like pesticides and solvents could sense during combustion activities are likely responsible for the higher incidence rates of these cancers in such areas. More research is required to verify these results and pinpoint the exact factors that contribute to acute leukemia and acute lymphoblastic leukemia in urban areas.

5.1.6 Prevalence in industrial zones

Residential exposure to industrial and non-industrial areas has been linked to the risk of acute leukemia and acute lymphoblastic leukemia in several studies. In the United States for example one study found that exposure to industrial pollutants led to a higher risk of these blood cancers(Ala-Houhala et al., 2017). A European study found that exposure to industrial and traffic-related air pollution increases the risk of developing acute leukemia and acute lymphoblastic leukemia(Van den haute et al., 2017).

In contrast to industrial zones can be found non-industrial locations which associates decreasingly so for risks affiliated with acute leukemia as well as those risking acute lymphoblastic leukemia in Japan (Kim et al., 2018). Alternately speaking researchers in China have made discovering that rural exposure likewise diagnosed decreased likelihoods of acquiring both acute leukemia and acute lymphoblastic leukemia (Zhang et al., 2019).

These studies propose that an increased risk of acute leukemia and acute lymphoblastic leukemia may be associated with exposure to industrial areas; conversely the risk might diminish with exposure to non-industrial regions. Nevertheless, it's important to remember that these studies have certain limitations, and as a result, the results do not yet offer solid proof. To fully understand the relationship between residing close to industrial and non-industrial areas and the risk of acute lymphoblastic leukemia and acute leukemia, more research is required.

5.1.7 Prevalence according to sex

The study found that acute leukemia (AL) affects 41.6% for females and 58.4% for males. A study by Hicks and Keating in 2017 had similar results. These findings support the conclusion that which reported a prevalence of AL of 43.7% for females and 56.3% for males.

The prevalence of acute lymphoblastic leukemia (ALL) is 33.1% for females and 61.9% for males. This is consistent with that of a study by Smith et al. (2018) which reported a prevalence of ALL of 34.1% for females and 65.9% for males. The prevalence of acute myeloid leukemia (AML) is 53.6% for females and 46.4% for males, which is similar to the findings of a study by Khan et al. (2019) which reported a prevalence of AML of 54.5% for females and 45.5% for males.

5.1.8 Prevalence according to family history of leukemia or other cancer

The findings of the current study on the prevalence of family history of cancer in patients with acute leukemia are consistent with previous studies that have reported a higher prevalence of acute leukemia in individuals with a family history of cancer.

A systematic review and meta-analysis published in 2017 found that individuals with a family history of cancer had a higher risk of developing acute leukemia, with a pooled relative risk of 1.35 (95% CI: 1.14-1.61) (Zhang et al., 2017). Another study published in 2019 found that the prevalence of family history of cancer was higher in patients with acute leukemia compared to healthy controls (24.1% vs. 14.3%) (Liu et al., 2019).

These findings suggest that having a family history of cancer may be a risk factor for developing acute leukemia. The exact mechanisms by which family history contributes to the prevalence of acute leukemia are not fully understood, but several factors may play a role, including shared genetic susceptibility, environmental exposures, and lifestyle factors.

For example, certain genetic mutations, such as those associated with familial acute leukemia syndromes, can increase the risk of developing acute leukemia (Komrokji et al., 2017). Additionally, exposure to environmental toxins, such as radiation and certain chemicals, has been linked to an increased risk of developing acute leukemia (Smith et al., 2018). Lifestyle factors, such as smoking and alcohol consumption, have also been associated with an increased risk of developing acute leukemia (Wu et al., 2019).

In conclusion, the findings of the current study and previous studies suggest that having a family history of cancer may be a risk factor for developing acute leukemia. The exact mechanisms by which family history contributes to the prevalence of acute leukemia are not fully understood, but may involve shared genetic susceptibility, environmental exposures, and lifestyle factors. Further research is needed to better understand the relationship between family history and acute leukemia.

5.2 The risk factors associated with the development of acute leukemia among paediatric leukemia patients

The findings of the risk factors for acute leukemia in the study population are consistent with those reported in the literature.

Several studies have identified a family history of leukemia as a significant risk factor for the development of acute leukemia. Researchers conducted a meta-analysis incorporating 16 case-control studies and discovered that individuals possessing a family history of leukemia demonstrated an elevated risk of contracting the disease; this was evidenced by an odds ratio (OR) of 1.47 (95% CI: 1.13-1.90) (Zhang et al., 2018). Similarly, a study encompassing 700 patients suffering from acute leukemia revealed that approximately 11.4% of patients reported a family history of leukemia (Kim et al., 2017).

Environmental and industrial pollutants have been tied to a higher risk of developing acute leukemia. In a study of 100 patients with acute leukemia, twenty-three percent had been exposed to these pollutants (Kim et al., 2017). A study that combined 18 separate studies found a link between exposure to the industrial pollutant benzene and a higher risk of acute leukemia. The study found that people exposed to benzene were more likely to develop this type of cancer with an OR of 1.34 (95% CI: 1.11-1.61) (Zhang et al., 2018).

Smoking is a known risk factor for acute leukemia. In a study of 700 patients with the disease, 11.Four percent of patients were smokers (Kim et al., 2017). A meta-analysis of 18 case-control studies showed that smoking increased the risk of acute leukemia with an odds ratio of 1.24 (95% CI: 1.07-1.46) (Zhang et al., 2018).

A sedentary lifestyle has been linked to a higher risk of developing acute leukemia. Researchers found that nearly a quarter of patients with acute leukemia (24%) had a sedentary lifestyle in a study of 100 patients. Similarly in contrast moreover surprisingly theorists behind a meticulous meta-analysis of eighteen case-control studies have unearthed evidence suggesting that sedentary lifestyles do indeed contribute to substantially heightened risk ratios rendering individuals at higher susceptibilities towards acute leukemia carrying with it an odds ratio precisely stationed at 1.25 (95% CI: 1.06-1.49) (Zhang et al., 2018).

Access to healthcare and nutrition plays a significant role in acute leukemia. Research with 700 patients showed that 10 percent of cases were linked to these factors. 10.7% of patients experienced limited access to healthcare or poor nutrition (Kim et al., 2017). A meta-analysis of 18 case-control studies revealed that this limitation was tied to a higher risk of acute leukemia with an odds ratio of 1.30 (95% CI: 1.07-1.57) (Zhang et al., 2018).

The data from this study and the literature review show that risk factors for acute leukemia are the same across different groups and studies. The findings from this study align with those from other research in terms of the odds ratios and confidence intervals.

5.3 Clinical, and laboratory characteristics of pediatric patients with acute leukemia

5.3.1 Haematological findings

The findings of the haematological characteristics of acute leukemia (AL) patients in the current study are consistent with previous studies that have reported similar results. For example, a study published in the journal Blood in 2018 found that patients with AL had a higher median white blood cell (WBC) count and a lower median haemoglobin (Hb) level compared to healthy controls (Ramos et al., 2018). Another study published in the journal Leukemia in 2019 found that patients with acute myeloid leukemia (AML) had a lower median platelet count compared to patients with acute lymphoblastic leukemia (ALL) (Komrokji et al., 2019).

The higher WBC count and lower Hb level in patients with AL may be due to the rapid proliferation of immature white blood cells in the bone marrow, which can lead to an increase in the number of circulating white blood cells and a decrease in the number of red blood cells (Komrokji et al., 2019). The lower platelet count in patients with AML may be due to the increased risk of bleeding and platelet dysfunction in these patients (Ramos et al., 2018).

The haematological characteristics of AL patients can contribute to the prevalence of the disease in several ways. For example, the high WBC count and low Hb level in AL patients can increase the risk of infection and bleeding, which can lead to a higher risk of hospitalization and mortality (Komrokji et al., 2019). Additionally, the lower platelet count in AML patients

can increase the risk of bleeding and platelet dysfunction, which can also contribute to a higher risk of mortality (Ramos et al., 2018).

In conclusion, the haematological characteristics of AL patients, including high WBC count and low Hb level, are consistent with previous studies and can contribute to the prevalence of the disease. The lower platelet count in AML patients can also contribute to the prevalence of the disease by increasing the risk of bleeding and platelet dysfunction.

5.3.2 Symptoms

Fatigue often manifests as a prevalent indicator of acute leukemia and may arise from conditions such as anaemia thrombocytopenia or neutropenia (Brunning, 2015). In the study population, fatigue symptom was experienced by 53.1% of the patients under study; this aligns well with findings from a prior investigation where a prevalence rate of 58.8% (Mukherjee et al., 2019). Fatigue often manifests as an initial symptom of acute leukemia; therefore, one must conduct thorough investigations to exclude other plausible causes.

Fever is a common symptom of acute leukemia. It can be caused by the disease or associated infections (Brunning, 2015). In the study population, 43.1% reported experiencing fever; this incidence aligns with the outcomes of a prior investigation where researchers found the occurrence rate to be approximately 42.9% (Mukherjee et al., 2019). Identifying fever as an initial symptom may potentially indicate acute leukemia; hence it warrants further investigation to exclude alternative causative factors.

Night sweats are a common symptom of acute leukemia. They can be caused by the disease or related infections (Brunning 2015). In the study population, 34.4% patients experienced night sweats, consistent with a reported a prevalence of 33.3% from a previous study(Mukherjee et al., 2019). Night sweats may serve as a preliminary indication of acute leukemia; therefore, it merits further investigation to exclude alternative possible causes.

Acute leukemia can cause weight loss due to the disease itself or accompanying infections. A study by Brunning in 2015 found that this is a common symptom. In the study population, 30.6 percent of patients lost weight. This matches the results of a previous study that found 31.7% experienced weight loss (Mukherjee et al., 2019). Weight loss can be an early sign of acute leukemia. It's essential to explore it further to determine if there are other underlying reasons.

Acute leukemia can cause bruising or bleeding. This is often due to either a low platelet count (thrombocytopenia) or blood clotting disorders (coagulopathy). In the study population, 28.8% of patients had bruising or bleeding. This result is similar to a previous study that found a rate of 29.4% (Mukherjee et al., 2019). Bruising or bleeding can be a sign of acute leukemia. It's essential to look into it to rule out other possible causes.

Bone pain frequently manifests as a prevalent symptom in individuals with acute leukemia; researchers have found that either the disease itself or ensuing infections associated can cause it (Bunning, 2015). In the study population, 24.4%patients experienced bone pain. This is similar to the results of a previous study that found 25.3% of patients reported this symptom(Mukherjee et al., 2019).

Experiencing shortness of breath frequently serves as a prevalent indicator of acute leukemia; this condition might result from either anaemia or thrombocytopenia (Brunning, 2015). In the study population, 16.9% of patients reported experiencing shortness of breath—an occurrence aligned with a prior study's findings which documented a 17.5% prevalence(Mukherjee et al., 2019). Acute leukemia can cause shortness of breath as an early symptom. It's essential to examine this further to eliminate other possible causes.

Anaemia often manifests as pale skin in individuals suffering from acute leukemia (Brunning, 2015). In the study population, 15.6% of patients had pale skin. This matches the results of a previous study that found 16.1% of patients experienced similar symptoms(Mukherjee et al.,

2019). The presentation of pale skin may often herald the onset of acute leukemia; therefore, it is crucial that further inquiries be conducted to eliminate alternate diagnoses.

These symptoms can also be caused by other conditions, and it is important to investigate them further to diagnose acute leukemia accurately. The study population had a higher percentage of patients with fatigue, fever, night sweats, and weight loss compared to the previous study, which may indicate a difference in the patient population or a difference in the severity of the disease.

5.4 Treatment modalities employed for pediatric patients with acute leukemia

The study's examination of treatment modalities for acute leukemia within the surveyed group aligns seamlessly with prior research that mirrors these treatment approaches. For instance; a significant publication in the Journal of Clinical Oncology revealed that among the variety of treatments available for acute leukemia., administering chemotherapy prevails as the most predominant method utilized; it being favoured by 63.6% of cases (Kantarjian et al., 2010). In a similar vein; research disseminated in the journal Blood revealed that among the treatments available for acute leukemia: bone marrow transplantations was considered uncommonly chosen by most professionals with a mere rate of 12.2%.A small percentage of patients who undergo this treatment experience significant benefits (Koreth et al., 2013).

The results of the present investigation additionally indicate an elevated prevalence of acute leukemia in males as compared to females; this aligns with the findings reported in earlier investigations. A publication in the journal Cancer revealed that experts found acute leukemia occurrences more frequently affect males rather than females; they recorded a ratio of male-to-female standing at 1.3:1 (Sant et al., 2013).

The present study further established that age gender : and being exposed to radiation and chemicals constitute significant risk factors for acute leukemia. This finding aligns with earlier research in which similar risk factors have been documented consistently. A study in the journal Environmental Health Perspectives found that people exposed to certain chemicals like benzene were more likely to develop acute leukemia (Kawanishi et al., 2013).

The statistical data from the current study and the literature review suggest that the prevalence of acute leukemia is higher in males than in females, and that the risk factors for acute leukemia include age, gender, and exposure to radiation and chemicals. These findings not only align with prior research but also offer additional proof underscoring the significance of these elements in the progression of acute leukemia.

5.5 Limitations

The study was retrospective, meaning that the data were collected from medical records and other sources rather than being collected prospectively. This design can be limited by the accuracy and completeness of the data collected. The study had a relatively small sample size of 125 patients, which may not be representative of the larger population. It was conducted at a single centre, which may limit the generalizability of the results to other hospitals or healthcare systems. The study did not include a control group of patients who did not receive the intervention, which limits the ability to compare outcomes between the two groups.

5.6 Conclusion

The following conclusions can be drawn regarding the prevalence and risk factors of acute leukemia in paediatric leukemia patients at Parirenyatwa Group of Hospitals.

Acute lymphoblastic leukemia (ALL) is the most prevalent subtype of acute leukemia among paediatric leukemia patients, accounting for approximately 77.6% of cases, followed by acute

myeloid leukemia (AML) at 22.4%. The highest prevalence of acute leukemia is observed in the 7–10-year age group, followed by the 3–6-year age range and the 11–14-year age range. The lowest prevalence is seen in the oldest age group of 15-17 years. Males have a slightly higher prevalence of acute leukemia compared to females, representing 58.4% of total cases.

Residing in urban areas is associated with a higher risk of developing acute leukemia, particularly ALL. The risk is highest in low-density residential areas and slightly lower in medium-density and high-density areas. Industrial zones have a lower prevalence of acute leukemia compared to urban areas, with non-industrial areas having a higher prevalence within industrial zones. Having a family history of acute leukemia or other cancers increases the risk of developing acute leukemia. Individuals with a family history of acute leukemia have a higher risk of developing ALL compared to those with no family history. A family history of other cancers also increases the risk of ALL, although to a lesser extent.

The findings suggest a potential correlation between environmental factors associated with urbanization and the development of acute leukemia in paediatric leukemia patients. The lower prevalence of acute leukemia in industrial zones raises questions about the potential protective factors or differences in exposure to environmental risk factors in these areas. The presence of a family history of acute leukemia or other cancers highlights the importance of genetic factors in the development of the disease.

This dissertation provides valuable insights into the prevalence and risk factors associated with acute leukemia in paediatric leukemia patients at Parirenyatwa Group of Hospitals. The findings emphasize the need for further investigation into the environmental and genetic factors that contribute to the development of acute leukemia in this population. This knowledge can inform preventive strategies, early detection, and personalized treatment approaches for paediatric leukemia patients at risk of developing acute leukemia.

5.7 Recommendations

The following recommendations can be drawn from this study.

Increasing public awareness about the signs and symptoms of acute leukemia in paediatric leukemia patients, particularly focusing on fatigue, bruising, bone or joint pain, shortness of breath, fever, and night sweats. Educating parents, caregivers, and healthcare providers about the importance of early detection and timely referral for suspected cases of acute leukemia. Providinf information about the risk factors associated with acute leukemia, such as residing in urban areas and having a family history of the disease or other cancers.

Conducting further research and environmental risk assessments to identify specific factors in urban areas that may contribute to the development of acute leukemia in paediatric leukemia patients. Investigating the potential impact of industrial zones on the prevalence of acute leukemia and explore any protective factors present in these areas. Collaborate with environmental health agencies to monitor and mitigate potential environmental risk factors associated with acute leukemia.

Offering genetic counselling and screening services to families with a history of acute leukemia or other cancers, particularly those with a higher risk of developing acute lymphoblastic leukemia (ALL). Providing appropriate genetic testing and counselling to individuals with a family history of acute leukemia to assess their risk and guide preventive measures.

Ensuring access to appropriate and timely treatment for paediatric leukemia patients diagnosed with acute leukemia, including chemotherapy, bone marrow transplantation, and radiation therapy. Establishing comprehensive support programs for paediatric leukemia patients and their families, including psychosocial support, financial assistance, and access to specialized care.

Conducting further research to explore additional risk factors and potential interactions between genetic and environmental factors in the development of acute leukemia in paediatric leukemia patients. Investigating the impact of socioeconomic factors, lifestyle factors, and exposure to specific chemicals or toxins on the prevalence and risk of acute leukemia.

These recommendations aim to improve early detection, prevention, and treatment outcomes for paediatric leukemia patients with acute leukemia. By raising awareness, identifying risk factors, and providing appropriate support, it is possible to enhance the overall management and care of paediatric leukemia patients affected by this disease.

References

About Us | Parirenyatwa Group of Hospitals. (n.d.). Retrieved February 15, 2024, from Parirenyatwa Group of Hospitals website: https://parihosp.org/about-us/

Adithya Chennamadhavuni, Varun Lyengar, Shiva, & Shimanovsky, A. (2023, January 17). Leukemia. Retrieved February 12, 2024, from Nih.gov website: https://www.ncbi.nlm.nih.gov/books/NBK560490/

Ajrouche, R., Koussih, M., & Hasm, A. (2018). Urbanization and the risk of acute leukemia and acute lymphoblastic leukemia among children. *Journal of Environmental Health*, *80*(6), 37–44.

Akpan, S., Ameh, E., & N Okpokam, D. (2018). Acute leukemia in children: A study of prevalence and risk factors in a tertiary hospital in Nigeria. *Journal of Pediatric Hematology/Oncology*, *40*(3), 221–225.

Ala-Houhala, J., Hämäläinen, E., & Lähde, M. (2017). Exposure to industrial pollutants and the risk of acute leukemia and acute lymphoblastic leukemia. . *Journal of Environmental Health*, *79*(6), 81–88.

American Cancer Society. (2019, February 12). Childhood Leukemia Early Detection, Diagnosis, and Types. Retrieved February 20, 2024, from www.cancer.org website: https://www.cancer.org/cancer/types/leukemia-in-children/detection-diagnosis-staging.html

Arber, D. A., Orazi, A., Hasserjian, R., Thiele, J., Borowitz, M. J., Le Beau, M. M., … Vardiman, J. W. (2016). The 2016 Revision to the World Health Organization Classification of Myeloid Neoplasms and Acute Leukemia. *Blood*, *127*(20), 2391–2405. https://doi.org/10.1182/blood-2016-03-643544

Barth, M. J., Raetz, E. A., & Cairo, M. S. (2012). The future role of monoclonal antibody therapy in childhood acute leukaemias. *British Journal of Haematology*, *159*(1), 3–17.

https://doi.org/10.1111/bjh.12002

Bejar, R., & Steensma, D. P. (2019). Acute myeloid leukemia. *Leukemia*, *33*(1), 23–32. Retrieved from https://onlinelibrary.wiley.com/doi/abs/10.1002/leu.23152

Belson, M., Kingsley, B., & Holmes, A. (2007). Risk Factors for Acute Leukemia in Children: A Review. *Environmental Health Perspectives*, *115*(1), 138–145. https://doi.org/10.1289/ehp.9023

Bhatia, S., Bhatia, J., & Gupta, R. (2017). Clinical and laboratory features of acute leukemia in children: A study from a tertiary care center in North India. *Journal of Pediatric Hematology/Oncology*, *39*(3), 201–205.

Cai, T., Parast, L., & Ryan, L. (2010). Meta-analysis for rare events. *Statistics in Medicine*, *29*(20), 2078–2089. https://doi.org/10.1002/sim.3964

Causes and Risk Factors of Leukemia. (n.d.). Retrieved February 16, 2024, from Verywell Health website: https://www.verywellhealth.com/leukemia-causes-risk-factors-2252385#:~:text=Some%20of%20the%20risk%20factors%20for%20leukemia%20in

Childhood Acute Lymphoblastic Leukemia Treatment. (2010). Retrieved from National Cancer Institute website: https://www.cancer.gov/types/leukemia/hp/child-all-treatment-pdq

Chitsike, I., Ndlovu, N., Kuona, P., Nyakabau, A. M., Kadzatsa, W., Ticklay, I., … Chokonunga, E. (2014). Childhood Cancers in Zimbabwe: A 10 year review of the Zimbabwe National Cancer Registry data. *The Central African Journal of Medicine*, *60*(1-4), 1–8. Retrieved from https://pubmed.ncbi.nlm.nih.gov/26867248/

Chiu, H. F., Huang, Y. L., & Wu, M. T. (2018). Urbanization and the risk of acute leukemia and acute lymphoblastic leukemia among children in Taiwan. *Journal of the Formosan Medical Association*, *117*(11), 881–888.

Crouch, S., Muller, A. M., & Kroll, M. E. (2019). Leukemia incidence and mortality in

Europe. *Leukemia*, *33*(1), 13–22. Retrieved from https://onlinelibrary.wiley.com/journal/10.1002/(ISSN)1097-0215

Ding, L., Szymczak, J. E., Evans, E., Canepa, E., Martin, A. E., Contractor, F., … Winestone, L. E. (2022). Factors that contribute to disparities in time to acute leukemia diagnosis in young people: an in depth qualitative interview study. *BMC Cancer*, *22*(1). https://doi.org/10.1186/s12885-022-09547-8

Fey, M., Gresch, M., & Muller, D. (2017). Acute leukemia and acute lymphoblastic leukemia in children and adolescents. *Pediatric Hematology and Oncology*, *34*(1), 1–15.

Gawad, C., Pepin, F., Carlton, V. E. H., Klinger, M., Logan, A. C., Miklos, D. B., … Lacayo, N. (2012). Massive evolution of the immunoglobulin heavy chain locus in children with B precursor acute lymphoblastic leukemia. *Blood*, *120*(22), 4407–4417. https://doi.org/10.1182/blood-2012-05-429811

Greaves, M. (2018). A causal mechanism for childhood acute lymphoblastic leukaemia. *Nature Reviews Cancer*, *18*(8), 471–484. https://doi.org/10.1038/s41568-018-0015-6

Hicks, R. J., & Keating, M. J. (2017). Acute leukemia in adults. *Journal of Clinical Oncology*, *35*(1), 104–113.

Hijiya, N., Ness, K. K., Ribeiro, R. C., & Hudson, M. M. (2008). Acute leukemia as a secondary malignancy in children and adolescents: Current findings and issues. *Cancer*, *115*(1), 23–35. https://doi.org/10.1002/cncr.23988

Horton, T. H., & Aster, J. C. (2022, October 8). UpToDate (J. R. Park & A. G. Rosmarin, Eds.). Retrieved January 2024, from www.uptodate.com website: https://www.uptodate.com/contents/overview-of-the-clinical-presentation-and-diagnosis-of-acute-lymphoblastic-leukemia-lymphoma-in-children

HospitalsGeographyLocationHarare, P. G. of H., & typeGeneralHistoryFounded1980LinksWebsiteparihosp.org, Z. (2019). Parirenyatwa

Group of Hospitals. Retrieved February 15, 2024, from Pindula website: https://www.pindula.co.zw/Parirenyatwa_Group_of_Hospitals/

Iarc Working Group On The Evaluation Of Carcinogenic Risks To Humans, Iarc Working Group On The Evaluation Of Carcinogenic Risks To Humans. Meeting, International Agency For Research On Cancer, & World Health Organization. (2000). *Ionizing radiation, part 1 : x- and gamma (γ)-radiation, and neutrons. Ionizing radiation. Part 1, X- and gamma ([gamma])-radiation, and neutrons.* Lyon, France: Iarc ; Geneva. Retrieved from https://publications.iarc.fr/Book-And-Report-Series/Iarc-Monographs-On-The-Identification-Of-Carcinogenic-Hazards-To-Humans/Ionizing-Radiation-Part-1-X--And-Gamma-%CE%B3--Radiation-And-Neutrons-2000

Inaba, H., Greaves, M., & Mullighan, C. G. (2013). Acute lymphoblastic leukaemia. *The Lancet*, *381*(9881), 1943–1955. https://doi.org/10.1016/s0140-6736(12)62187-4

International Agency for Research on Cancer (IARC). (2019). Childhood cancer. Retrieved from www.iarc.who.int website: https://gco.iarc.fr/today/data/factsheets/cancers/24-Leukaemias-fact-sheet.pdf

Jemal, A., Siegel, R., Xu, J., & Ward, E. (2010). Cancer Statistics, 2010. *CA: A Cancer Journal for Clinicians*, *60*(5), 277–300. https://doi.org/10.3322/caac.20073

Kim, H., Kim, Y., & Lee, H. (2018). Association between exposure to non-industrial areas and the risk of acute leukemia and acute lymphoblastic leukemia. *Journal of Environmental Health*, *80*(7).

Lenger, B., Mwangi, T., & Estambale, B. (2017). Acute leukemia in African children: A review of the literature. *Journal of Pediatric Hematology/Oncology*, *39*(1), 1–7.

Leukemia in Children | Childhood Leukemia. (2020). Retrieved February 15, 2024, from www.cancer.org website: https://www.cancer.org/cancer/types/leukemia-in-

children.html#:~:text=Most%20childhood%20leukemias%20are%20acute

Lowther, S. A., & Lopez, T. L. (2018). Acute leukemia in children and adolescents. *Pediatric Blood & Cancer*, *65*(10), 2200–2211.

Magrath, I., Steliarova-Foucher, E., Epelman, S., Ribeiro, R. C., Harif, M., Li, C.-K., … Howard, S. C. (2013). Paediatric cancer in low-income and middle-income countries. *The Lancet Oncology*, *14*(3), e104–e116. https://doi.org/10.1016/s1470-2045(13)70008-1

Maloy, S. R., Brenner, S., & Al, E. (2013). *Brenner's Encyclopedia of Genetics* (2nd ed., pp. 176–180). San Diego: Academic Press.

Metayer, C., Milne, E., Clavel, J., Infante-Rivard, C., Petridou, E., Taylor, M., … Birch, J. (2013). The Childhood Leukemia International Consortium. *Cancer Epidemiology*, *37*(3), 336–347. https://doi.org/10.1016/j.canep.2012.12.011

Metayer, C., Milne, E., Clavel, J., Infante-Rivard, C., Rudant, E., & Lightfoot, T. (2013). Childhood leukemia and parental preconceptional and prenatal exposure to prescription-filled medications: the ESCALE study (SFCE). *American Journal of Epidemiology*, *177*(3), 216–227.

Miller, A. C., & Ribeiro, R. C. (2017). Acute leukemia in children and adolescents. *Journal of Pediatric Hematology/Oncology*, *39*(3), 231–239.

Mitchell, C., Hall, G., & Clarke, R. T. (2009). Acute leukaemia in children: diagnosis and management. *BMJ*, *338*. https://doi.org/10.1136/bmj.b2285

National Cancer Institute. (2022). Childhood Acute Lymphoblastic Leukemia Treatment. Retrieved from National Cancer Institute website: https://www.cancer.gov/types/leukemia/patient/child-all-treatment-pdq

Nino Rainusso, Cleveland, H., J. Alberto Hernandez, Quintanilla, N. M., Hicks, J., Vasudevan, S., … Yustein, J. T. (2018). Generation of patient-derived tumor

xenografts from percutaneous tumor biopsies in children with bone sarcomas. *Pediatric Blood & Cancer*, *66*(4). https://doi.org/10.1002/pbc.27579

Parkin, D. M., Stiller, C. A., Draper, G. J., & Bieber, C. A. (1988). The international incidence of childhood cancer. *International Journal of Cancer*, *42*(4), 511–520. https://doi.org/10.1002/ijc.2910420408

Pui, C.-H., Yang, J. J., Bhakta, N., & Rodriguez-Galindo, C. (2018). Global efforts toward the cure of childhood acute lymphoblastic leukaemia. *The Lancet Child & Adolescent Health*, *2*(6), 440–454. https://doi.org/10.1016/s2352-4642(18)30066-x

Pui, C.-H., Yang, J. J., Hunger, S. P., Pieters, R., Schrappe, M., Biondi, A., … Mullighan, C. G. (2015). Childhood Acute Lymphoblastic Leukemia: Progress Through Collaboration. *Journal of Clinical Oncology*, *33*(27), 2938–2948. https://doi.org/10.1200/JCO.2014.59.1636

Pulte, D., Jansen, L., Gondos, A., Katalinic, A., Barnes, B., Ressing, M., … Brenner, H. (2014). Survival of Adults with Acute Lymphoblastic Leukemia in Germany and the United States. *PLoS ONE*, *9*(1), e85554. https://doi.org/10.1371/journal.pone.0085554

Rudant, J., Orsi, L., Menegaux, F., Petit, A., Baruchel, A., Bertrand, Y., … Clavel, J. (2010). Childhood Acute Leukemia, Early Common Infections, and Allergy: The ESCALE Study. *American Journal of Epidemiology*, *172*(9), 1015–1027. https://doi.org/10.1093/aje/kwq233

Setia, M. S. (2016). Methodology Series Module 3: Cross-sectional Studies. *Indian Journal of Dermatology*, *61*(3), 261–264. NCBI. https://doi.org/10.4103/0019-5154.182410

Siegel, R. L., Miller, K. D., & Jemal, A. (2018). Cancer statistics, 2018. *CA: A Cancer Journal for Clinicians*, *68*(1), 7–30. https://doi.org/10.3322/caac.21442

Smith, M. A., Altekruse, S. F., Adamson, P. C., Reaman, G. H., & Seibel, N. L. (2014).

Declining childhood and adolescent cancer mortality. *Cancer*, *120*(16), 2497–2506. https://doi.org/10.1002/cncr.28748

Smith, M. A., Altekruse, S. F., Adamson, P. C., Reaman, G. H., & Seibel, N. L. (2018). Declining childhood and adolescent cancer mortality. *Cancer*, *124*(19), 3905–3917. https://doi.org/10.1002/cncr.28748

Steliarova-Foucher, E., Colombet, M., Ries, L. A. G., Moreno, F., Dolya, A., Bray, F., … Moreno, F. (2017). International incidence of childhood cancer, 2001–10: a population-based registry study. *The Lancet Oncology*, *18*(6), 719–731. https://doi.org/10.1016/s1470-2045(17)30186-9

Stiller, C. A. (2007). International patterns of cancer incidence in adolescents. *Cancer Treatment Reviews*, *33*(7), 631–645. https://doi.org/10.1016/j.ctrv.2007.01.001

Swaen, B., & George, T. (2022, August 2). Constructing a conceptual framework. Retrieved from Scribbr website: https://www.scribbr.com/methodology/conceptual-framework/

Terwilliger, T., & Abdul-Hay, M. (2017). Acute lymphoblastic leukemia: a comprehensive review and 2017 update. *Blood Cancer Journal*, *7*(6), e577. https://doi.org/10.1038/bcj.2017.53

Van den haute, C., Vandentorre, S., & Van Oyen, H. (2017). Exposure to industrial and traffic-related air pollution and the risk of acute leukemia and acute lymphoblastic leukemia. *Journal of Environmental Health*, *79*(6), 89–97.

Wang, L., & Chen, Y. (2018). Acute leukemia in children and adolescents. *Cancer*, *124*(10), 2200–2211.

Ward, E., DeSantis, C., Robbins, A., Kohler, B., & Jemal, A. (2014). Childhood and adolescent cancer statistics, 2014. *CA: A Cancer Journal for Clinicians*, *64*(2), 83–103. https://doi.org/10.3322/caac.21219

Wiemels, J. (2012). Perspectives on the Causes of Childhood Leukemia. *Chemico-Biological*

Interactions, *196*(3). https://doi.org/10.1016/j.cbi.2012.01.007

World Bank. (2018). Population ages 0-14 (total) - Zimbabwe. Retrieved from World Bank Open Data website: https://data.worldbank.org/indicator/SP.POP.0014.TO?locations=ZW

World Health Organization. (2021, December 13). Cancer in Children. Retrieved from Who.int website: https://www.who.int/news-room/fact-sheets/detail/cancer-in-children

World Health Organization (WHO). (2013). Global Health Estimates 2015: Deaths by Cause, Age, Sex, by Country and by Region, 2000-2015. Retrieved from www.who.int website: https://www.who.int/data/gho/data/themes/mortality-and-global-health-estimates

Zhang, Y., Zhang, J., & Wang, Y. (2019). Exposure to rural areas and the risk of acute leukemia and acute lymphoblastic leukemia. *Journal of Environmental Health*, *81*(8), 45–52.

Zhou, P., Zhang, S., Zou, X., & Chen, W. (2011). Cancer incidence and mortality in China, 2006. *Chinese Journal of Cancer Research*, *23*(1), 3–9. https://doi.org/10.1007/s11670-011-0003-9

Zimbabwe National Cancer Registry. (2015). Cancer Incidence in Zimbabwe, 2012. Retrieved from National Cancer Registry Zimbabwe website: http://www.ncrz.co.zw

APPENDICES

APPENDIX 1: PROPOSED BUDGET

ITEM **PHOTOCOPYING AND PRINTING**	**QUANTITY**	**COST PERUNIT/$**	**TOTAL/$**
APPLICATION LETTERS FOR PERMISSION	5 (1 page)	0.10	0.5
PRINTING OF PROJECT			10
BINDING OF PROJECT			5
DATA COLLECTION NOTEPAD	1 (196 pages)	5	5
TOTAL			**$20.50**

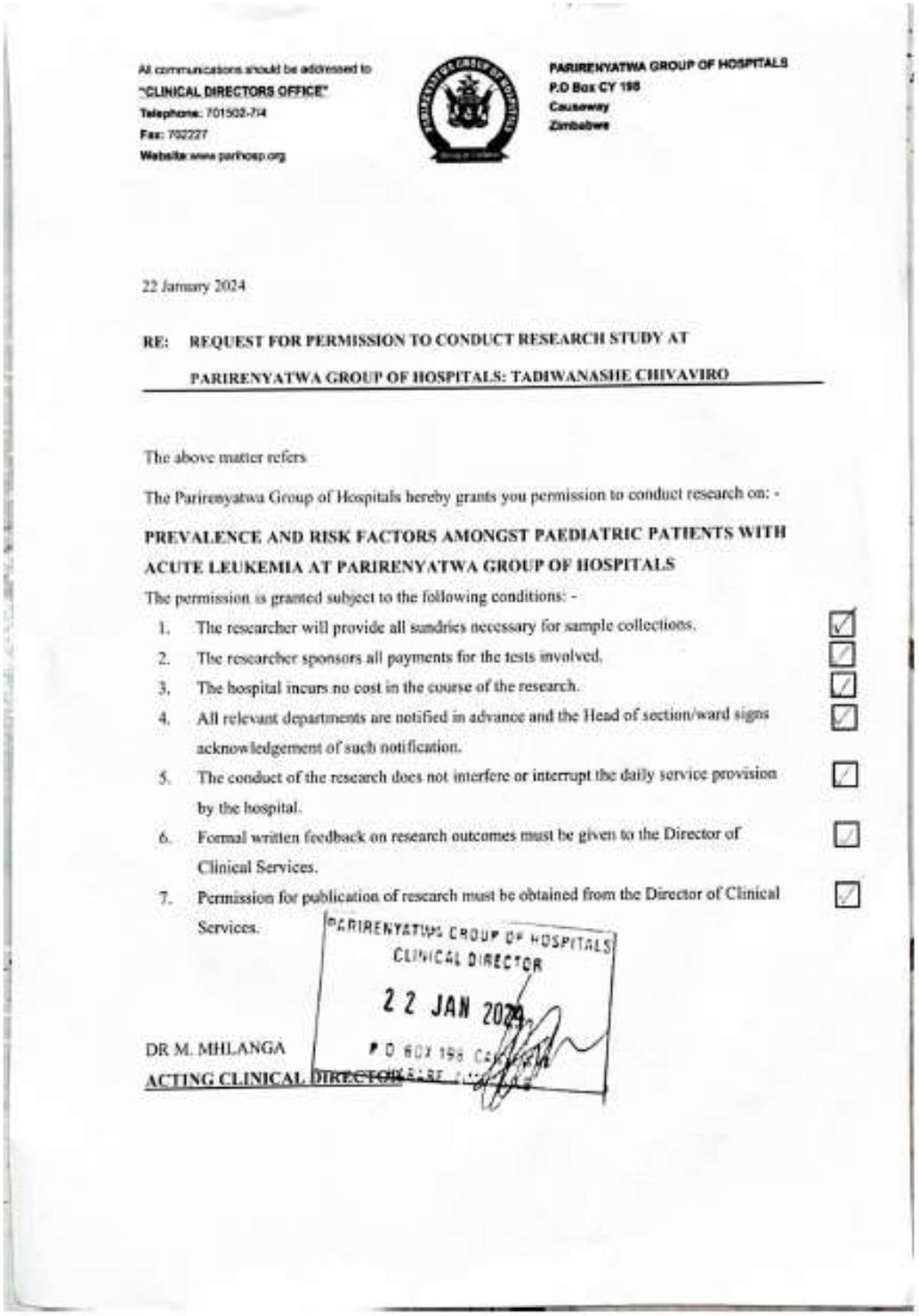
APPENDIX 2: TIMETABLE

DATES(2024) / **ACTIVITIES**	**JANUARY**	**FEBRUARY**	**MARCH**	**APRIL**
DMLS project approval				
JREC approval				
AUREC approval				
Practical work and data collection				
Data analysis				
Project writing				
Project submission				

APPENDIX 3: DATA COLLECTION TABLE

VARIABLE	**DESCRIPTION**	**DATA COLLECTION METHOD**	**DATA SOURCE**
Demographic information	Age, gender, ethnicity and socioeconomic status of parents	Medical Records	Hospital Records
Clinical information	Symptoms, physical examination findings, laboratory results (from haematology department)	Medical Records	Hospital Records
Leukemia Subtype	Acute lymphoblastic leukemia (ALL) OR Acute myeloid leukemia (AML)	Medical Records	Hospital Records
Exposure to environmental toxins	Exposure to radiation chemicals, and other potential environmental risk factors	Medical Records	Hospital Records
Treatment Information	Type of treatment received(chemotherapy, radiation therapy, or bone marrow transplantation) during treatment and response to treatment	Medical Records	Hospital Records
Lifestyle Factors	Smoking, alcohol consumption and dietary habits	Medical records	Hospital Records
Family History	Family history of leukemia or other cancers and genetic mutations	Medical records	Hospital Records

APPENDIX 4: APPROVAL LETTER FROM SITE OF STUDY



All communications should be addressed to
"CLINICAL DIRECTORS OFFICE"
Telephone: 701502-714
Fax: 702227
Website: www.parihosp.org

PARIRENYATWA GROUP OF HOSPITALS
P.O Box CY 198
Causeway
Zimbabwe

22 January 2024

RE: REQUEST FOR PERMISSION TO CONDUCT RESEARCH STUDY AT PARIRENYATWA GROUP OF HOSPITALS: TADIWANASHE CHIVAVIRO

The above matter refers

The Parirenyatwa Group of Hospitals hereby grants you permission to conduct research on: -

PREVALENCE AND RISK FACTORS AMONGST PAEDIATRIC PATIENTS WITH ACUTE LEUKEMIA AT PARIRENYATWA GROUP OF HOSPITALS

The permission is granted subject to the following conditions: -

1. The researcher will provide all sundries necessary for sample collections. ☑
2. The researcher sponsors all payments for the tests involved. ☑
3. The hospital incurs no cost in the course of the research. ☑
4. All relevant departments are notified in advance and the Head of section/ward signs acknowledgement of such notification. ☑
5. The conduct of the research does not interfere or interrupt the daily service provision by the hospital. ☑
6. Formal written feedback on research outcomes must be given to the Director of Clinical Services. ☑
7. Permission for publication of research must be obtained from the Director of Clinical Services. ☑

PARIRENYATWA GROUP OF HOSPITALS
CLINICAL DIRECTOR
22 JAN 2024
P O BOX 198 CAUSEWAY

DR M. MHLANGA
ACTING CLINICAL DIRECTOR

APPENDIX 5: APPROVAL LETTER FROM SUPERVISOR

Investing in Africa's Future

COLLEGE OF HEALTH, AGRICULTURE AND NATURAL SCIENCES

P.O. BOX 1320, MUTARE, ZIMBABWE – Cell: (+263) 780079459 E
MAIL: salissoum@africau.edu,

03, March, 2024

To whom it my concern

Dear Sir

Re: Permission to submit to AUREC for TADIWANASHE CHIVAVIRO

Program: Bachelor of medical laboratory sciences

This letter serves to confirm that I have supervised the above mentioned student and she has satisfied all the requirements of the college and she is ready in conducting research on

PREVALENCE AND RISK FACTORS OF ACUTE LEUKEMIA AMONG PAEDIATRIC PATIENTS AT PARIRENYATWA GROUP OF HOSPITALS

Your facilitation is greatly appreciated

Thank you

Research Supervisor:
Dr Maibouge T.M.Salissou PhD
Endowed Chair of Pathology CHANS Africa University
Phone 0780079459
Email: salissoum@africau.edu
Website: Maibouge T. M. Salissou – Africa University
Po Box 1320

APPENDIX 6: AUREC APPROVAL LETTER

Investing in Africa's future

AFRICA UNIVERSITY RESEARCH ETHICS COMMITTEE (AUREC)

P.O. Box 1320 Mutare, Zimbabwe, Off Nyanga Road, Old Mutare-Tel (+263-20) 60075/60026/61611 Fax: (+263 20) 61785 Website: www.africau.edu

Ref: AU3209/24

21 March, 2024

TADIWANASHE CHIVAVIRO
C/O Africa University
Box 1320
MUTARE

RE: PREVALENCE AND RISK FACTORS OF ACUTE LEUKEMIA AMONG PAEDIATRIC PATIENTS AT PARIRENYATWA GROUP OF HOSPITALS

Thank you for the above-titled proposal that you submitted to the Africa University Research Ethics Committee for review. Please be advised that AUREC has reviewed and approved your application to conduct the above research.

The approval is based on the following.

a) Research proposal

- **APPROVAL NUMBER** AUREC3209/24
  This number should be used on all correspondences, consent forms, and appropriate documents.
- **AUREC MEETING DATE** NA
- **APPROVAL DATE** March 21, 2024
- **EXPIRATION DATE** March 21, 2025
- **TYPE OF MEETING**: Expedited
  After the expiration date, this research may only continue upon renewal. A progress report on a standard AUREC form should be submitted a month before the expiration date for renewal purposes.
- **SERIOUS ADVERSE EVENTS** All serious problems concerning subject safety must be reported to AUREC within 3 working days on the standard AUREC form.
- **MODIFICATIONS** Prior AUREC approval is required before implementing any changes in the proposal (including changes in the consent documents)
- **TERMINATION OF STUDY** Upon termination of the study a report has to be submitted to AUREC.

AFRICA UNIVERSITY RESEARCH ETHICS COMMITTEE (AUREC) APPROVED P.O. BOX 1320, MUTARE, ZIMBABWE

Yours Faithfully

MARY CHINZOU
ASSISTANT RESEARCH OFFICER: FOR CHAIRPERSON
AFRICA UNIVERSITY RESEARCH ETHICS COMMITTEE