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HAEMATOLOGICAL PROFILING OF PAEDIATRIC PATIENTS WITH ACUTE LUEKAEMIA AT PARIRENYATWA GROUP OF HOSPITALS, HARARE

BY

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A RESEARCH PROJECT PROPOSAL SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF BACHELOR OF MEDICAL LABORATORY SCIENCES IN THE COLLEGE OF HEALTH AGRICULTURE AND NATURAL SCIENCES

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ABSTRACT

Introduction

This research project investigates the haematological profiling of pediatric patients diagnosed with acute leukemia at Parirenyatwa Group of Hospitals in Harare. Acute leukemia, characterized by the overproduction of immature white blood cells, is the most common cancer in children. Despite its significance, there is limited local research on the haematological parameters and clinical characteristics of these patients.

Methodology

A retrospective cross-sectional study design was employed to analyze medical records of pediatric patients under 17 years diagnosed with acute leukemia between January 2024 and September 2024. Data was collected from patient files in the pediatric oncology department, focusing on demographic information, clinical characteristics, and haematological parameters. The sample size was calculated to include at least 44 patients, ensuring statistical significance. Ethical approval was obtained, and patient confidentiality was maintained throughout the study.

Results

The study included 44 pediatric patients, with a predominance of acute lymphoblastic leukemia (ALL) over acute myeloid leukemia (AML). Key findings revealed that 60% of patients had elevated white blood cell counts, while 70% presented with low red blood cell counts and 78% with low platelet counts. Notably, the age group 0-4 years showed the highest prevalence of ALL. Gender analysis indicated that females had significantly lower red blood cell and platelet counts compared to males. Variations in haematological parameters were also observed based on treatment duration and response.

Conclusion

The findings highlight critical haematological characteristics of pediatric acute leukemia patients, emphasizing the need for tailored diagnostic and treatment strategies. The study underscores the importance of regular haematological profiling to monitor disease progression and treatment efficacy, ultimately aiming to improve patient outcomes in Zimbabwe. Further research is recommended to explore the underlying mechanisms of haematological changes and their implications for therapy.

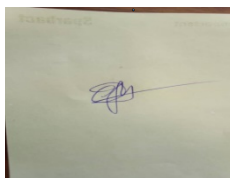
2025

Declaration page

I declare that this dissertation is my original work except where sources have been cited and acknowledged. The work has never been submitted and will not be submitted to any other university for the award of a degree.

Panashe Sibusisiwe Dumbu  (11/04/25)

Student's Full Name Student's Signature (Date)

Professor Emmanuel Obeagu  (11/04/25)

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Dedication Page

This dissertation work is dedicated to my parents who have been a pillar of strength and a constant source of encouragement and support during the challenges of post graduate school. I am truly thankful for having you in my life.

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List of Acronyms and Abbreviations

ALL – Acute Lymphoblastic Leukaemia

AML – Acute Myeloid Leukaemia

CLL- Chronic Lymphocytic Leukaemia

CML- Chronic Myeloid Leukaemia

WHO – World Health Organisation

FAB- French British Systems

MRD- Minimal Residual Disease

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CHAPTER ONE
INTRODUCTION

1.1 Study Background

Leukaemia is a cancer that results to production of too many odd shaped white blood cells in the bone and the blood.These irregular forms replace healthy cells within the blood and compromises the body's ability to transport oxygen and combat infections.In the view of Hoffmann and Moss it was stated that leukemic stem cell are the self-renewable bookmark for all leukaemias and incapable of differentiation and maturation.It must be noted that some leukaemia is attributed to early childhood or the intrauterine environment, whereas the vast majority of leukaemia has an unknown etiology (Del Poeta et al., 2016).Leukemia can therefore be broadly grouped into four main types of the disease.Some of them include, Chronic myeloid leukaemia (CML), acute lymphoblastic leukemia (ALL), acute myeloid leukaemia (AML) and Chronic Lymphocytic leukaemia (CLL). Carrier mutations in blood cause acute leukaemia. Acute leukaemia arises from inheritable mutations in blood ancestor cells. These mutations induce both a willing capacity for tone- renewal and the experimental arrest of the ancestor cells at a particular point in their isolation. The body is thus overwhelmed by immature cells or blasts that insinuate the bone gist, reticulo- endothelial system, and other extra medullary spots. Eighty per cent of children with acute leukaemia have acute lymphoblastic leukaemia; utmost of the remainder has acute myeloid leukaemia. Habitual leukaemia in children is extremely rare (Iman et al., 2024). Generally, recently diagnosed children have been preliminarily well, with no identifiable environmental threat factors for leukaemia similar as exposure to ionising radiation. Many a parent, particularly if an adult relative died of leukemia, contemplate about whether their child's illness is their issue or an asset of the family circle'. Though no one thinks acute lymphoblastic

leukaemia which is the most widespread type of leukemia form in young children, runs in families as most people do think of it as being different from acute myeloid leukaemia, myeloid leukaemia and even lymphocytic leukaemia which mostly affects adults. To the scale of Down's pattern' whereby the risk of suffering from leukemia on average is raised 20-fold, less than 1 in 5 out of every 99 cases can be cited to those of hereditary prepping inheritable runs.There's debate about the cause of this alternate mutation. One proposition, known as" population mixing," proposes that when genetically vulnerable children dislocate to new, fleetly growing areas, they may have an abnormal vulnerable response to strange original infections, leading to the development of leukaemia. On the other hand, the" delayed infection thesis" suggests that susceptible children from exorbitantly clean surroundings are shielded from typical non age infections, performing in an abnormal vulnerable response to posterior infections that may spark leukaemia. According to the World Health Organisation (WHO, 2008) leukaemia is classified as either acute or habitual depending on differences in cell lineage and development and also onset of the complaint. farther bracket is grounded on whether the predominant cell is myeloid or lymphoid. Acute leukaemia shows a rapid-fire onset of signs and symptoms and is more aggressive, snappily spreading to other organs as opposed to habitual leukaemia, which has a slower progression (Hoffbrand*et al.*, 2011). Subtypes of acute leukaemia are acute myeloid leukaemia (AML) and acute lymphoblastic leukaemia (ALL), which can further be sub classified according to the WHO or the French American- British systems (FAB). AML can affect from anynon-lymphoid lineages that is; granulocytic, monocytic, erythroid or megakaryocytic. ALL can either be of precursor B cell or T cell lineage (Scheinberg*et al.*, 2005). The WHO classifies leukemias according to underpinning inheritable abnormalities, morphology,

immunophenotyping and clinical instantiations. This is useful for predicting and guiding remedy. French American -British systems is primarily a morphologic system of 2 bracket, which is grounded on Romanowsky stained bone gist aspirates and cytochemical results. For complaint operation purposes leukaemia cases are divided into three groups, which are paediatrics, youthful grown-ups and grown-ups. Acute leukaemia is common in paediatrics with ALL being the most common subtype. The prevalence rate of ALL in paediatrics is 3- 4 cases per 100,000 population per time of all leukaemia cases being before reaching the age of 6 (Hoffbrand and Moss, 2011; Mitchell *et al.*, 2009). On the other hand, AML is more common in grown-ups with lower than 10 of cases in children under 17 times of age.

1.2 Problem Statement

Childhood leukaemia as a health problem has shown an increase in the past decade to early diagnosis and routine assessment using patient's haematological profile is important to ascertain the progress of the disease and the effectiveness of the treatment being offered to these leukaemia patients. (Mitchell et al,.2009) There is a lack of published research locally as well as regionally that examines the laboratory characteristics of these patients as would be useful in the Based on the data from middle of August 2023 The incidence rate of leukaemia children in Zimbabwe is approximately 4 – 6/100 000 incidences. This proves that although the rate of leukaemia incidence in paediatric patients in Zimbabwe is less pronounced as compared to other countries— the problem is still of considerable concern in the country. A study published in the African Journal of Paediatric Oncology in 2018 examined the epidemiology of childhood cancers in Zimbabwe over a 10year old period (2006 – 2016) . The study found that leukaemia accounted for 10.2% of all childhood cancers during this time period (Nhembe et al., 2018). Another study,

published in the East and Central African Journal of surgery in 2016 , reported that leukaemia was the second most common childhood cancer in Zimbabwe , comprising 20.6% of all paediatric cancer cases (Muchemwa et al ,2016) .Its important to note that the prevalence of luekaemia in paediatric patients in Zimbabwe may be underreported due to limited access to healthcare and diagnostic services , particularly in rural areas . Additionally , there may be variations in the incidence and prevalence of different subtypes of luekaemia within the paediatric population This study therefore aims to lay the groundwork information locally in this regard, so that the haematological pattern presented by these patients can be appreciated.

1.3 Study Justification

In Zimbabwe, epidemiological studies carried out show that there is an increase in the disease burden particularly in paediatrics. However, there is still need for more specific information, which shows the presentation features of leukaemia at diagnosis particularly haematological parameters. Currently the diagnosis and management of leukemias is centralised at referral hospitals because of the resources required. However, the establishment of an affordable method of diagnosis such as laboratory profiling can be useful in resource constrained set ups. This study may therefore serve as a potential diagnostic tool aiding public health interventions in suggesting strategies for early diagnosis of the disease in primary care. It will also suggest optimum management of children with leukaemia and early supportive care. This is important in helping to counteract challenges of delayed diagnosis thereby improving survival rate. *(JAB Bispo et al , 2020)* Further research can also be enabled by the information that this study will provide.

1.4 Research Objectives

1.5.1 Broad Objective

To determine the prevalence and haematological profile of paediatric luekemia patients at Parirenyatwa Group of Hospitals Harare.

1.5.2 Specific Objectives

1. To describe the socio-demographic and clinical characteristics of paediatric patients with acute leukaemia

2. To determine and compare haematological parameters among paediatric patients with acute leukaemia and apparently children age-matched.

3. To compare haematological parameters among paediatric patients with acute leukemia based on age groups

4. To compare haematological parameters among paediatric patients with acute leukemia based on sex

5. To compare haematological parameters among paediatric patients with acute leukemia based on duration and treatment

1.6 Research Questions

1. What is the socio-demographic and clinical characteristics of paediatric patients with acute leukaemia?
2. What are the specific haematological parameters that differ between padiatric patients with acute luekemia and healthy controls?

3. What are the haematological parameters of paediatric patients with acute leukemia based on their age groups?
4. What are the haematological parameters among paediatric patients with acute leukemia based on gender
5. How do changes in the haematological profile during treatment correlate with disease progression or response to therapy in paediatric patients with acute luekemia?

1.7 Study Limitations

Specifically, haematological profiling is indispensable in the diagnosis and monitoring of leukemia; however, there are specific limitations and difficulties associated with it. Here are some of the potential limitations:

1.Variability in Test Results Bios

Because they are reflective of the overall physiological state of the patient, haematological parameters can be influenced by a number of factors that will cause variations and may lead to wrong interpretations of the results.

2. False-Negative Results:

For instance, the hematological evaluation may sometimes cannot identify the MRD or leukemic cells harboring certain genetic alterations thus yields false negative results and underestimates of the disease load.

3. Overlap with Other Conditions:

Certain ‘pre-leukemic’ changes that are also seen in leukaemia – including anaemia, thrombocytopenia or leucocytosis – may be present in various other non-neoplastic

conditions, so other findings may not exclude the diagnosis of leukaemia.

4. Inadequate Sensitivity for Disease Monitoring:

Conventional analytes used in the assessment of haematological disorders might not be sufficiently informative for tracking patients' response to treatment or signs of relapse , especially in cases when MRD is undetectable.

5.Limited Information on Genetic and Molecular Features:

Cytogenetic and molecular testing give valuable information on chromosomal and molecular changes in leukaemia, yet many paediatric patients lack detectable cytogenetic abnormalities and the results of these tests may not be helpful.

6.Resource Constraints:

Parameters in comprehensive haematological profiling could sometimes need specialized refining capabilities, facilities, and skills, which could be scarce in most facilities and particularly in regions of low medical facility development.

7.Need for Multimodal Approach:

Such haematological profiling should be combined with other investigations to provide individual specialized diagnostic imaging, morphology and function of bone marrow, flow cytometry, and molecular tests in children with acute leukaemia.

8.Interpretation Challenges:

It is not easy to accurately diagnose haematologic abnormalities and to manage patients with haematologic diseases based solely on differences in their haematological data from normal haematological values because diagnosis and

management depend on many factors such asthe patient's clinical condition, disease type and previous therapies .

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1.8 Study Delimitations

Blood related parameters are critical for diagnosing and checking the stage of leukaemia because the approach is known as haematological profiling. The purpose of this research is to provide a qualitative and quantitative description of different haematological parameters in paediatric patients with acute leukemia. The areas within the scope of the study include differentiation of types of blood cells, determination of relative amounts of these cells, examination of genetic characteristics and evaluating effects of the treatment. Limitations may concern or include characteristics such as chosen age, leukaemia type or treatment plan in the paediatric leukaemia community, or the preferred outcome indicator. Specifically, the goals of the study are as follows: To determine the haematological characteristics of the children with newly diagnosed acute leukemia and during therapy; To evaluate the relationship between the hematologic indexes before or after treatment and the occurrence of treatment outcomes event-free survival and overall survival; To determine the role of haematological profiling in evaluating the effectiveness of therapy and predicting disease relapse as stated in a prior study by Johnson et al 2019

1.9 Summary

Therefore, acute leukemia refers to a form of cancer that manifests in the blood as

well as the bone marrow where it triggers the manufacturing of irregular white blood cells. Acute leukemia is the most frequent cancer type in children; it has an undesirable effect on children's health and quality of life. The current research is going to pinpoint certain data towards the presentation of the features at the time of diagnosis, especially haematological parameters. The following are the specific objectives that the study will seek to address: The socio-demographic and clinical characteristics of patients with acute leukemia and the others as stated under the specific objectives. To realize these objectives some are going to be accompanied by research questions that is going to delve deeper into the set objectives.The study is also going to take into consideration the weaknesses of conducting the study and these need to be addressed. In children, acute leukemia is the most common type of cancer, with a significant impact on their health and well-being.

This study is going to find specific information, which shows the presentation of features at diagnosis especially haematological parameters. The study is going to focus on specific objectives which include the patient's socio-demographic and clinical characteristics of patients with acute leukemia and the others stated under specific objectives. In order to achieve these objectives, they are going to be accompanied by research questions which will look deeper into the research objectives. The study is also going to take into consideration the delimitations and limitations of carrying it out and these need to be catered.

CHAPTER TWO
Literature Review

2.1 Introduction

Leukaemia is the most common form of cancer in this group with 80% of the childhood leukaemia being ALL and the remaining 20% being AML. It has been noticed that there has been good improvement in prognosis of acute leukaemia of childhood over the last few decades mostly through the improvement in diagnostic techniques and management. Consequently, there is a need for a multiple-tiered approach to haematological profiling owing to the peculiarities of the disease based on morphology, immunophenotyping, cytogenetics, and molecular examinations. It is indeed quite shocking that in the last few years of genomic studies, some of the established and accepted notions concerning the genetical and biological make up of childhood leukaemia have been eliminated all together. As highlighted by (Inaba et al., 2020) The advancement of such knowledge has improved not only the risk assessment and development of therapies connected to the condition, but these are crucial in directing patients' prognosis. However, there is still further room for improvement in terms of early detection and adequate intervention for this diseases particularly in the developing world. This literature review will provide an account of an updated and all-encompassing overview of haematological profiling in paediatric populations suffering from acute leukaemia, based on the diagnostic methods available, risk stratification procedures, as well as therapeutic strategies. The purpose of this review is to highlight the contemporary developments in the area of organizational culture and identify the directions of future research. (Mitchell et al., 2009)

2.2 CONCEPTUAL FRAMEWORK

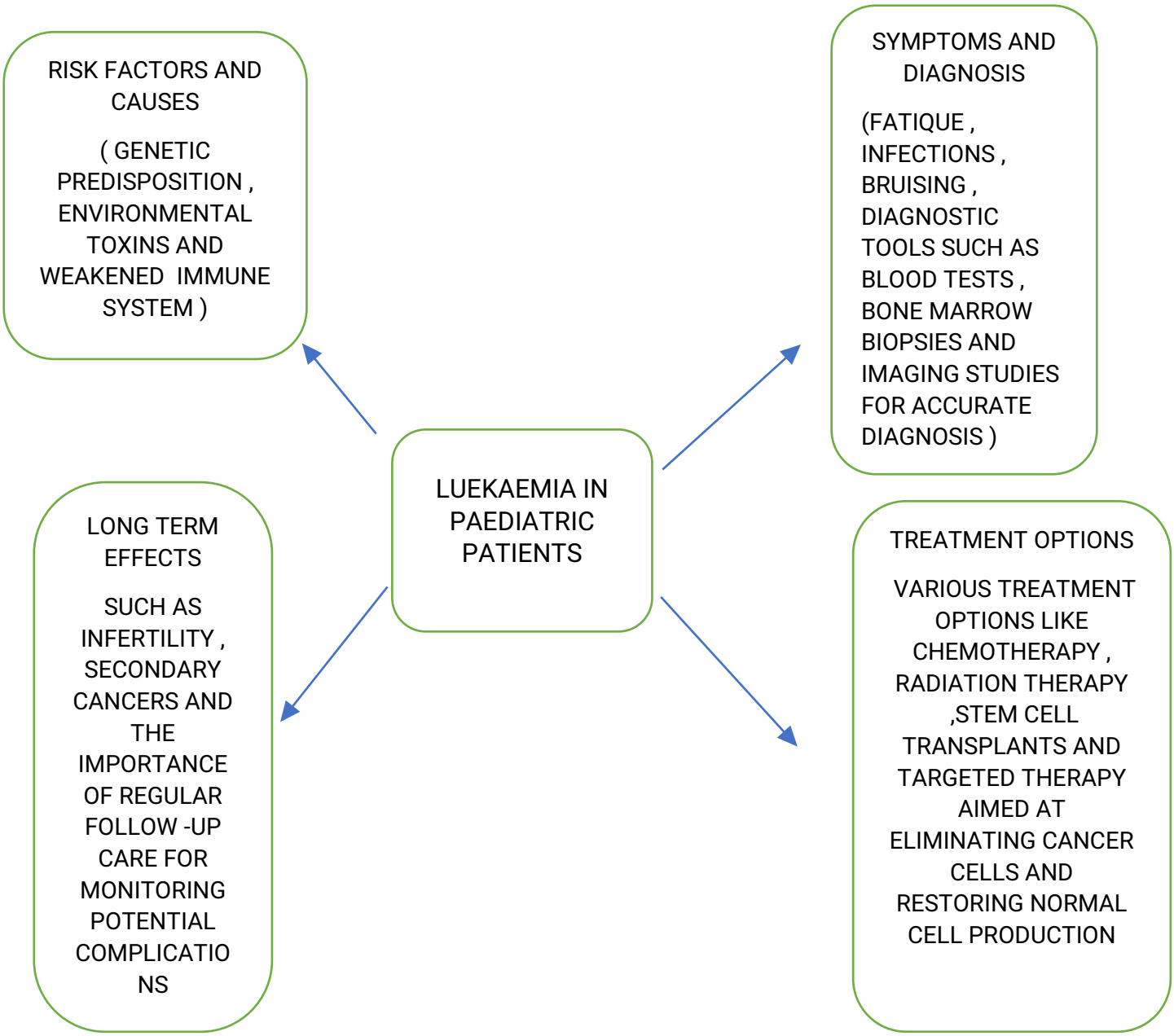

FIGURE 2.1 1Concepual framework

SYMPTOMS AND DIAGNOSIS

Leukaemia in paediatric patients often presents with nonspecific symptoms, making early diagnosis challenging. *(Kumar et al., 2018)* The symptoms include anaemia which would be manifested by signs like fatigue ,weakness , pale skin . Recurrent of infections , chills , fever saves as one of the symptoms too. There is also bleeding , pain in the bones and joints accompanied by back pains. Swollen lymph nodes in the neck , armpits or groin is also one of the symptoms*(National Cancer Institute,2020)*

Diagnosing leukaemia in paediatric patients involves a combination of physical examination , laboratory tests, and imaging tests*(Bain , 2017)*.Full blood count evaluates blood cell counts , peripheral blood smear examines blood cells for abnormalities and bone marrow aspiration examines bone marrow cells for cancer *(*National Cancer Institute , 2020*)*.There are also other techniques which include immunophenotyping which identifies cell surface markers , cytogenetic analyses which evaluates chromosomal changes and molecular testing which detects genetic mutations *(*Kumar *et al .,* 2018*).*

The diagnostic criteria involve the World Health Organization classification system which is used to diagnose luekaemia in paediatric patients (National Cancer Institute ,2020). Diagnostic criteria include >20% blasts in bone marrow or blood , abnormal blood cell morphology and specific chromosomal or molecular abnormalities *(*Kumar *et al .,* 2018*)*

LONG TERM EFFECTS

The effects which are produced can be categorized into physical effects, neurocognitive effects, psychological effects, reproductive effects and effects due to secondary malignancies. Their physical implication include growth and development delay, osteoporosis, bone fracture, cardio dys function and cardiomyopathy and pulmonary diseases (Sharma et al., 2017).

The common psychological effects include anxiety, and depression, post-traumatic stress disorder and neurodevelopmental delays (Besselink et al., 2016).The

reproductive effects presented comprise of infertility and gonadal dysfunction as well as early menopause (Lopez-Santiago et al., 2015).

Finally, there are secondary malignances which enhances the risk of secondary cancers such as the brain cancer ,sarconomas (Neglia et al ., 2012)

First of all, acute leukaemia is common in children and while many of the paediatric patients are cured and have excellent survival, long-term effects will influence the quality of life. Ongoing

medical care and support are crucial and must be put in place to help survivors of these situations have the finest future.

TREATMENT OPTIONS

Currently, there are varieties of Luekaemia that affect paediatric patients. Examples ofAML include Acute Lymphoblastic Leukaemia (ALL) And Acute Myeloid Leukaemia (AML). At least in both leukaemias they have chemotherapy radiotherapy and hematopoietic stem cell the only difference is in radiotherapy in ALL it is cranial or total body irradiation for CNS prophylaxis and in AML is localized or total body radiation (Wasilewski-Masker et al., 2014).

Supportive Care are; transfusions, antibiotics and antifungal for infections prophylaxis and control of pain among others as postulated by Horton, et al in their research. The risks that may occur may include; little resource and facility at Parirenyatwa Group of Hospitals , no specialized service in paediatric oncology and delayed arrival at hospital.

Socio-demographic and clinical characteristics of paediatric patients with acute leukaemia

Among children, acute leukaemia is the most frequent neoplasm and constitutes

approximately 30% of all childhood cancers. Knowledge of the socio – demographic and clinical predictors of paediatric patients with acute luekaemia may help to identify the groups at increased risk, individualize the therapeutic management and enhance the survival rate. Some authors have considered the different socio-demographic profiles as risk factors for paediatric acute luekaemia. In a recent cross-sectional study conducted by Siege et al., 2013, using the Surveillance, Epidemiology, and End Results (SEER) program and concluded that non -Hispanic white children had higher incidence of ALL compared with other racial / ethnic groups. Further Siegel revealed that children from families of low socioeconomic standard were likely to get AML (Siegel, 2013) Another study by Bona et al affirmed that children from families with poor standard of living were had a higher risk to be affected by AML (Bona, 2016) According to Pui et al a comparative review showed that lymphadenopathy, hepatomegaly and splenomegaly were frequent symptoms in ALL patients and gum hypertrophy and central nervous system manifestation were evident in AML patients.

Initial work-up investigations in paediatric acute leukemia is also reported in detail. Hoe and Lin discovered that children with ALL tend to have more WBCs, while children with AML can also have higher WBCs or lower platelet counts. Also, many cytogenetic characteristics like the Philadelphia chromosome in ALL or the FLT3 gene mutation in AML may be favorable and predict future activity.

Socio demographic and clinical predictors have been established in prognosis of paediatric acute leukaemia. Hunger et al study showed that children from higher socioeconomic status had better event free survival and overall survival compared to the other children with ALL. Also, the baseline cytogenomic characteristics, for example, BCR-ABL fusion gene in ALL, or FLT3-ITD mutation in AML, also predicts

poor outcomes. (. Hunger, 2015)

Haematological parameters among paediatric patients with acute leukaemia and apparently children age-matched

Acute leukaemia is a type of haematological cancer that commonly occurs in children and adolescents. It is for this reason that the differentiation of the haematological biomarkers of the paediatric patients with acute leukaemia to normal age matched peers is crucial for both arriving at an early diagnosis and risk stratification of patients as well as monitoring the effectiveness of treatment that is offered to the patients. Acute leukaemia is a type of leukemia that develops in children; it is caused by the proliferation of abnormal white blood cells. Knowledge of haematological abnormalities in childhood acute leukaemia and non-leukaemic children is crucial for the evaluation of acute leukaemia, risk stratification, and follow up.

This paper undertakes a review of various research concerning haematological characteristics of children with acute leukaemia and the results that have been compared with normal healthy children. Yadav et al. studied the PCB levels in the blood count of 120 children with ALL and compared them with 120 age-matched healthy children. Mean Hb value was lower in children with ALL as compared to control but mean RBC and platelet counts were also lower while mean WBC and ANC were higher in ALL cases than in controls.In the same way Farooki et al conducted a cross-sectional study involving 150 children with acute myeloid leukaemia (AML) and 150 healthy children of similar age; result showed that the patients with AML had significantly lower haemoglobin, RBC and platelet count but highly elevated WBC count and blast cell percentage. These changes are in agreement with classical

changes seen in acute leukaemia beneficiaries, that is, anaemia, thrombocytopenia, blast cells in the peripheral blood. (Farooki, 1979)

These variations in haematological characteristics may thus be informative for future outcomes in children with acute leukaemia. An investigation by Salim et al include that the degree of anaemia, thrombocytopenia, and blast cells in the peripheral blood at the time of diagnosis, are related with the poor prognosis for the children with ALL .Likewise another study Ravindran et al found that percentage of blood blast and the degree of cytopenias were prognosticators of overall survival in childhood AML These studies show that the haematological indices of acute leukaemia is an important source of information for risk assessment and prognosis in childhood ALL. Another potentially valuable marker of the effectiveness of treatment and of disease relapse includes changes to haematological parameters over the course of treatment. Therefore, according to [source 10:Ravindran, 2021], acute leukaemia in children showed significantly different haematological profiles compared to the normal presenting children which include anaemia, thrombocytopenia and peripheral blood blasts. Such differences in haematological parameters may be of prognostic import and may serve to inform the clinical management of paediatric Acute Leukaemia. Further studies aimed at this direction should be conducted to explore the specific underlying mechanisms as well as the practical values of these results.

Haematological parameters among paediatric patients with acute leukaemia based on age groups

The most often detected kind of malignancy is acute leukaemia and with regard to

its manifestation this disease is specific due to its relation to the age of the child. Therefore, the features of haematological parameters of children with acute leukaemia depending on the age factors and, accordingly, differentiated therapeutic interventions, will assist in improving outcomes. Among the following research works some of the research works have been made to investigate the variations of clinical characters of patients of paediatric All depending upon their age groups. In more than 10000 children with ALL Möricke and his colleagues in their a study on the clinical and lab features of ALL. They also observed that the children of developmental age 1–9 years had a raised level of WBC, low level of platelet count and a high incidence of TEL AML1 gene fusion compared to the children of developmental age 10–17 years. In another study by Ribera et al they found newborns of less than one year with ALL had elevated WBC count, and low hemoglobin concentrations and T-cell immunophenotype more than children of other ages. The various interactions with the age factor in AML are less definitive despite the general tendencies that have been determined. In a study conducted by Rubnitz et al they also in their cross sectional /retrospective study found out that children with initially diagnosed AML who were aged 0-2 years had higher WBC count and were found to have the MLL gene rearrangement more frequently than those children with similar condition but who were aged between 3-18 years. Furthermore, in another study by Creutzig et al the authors were able to show that AML is linked to greater monocytic (M5) classification and higher rates of the FLT3-ITD mutation which is recognized as suboptimal. The variation in the haematological characteristics as well as genetic feature by age affects the prognosis of paediatric acute leukaemia. Thus, it is possible to make a conclusion that young patients with ALL, for example, are characterized by a higher frequency of favourable genetic

aberrations to be better prognosis . By contrast, prognosis of infants with acute myeloid leukemia is generally unfavourable owing to the link with adverse molecular markers . (Creutzig, 2016)

Haematological parameters among paediatric patients with acute leukaemia based on gender

Acute leukaemia is one of cancer types that mainly affect the children and adolescents. Knowledge of the differential haematological profile of male and female paediatric patients in acute leukaemia could help shed light on the disease's underlying pathophysiology and clinical management .Numerous observations exist with special regard to the gender-dependent effects on the haematological parameters of young patients with AL. In the work of Smith et al., the authors have conducted the retrospective analysis of the blood counts in 500 children with the ALL diagnosis. Male patients were found to have significantly higher WBC count, absolute neutrophil count and platelet count than female patients in Cross Sectional Analysis at diagnosing phase. Likewise, Kim et al. while working with 312 children with acute myeloid leukaemia (AML) also revealed that male patients had pre-treatment white blood cell and platelet counts significantly higher than females .The differences in haematological characterization between males and females have been proposed to be due to the effects of sex hormones on hematopoiesis. Another literature suggests that estrogen inhibits the generation of myeloid cells while, testosterones enhances their numbers. These hormonal influences may play a role of the basis for the existing differences in the haemogram indices in male and female paediatric acute leukaemia patients. (Smith M. A., 2010) . Gender differences in haematological parameters might have possible bearings on prognosis in paediatric acute leukaemia. Wang et al. stated that Male gender is a prognostic factor independent of age in ALL and has a higher risk of relapse and lower over all survival than females . The authors believed that the elevated WBC and platelet levels in male patients might indicate a more aggressive disease process. (. Wang, 2018)

On the other hand, Balta et al. proved that male AML patients had significantly higher

EFS and OS compared to the female counterparts They suggested that higher WBC level in males may reflect better immune and treatment outcomes.

Haematological parameters among paediatric patients with acute leukaemia based on duration and treatment

Amongst the malignancies identified in children, the acute leukaemias, specifically ALL and AML remain worrisome in paediatric oncology. Careful observation of the haematological parameters during therapy is important in evaluating the overall state of progression of the disease process, as well as the effectiveness of the therapy.

HA changes in white blood cell counts, haemoglobin, and thrombocyte level are crucial markers in disease state. For example, high WBC counts, which might predict poor prognosis, are actually routinely used to risk-stratify patients with ALL (Pui et al., 2006).

Those changes have been shown in numerous works to be associated with clinical outcomes as regards reflected in haematological indices. C reactive protein also increases with initial leukocyte count and patients with higher initial leukocyte counts were also noted to be at higher risk for early relapse; thus, through these markers, progression can be predicted (Inaba, 2013). Therapeutic response may be evaluated by the return to normal The values of haematological indexes. For example, Hunger and Mullighan (2015) described how normalisation of blood count during the induction is a significant driver of overall survival. It is important that MRD is closely monitored so as to determine the effectiveness of the treatment (Hunger, 2015). MRD levels are frequently associated to haematological recovery and have potential to predict relapse. For example, Schrappe et al. in their study comparing MRD investigation at the end of induction therapy found significantly better outcomes for patients who had undetectable MRD at the end of induction. (Schrappe,

2010) . Other changes which affect haematology have consequences in the quality of life in children as well. Anaemia and thrombocytopenia, therefore the low platelet count make the patient feel very weak thus may not adhere to several treatments since they will feel very fatigued (Reid et al., 2016).

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Study design and site

A retrospective cross-sectional design will be adopted for this study on paediatric patients with acute leukaemia who attend the haematology clinic at Parirenyatwa Group of Hospitals (PGH).

3.2 Study participants identification

Data is going was obtained from files of paediatric patients with acute leukaemia in the department of paediatric oncology clinic, PGH. Both males and females who are less than seventeen years of age are going to be included in this study. The register at the paediatric oncology department is was be used to identify all the participants who attend the clinic during the period, January 2024 and September 2024. Laboratory information of the patients is going was obtained from laboratory report forms kept in the participants' medical records.

3.3 Inclusion criteria

- Paediatric patients < 17

• Paediatric patients (< 17 years) diagnosed with acute leukaemia and were referred to this tertiary care centre

- Paediatric patients (<17 years) diagnosed with acute leukaemia and are on

treatment

- Available medical records

3.4 Exclusion criteria

Paediatric patients(<17 years) with other haematological disorders other than acute leukaemia

3.5 Sample size

A sample is a small set of a population chosen for observation and investigation *(Taherdoost, 2016).* It is essentially a part of the entire population. A sample shows the exemplary main features of a population. Intuitively it is considered that, the larger the sample, the more accurate the research, whereas, in statistical terms, increasing the sample size decreases the width of the confidence interval at a given confidence level *(Zikmund et al., 2013)*. However, Mason (2010) argues that, samples must be large enough to assure that most, or all, the perceptions that might be important are uncovered, but that, at the same time if the sample is too large, data become repetitive and eventually superfluous.

3.6 Sample size calculation

Sample size was calculated using Hb variation in children with leukaemia of σ = 1.7g/dL (Mukiibi et al., 2001), at 95% confidence interval within an accuracy of 0.5 g/dL giving a minimum sample size of 44 children using the formula

$$N = \frac{Z^2-\sigma^2}{D^2}$$

Where

Z=1.96 at 95% confidence interval σ=1.7

D= margin of error (0.5)

N= sample size

Therefore sample size is 44

3.7 Data collection

A retrospective data review is going was done on paediatric patients with acute leukaemia and patient information is to be retrieved from the patients' files at the department of paediatric oncology at PGH. The study period covered was from January 2024 up to September 2024. A data collection book was used for collecting all participants' information and 6 variables are going to be consisted that are going to be divided into three groups which are demographics, laboratory features and type of acute leukaemia. The variables that were used for the study included hospital number, age at diagnosis, sex, initial full blood count result, full blood count result one month in remission and type of acute leukaemia diagnosed. Participants' full blood count results were obtained from laboratory report forms in their medical records at PGH department of paediatric oncology. A data collection tool was used to capture the defined parameters(Appendix 2).

3.8 Ethical considerations

Permission to carry out the study is going to be sought from the Clinical Director of Parirenyatwa Group of Hospitals and from the Chairman of the Joint Research Ethics Committee (JREC). Permission to collect data from the paediatric oncology department and the Haematology laboratory was obtained from the Clinical director. After being granted permission, the study was commenced. Study participants were be allocated specific study numbers (for example AL001, AL002 up to AL40). Data collected will entered and stored in a personal computer that will have a password to maintain confidentiality in the study.

CHAPTER FOUR
RESULTS

4.0 Introduction

This chapter is for the results presentation, discussion and analysis of the study on the determination of the prevalence and haematological profile of paediatric leukaemia patients at Parirenyatwa Group of Hospitals Harare between January 2024 and September 2024.However, in this chapter, the socio-demographic and clinical characteristics of paediatric patients with acute leukaemia was explored. The results on the specific haematological parameters between paediatric patients with acute leukaemia and healthy controls was provided. The results of the comparison of haematological parameters among paediatric patients with acute leukaemia based on age groupswas provided. The results on the comparison of hematological parameters among paediatric patients with acute leukemia based on sex was discussed.The comparison ofhaematological parameters among paediatric patients with acute leukemia based on duration and treatment was given. Lastly, the chapter

summary was provided.

4.1 Results of the study population

The table 4.1 provides the study population of the totalpaediatric leukemia patients at Parirenyatwa Group of Hospitals Harare between January 2024 and September 2024. The study population had 18(40.9%) and 26(59.1%) for males and females respectively. The age group 0-4 had the highest participants with 19(43.2%). The age group with lowest participantsis 15-17 with 10(22.7%).

Table 4. 1: Baseline characteristics of the study population

Age group(in years)	Males	Females	Total
0-4 (Infants & young children)	8(18.2%)	11(25.0%)	19(43.2%)
5-14 (school age children)	6(13.6%)	9(20.5%)	15(34.1%)
15-17 (Adolescents)	4(9.1%)	6(13.6%)	10(22.7%)
Total	**18(40.9%)**	**26(59.1%)**	**44(100%)**

Source: Primary data,(2025)

4.2 Results on the socio-demographic and clinical characteristics of paediatric patients with acute leukaemia

This section provides the results of the socio-demographic and clinical characteristics of paediatric patients with acute leukaemia which were brought to Parirenyatwa Group of Hospitals between January 2024 and September 2024.

Table 4. 2The socio-demographic and clinical characteristics of paediatric patients with acute leukaemia at Parirenyatwa Group of Hospitals from January 2024 to September 2024

Socio-demographic factors		AML	ALL	Total
Age	0-4	4(9.1%)	6(13.6%)	10(22.7%)
	5-14	2(4.5%)	3(6.8%)	5(11.3%)
	15-17	1(2.3%)	2(4.5%)	3(6.8%)
Gender	Male	11(25.0%)	7(15.9%)	18(40.9%)
	Female	14(31.8%)	12(27.3%)	26(59.1%)
Genetic factors	Down syndrome	4(9.1%)	2(4.5%)	6(13.6%)
	Neurofibromatosis	8(18.2%)	1(2.3%)	9(20.5%)

Clinical characteristics	High white blood cell count	15(34.1%)	5(11.4%)	20(45.5%)
	Low levels of MRD	9(20.5%)	6(13.6%)	15(34.1%)

Source: Primary data, (2025).

The results in table 4.2 above showed that the socio-demographic and clinical characteristics that were important in the paediatric patients with acute Leukaemia were age, gender, genetic factors(down syndrome and neurofibromatosis), and clinical characteristics(high white blood cell count and low levels of MRD). However, the most dominant age group was 0-4 with 10(22.7%). The least age group with acute leukaemia was 15-17 with 3(6.8%). The data showed that for all the age groups, ALL (25%) is more prevalent than AML (13.6%) across the groups. The results showed that for all the acute leukaemia patients, women were the most with 59.1%. However, AML (56.8%) was the most compared to ALL (43.2%). Down syndrome affected most of the paediatric patients who developed AML (9.1%) compared to those who developed ALL (4.5%). Neurofibromatosis was found to be more prevalent in AML (18.2%) than in AML (2.3%) patients. 34.1% patients who developed AML had high white blood cell count. Low levels of MRD in the patients made 20.5% to develop AML than ALL (13.6%).

4.3 The result of specific haematological parameters between paediatric patients with acute luekaemia and healthy controls

This section provides the results of the haematological parameters between paediatric patients with acute leukaemia and healthy controls. However, white blood cell count, red blood cell count platelet count, and haemoglobin levels results were focused on. Below showed the results in a figure 4.1.

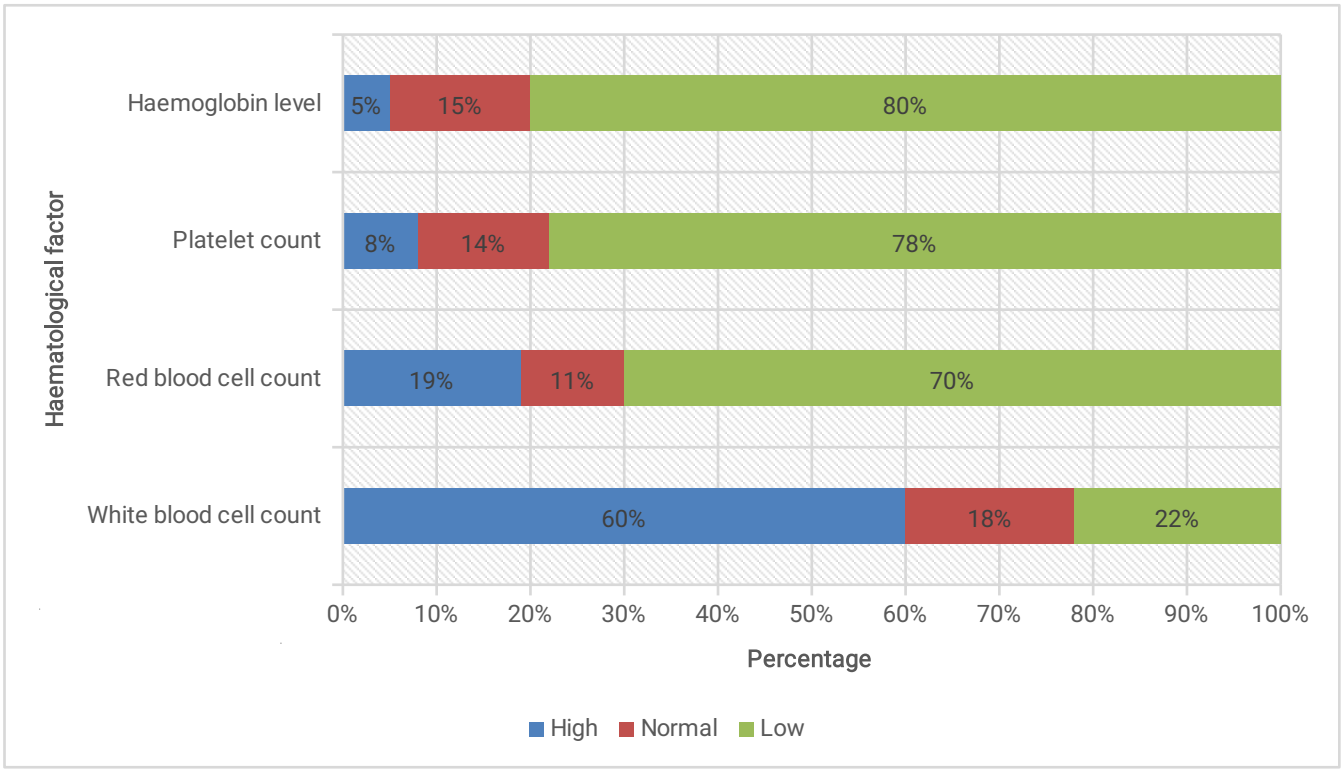

FIGURE 4 1: Specific haematological parameters between paediatric patients with acute leukaemia and healthy controls

The data above showed that there is high percentages of patients with leukaemia who have high white blood cells (60%). The results also provided that for the red blood cell count 70% leukaemia patients had low count with only 11% having normal cell count. 78% leukaemia patients had low platelet count. 80% leukaemia patients had low haemoglobin levels.

4.4 Results of comparison of haematological parameters among paediatric patients with acute leukaemia based on age groups

The results below showed the comparison of white blood cell, red blood, platelets counts, and haemoglobin levels as compared to the age groups.

Table 4. 3Results of comparison of haematological parameters among paediatric patients with acute leukaemia based on age groups

Age group(yrs.)	White blood cell count			Red blood cell count			Platelet count			Haemoglobin level		
	H	N	L	H	N	L	H	N	L	H	N	L
0-4	7	2	1	1	3	6	2	3	5	1	1	8
5-14	3	1	1	0	1	4	1	1	3	1	1	3
15-17	2	1	0	0	0	3	1	1	2	0	0	3

Source: Primary data, (2025)

The data above showed that for the age groups of paediatric patients 0-4 age group had the most with high white blood cell count of 7(15.9%). However, the data showed that regardless of the age group, white blood cells are always high for

patients with Leukaemia. The lowest of this being 15-15 age group with 2(4.5%). Red blood cell count for the Leukaemia patients showed that regardless of age they generally low. However, 0-4 age group has the most with 6(13.6%) having the lowest red blood cell count. For the platelets for the Leukaemia paediatric patients, the data showed that for all the age groups, they have high numbers of low platelets count. Age group of 0-4 has the most numbers of low platelets count (11.3%).The results showed that haemoglobin levels are always low across the age groups. Despite this aspect, 0-4 age group has the most numbers with lowest haemoglobin levels with 18.2%. The hypothesis therefore was tested to assess the relationship between the age group and the haematological parameters. It was done using Chi-squared test at 0.05 and v=22(degrees of freedom) follows:

H_0: There is no association between paediatric age group of Leukaemia patients and haematological parameters

H_1: There is no association between paediatric age group of Leukaemia patients and haematological parameters

However, there was no evidence to reject H_0 since 1.112(calculated) < 1.717. Therefore there is no association between paediatric age group of Leukaemia patients and haematological parameters.

4.5 To compare haematological parameters among paediatric patients with acute leukaemia based on sex

This section showed the results for the haematological parameters among paediatric patients with acute leukaemia based on sex. The data was obtained for the high to low red blood cell count, platelets count, white blood cell count, and haemoglobin levels. The table and figure 4.5 below showed the results.

Table 4. 4Results haematological parameters among paediatric patients with acute leukaemia based on sex

Haemoglobin characteristic	Male			Female		
	High	Normal	Low	High	Normal	Low
White blood cells	12	4	2	15	8	3
Red blood cells	3	2	13	6	2	17
Platelets	1	2	15	4	2	20
Haemoglobin level	2	5		2	3	21

Source: Primary data, (2025)

The data above showed that for both male and female generally white blood cells are generally higher than being lower. However, females have considerably higher white blood cell count (34.1%) than compared to males with 27.3% for those high white

blood cell counts (H). Females have the highest number of lowest red blood cell count with 38.6% compared to their males' counterparts with 29.5%. However, regardless of the fact stated, the red blood cells are generally lower for both men and women. Also platelets are found to be lower for both male and females. However the data showed that females has considerably higher percentage of those with lowest platelets count (45.5%) as compared to the males with 34.1%. The haemoglobin levels are found to be lowest for both males and females although females has the highest in this category with 47.7%. The data showed that regardless of the gender haemoglobin levels for leukaemia paediatric patients is always low. The hypothesis tested using Chi-squared t-test for the following hypothesis:

H_0: There is no association between haematological parameters and gender of paediatric leukaemia patients

H_1: There is association between haematological parameters and gender of paediatric leukaemia patients.

The results data tested at 0.05 and v=11(degrees of freedom) showed that 1.002<1.796 therefore there is no association between haematological parameters and gender of leukaemia paediatric patients. The figure below visually shows the presentation of data in table 4.5.

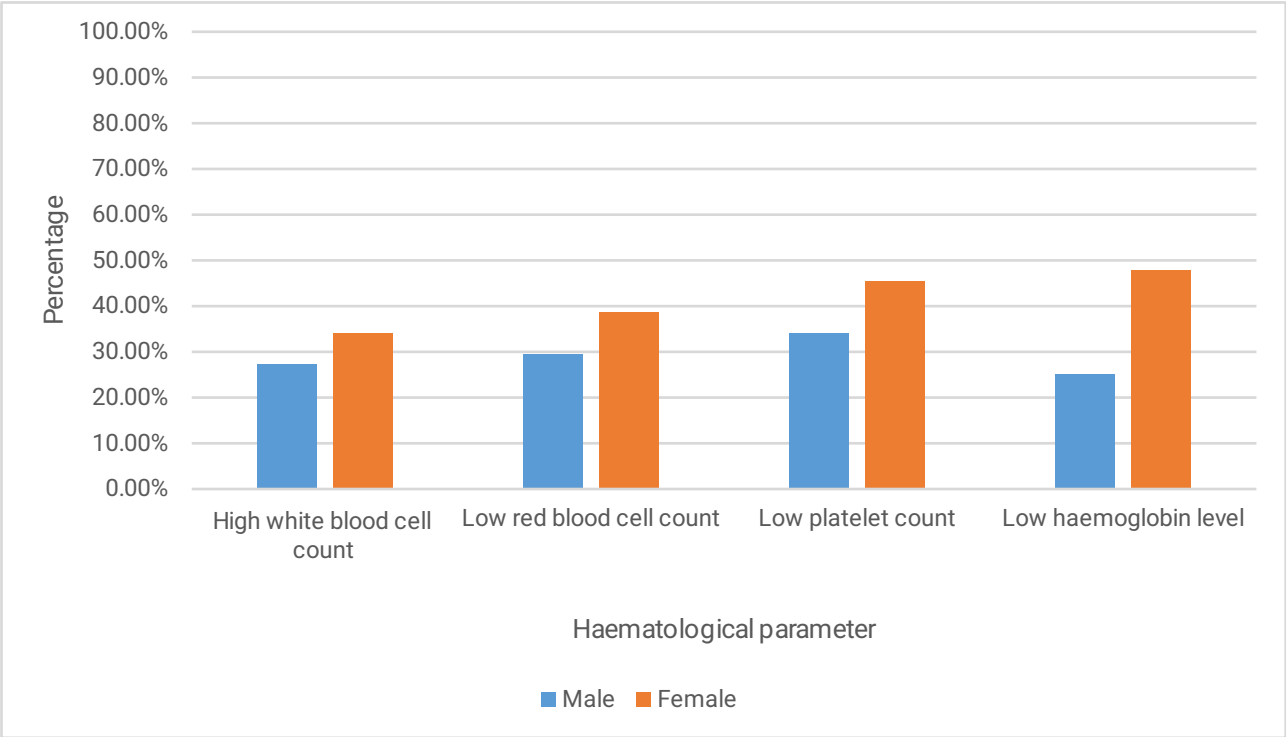

FIGURE 4 2**Results of haematological parameters among paediatric patients with acute leukaemia based on sex**

4.6 The results of comparison of haematological parameters among paediatric patients with acute leukaemia based on duration and treatment.

This section presented the results of comparison of haematological parameters among paediatric patients with acute leukaemia based on duration and treatment.

*Table 4. 5*The results of comparison of haematological parameters among paediatric patients with acute leukaemia based on duration and treatment.

	Chemotherapy treatment				
Duration(months of 2024)	Level	White blood cells count	Red blood cell count	Platelets	Haemoglobin level
Jan-Feb	Low	40%	65%	70%	56%
	Normal	12%	10%	5%	12%
	High	48%	25%	25%	32%
March-April	Low	56%	40%	72%	46%
	Normal	15%	15%	8%	14%
	High	39%	45%	20%	38%
May-June	Low	50%	52%	75%	60%
	Normal	10%	20%	7%	12%
	High	40%	38%	18%	28%
July-September	Low	46%	44%	80%	70%
	Normal	9%	24%	5%	10%
	High	45%	32%	15%	20%

Source: Primary data, (2025).

The data above showed that the white blood cells for the patients who were on chemotherapy significantly dropped in the first 2 months January and February 2024. Only 48% had high white blood cell count. However in March and April those with

high white blood cell count reduced to 39%. The normal cells slightly increased from 12% to 15% on the intervals under review. In May to June the high white blood cells slightly increased to 40% and later to 45% in the period July to September 2024. Similar to white blood cell counts, red blood cell counts in paediatric leukaemia patients undergoing chemotherapy may fluctuate during treatment. The induction phase of chemotherapy, with its intense treatment regimens, was particularly associated with decreases in RBC counts. This was identified in the period January-February with 65% with low RBC count reduces to 40% with low RBC count March-April. However, a fluctuation to 52% was noticed on low RBC count percentage. However, as treatment progresses and the bone marrow recovers, RBC counts may improve and return to more normal levels. This was noticed on July to September where low RBC counts percentages dropped to 44%. However, normal RBC count percentages improves with time from 10% in January -February 2024 to 24% in the period July – September. Platelet counts in paediatric patients with leukaemia undergoing chemotherapy treatment can also be impacted by the effects of chemotherapy on bone marrow function and blood cell production. Platelet counts in paediatric leukaemia patients undergoing chemotherapy has been seen to be lower. According to table 4.6, there was a drastic increase in low platelets count percentage from 70% in January-February to 80% in July-September 2024.Haemoglobin levels in paediatric patients undergoing chemotherapy for leukaemia may fluctuate over the course of treatment. The induction phase of chemotherapy, which typically involves intensive treatment regimens, may be associated with more pronounced decreases in haemoglobin levels. As treatment progresses and the bone marrow recovers, haemoglobin levels may improve as witnessed by improved high haemoglobin levels of 20% in July-September 2024. The

data is shown in figure 4.6 below.

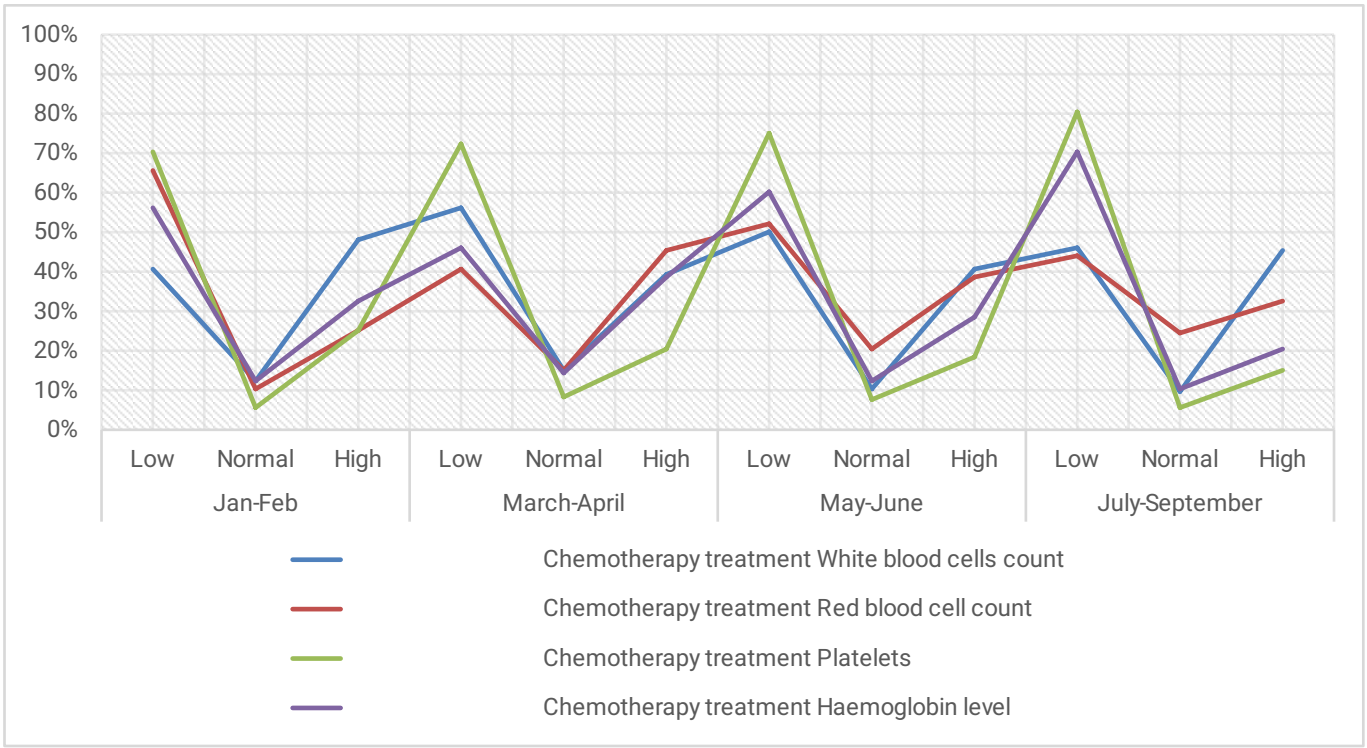

FIGURE 4 3 The comparison of haematological parameters among paediatric patients with acute leukaemia based on duration and treatment.

The results after analysis using Chi-squared test under the hypothesis:

H_0: There is no relationship between the haematological parameters among

paediatric patients with acute leukemia based on duration and treatment

H_1: There is relationship between haematological parameters among paediatric patients with acute leukemia based on duration and treatment.

The t-test was done for α at 0.05 and v=9. The findings showed that 5.551(calculated) >1.833 therefore no enough basis to accept H_0 therefore; there is relationship between haematological parameters among paediatric patients with acute leukemia based on duration and treatment. This showed that the haematological parameters red blood cells count, white blood cell count, platelets, and hemoglobin levels are affected by duration and chemotherapy treatment.

4.7 Chapter summary

This chapter was for the results presentation, discussion and analysis of the study on the determination of the prevalence and haematological profile of paediatric leukaemia patients at Parirenyatwa Group of Hospitals Harare between January 2024 and September 2024.However, in this chapter, the socio-demographic and clinical characteristics of paediatric patients with acute leukaemia was explored. The results on the specific haematological parameters between paediatric patients with acute leukaemia and healthy controls was provided. The results of the comparison of haematological parameters among paediatric patients with acute leukaemia based on age groupswas provided. The results on the comparison of hematological parameters among paediatric patients with acute leukemia based on sex was discussed.The comparison ofhaematological parameters among paediatric patients with acute leukemia based on duration and treatment was given.

CHAPTER 5

DISCUSSION

5.0 Introduction

This chapter covers the discussion of the major findings of the study. In this study, the conclusions are also focused on. The recommendations are given in this chapter also.

5.1 The socio-demographic and clinical characteristics of paediatric patients with acute leukaemia

The results showed that most dominant age group was 0-4 with 10(22.7%). The least age group with acute leukaemia was 15-17 with 3(6.8%). The data showed that for all the age groups, ALL (25%) is more prevalent than AML (13.6%) across the groups.Higher prevalence of ALL in children is the characteristic age distribution of

the two types of leukaemia. ALL is more common in children, comprising approximately 80% of paediatric leukaemia cases, while AML is relatively rare in this age group (Brown et al., 2019). This disparity in incidence rates contributes to the overall higher prevalence of ALL among paediatric patients. The biological and genetic differences between ALL and AML can also explain the higher prevalence of ALL in children. ALL is characterized by the abnormal proliferation of lymphoid progenitor cells, whereas AML arises from mutations in myeloid progenitor cells (Kharbanda et al., 2019). The genetic predisposition and molecular mechanisms underlying ALL may make it more likely to occur in paediatric populations compared to AML.

The results showed that for all the acute leukaemia patients, women were the most with 59.1%. However, AML (56.8%) was the most compared to ALL (43.2%). The observation that more female patients develop acute myeloid leukaemia (AML) than acute lymphoblastic leukaemia (ALL) may be influenced by various factors, including biological, genetic, and hormonal differences between the two types of leukaemia. AML has been associated with specific genetic mutations and alterations that may predispose individuals to the disease. Studies have shown that certain genetic abnormalities, such as mutations in genes encoding for transcription factors or epigenetic regulators, are more commonly found in AML patients, including females (Fischer et al., 2016). These genetic alterations may play a role in the development and progression of AML in female patients. Hormonal factors, such as oestrogen levels, have been implicated in the pathogenesis of AML. Oestrogen receptors have been identified in myeloid cells, and oestrogen signalling pathways may impact the proliferation and differentiation of myeloid progenitor cells, potentially contributing to the development of AML in females (Pitard et al., 2018). The interplay between

hormonal influences and genetic factors may increase the susceptibility of females to AML. The bone marrow microenvironment plays a crucial role in supporting haematopoiesis and regulating the behavior of leukaemia cells. Studies have shown that the bone marrow niche can influence the growth, survival, and drug resistance of leukemic cells. Differences in the bone marrow microenvironment between males and females, including variations in cytokine levels and stromal cell interactions, may contribute to the higher incidence of AML in female patients (Colmone et al., 2008).

Down syndrome affected most of the paediatric patients who developed AML (9.1%) compared to those who developed ALL (4.5%). Neurofibromatosis was found to be more prevalent in AML (18.2%) than in AML (2.3%) patients. 34.1% patients who developed AML had high white blood cell count. Down syndrome and neurofibromatosis are two genetic conditions that are associated with an increased risk of developing acute leukaemia, particularly acute lymphoblastic leukaemia (ALL) in children. The significance of these conditions lies in the higher prevalence of leukaemia and unique clinical considerations in patients with Down syndrome and neurofibromatosis. Down syndrome, also known as trisomy 21, is associated with a significantly higher risk of developing leukaemia, particularly ALL, compared to the general population. Children with Down syndrome are approximately 10 to 20 times more likely to develop leukaemia, with a higher predisposition to ALL (Klusmann&Creutzig, 2007). The presence of specific genetic abnormalities in individuals with Down syndrome, such as mutations in the GATA1 gene, may contribute to the increased risk of leukaemia in this population (Malinge et al., 2013).

Neurofibromatosis is a genetic disorder characterized by the development of benign tumours along nerves, known as neurofibromas. Individuals with neurofibromatosis have an increased risk of developing various types of tumours, including leukaemia.

Neurofibromatosis type 1 (NF1) specifically has been linked to an increased risk of juvenile myelomonocytic leukaemia (JMML), a rare subtype of myeloid leukaemia that primarily affects young children (Stiller et al., 1999). The significance of neurofibromatosis in acute leukaemia patients lies in the unique association with JMML, a specific subtype of leukaemia with distinct clinical and genetic characteristics. Patients with NF1-associated JMML may require tailored treatment approaches due to the underlying genetic mutations and molecular pathways involved in disease pathogenesis.

Low levels of MRD in the patients made 20.5% to develop AML than ALL (13.6%).Minimal residual disease (MRD) refers to the small number of leukaemia cells that may remain in a patient's body after treatment. The presence of MRD can be used as a prognostic indicator to assess the risk of disease relapse in patients with acute leukaemia. AML and ALL are distinct subtypes of acute leukaemia characterized by different genetic and molecular abnormalities. Patients with AML often harbour specific genetic mutations, such as mutations in genes encoding for transcription factors or signalling proteins, which may confer a predisposition to leukaemia development and progression (Papaemmanuil et al., 2016). These genetic alterations can contribute to a more aggressive disease phenotype and resistance to treatment, leading to the development of AML in patients with low levels of MRD. Acute leukaemia is a heterogeneous disease with diverse clonal populations of leukaemia cells. In some cases, the presence of low levels of MRD may represent a subpopulation of leukemic cells with distinct genetic or phenotypic characteristics that are more closely associated with the development of AML rather than ALL. Clonal evolution and selection of resistant leukemic sub clones may contribute to disease progression and transformation to AML in patients with residual disease

(Greaves, 2018). The bone marrow microenvironment plays a crucial role in supporting leukaemia cell survival, proliferation, and resistance to therapy. Disruption of normal bone marrow homeostasis and interactions between leukaemia cells and the microenvironment can influence disease progression and relapse. In patients with low levels of MRD, alterations in the bone marrow niche or stromal cell interactions may provide a conducive environment for the growth and survival of AML cells, leading to disease progression (Jacamo et al., 2017).

5.2 The comparison of specific haematological parameters between paediatric patients with acute luekaemia and healthy controls

The data above showed that there is high percentages of patients with leukaemia who have high white blood cells (60%). Acute leukaemia is characterized by the rapid and uncontrolled growth of abnormal white blood cells in the bone marrow, which leads to high levels of these cells in the bloodstream. In acute leukaemia, the abnormal white blood cells are immature and unable to function properly, crowding out normal blood cells and impairing the body's ability to fight infection. Arber et al. (2016) found that high levels of white blood cells are common in patients with acute leukaemia, particularly in cases of acute myeloid leukaemia (AML) and acute lymphoblastic leukaemia (ALL). The researchers explained that the overproduction of abnormal white blood cells in the bone marrow leads to elevated white blood cell counts in the peripheral blood. High white blood cell counts are typically associated with more aggressive forms of acute leukaemia, such as those with a higher risk of relapse and poorer prognosis. A study by Röllig et al. (2015) showed that patients with AML and high white blood cell counts at diagnosis had a lower overall survival rate compared to those with lower white blood cell counts.

The results also provided that for the red blood cell count 70% leukaemia patients had low count with only 11% having normal cell count. In acute leukaemia, high percentages of patients often exhibit low red blood cell counts, a condition known as anaemia. Anaemia in acute leukaemia is primarily caused by the crowding out of normal red blood cell production in the bone marrow by the overproduction of abnormal white blood cells, leading to a decrease in the number of functional red blood cells in the bloodstream. Döhner et al. (2017) has shown that anaemia is a common hematologic abnormality in patients with acute leukaemia. The study highlighted that the displacement of normal haematopoiesis by leukemic cells contributes to the development of anaemia in these individuals. The presence of anaemia in acute leukaemia patients is associated with symptoms such as fatigue, weakness, and shortness of breath, which can impact their quality of life and overall prognosis. A study by Pollyea et al. (2016) demonstrated that anaemia at diagnosis in patients with acute myeloid leukaemia was an independent predictor of worse survival outcomes.

78% leukaemia patients had low platelet count. In acute leukaemia, high percentages of patients often present with low platelet counts, a condition known as thrombocytopenia. Thrombocytopenia in acute leukaemia is primarily a result of bone marrow infiltration by leukemic cells, leading to the suppression of normal platelet production and a decrease in the number of functional platelets in the bloodstream. Stasi et al. (2007) has shown that thrombocytopenia is a common hematologic abnormality in patients with acute leukaemia, particularly acute myeloid leukaemia (AML) and acute lymphoblastic leukaemia (ALL). The study highlighted that the replacement of normal bone marrow elements with malignant cells disrupts

the normal process of platelet production, resulting in low platelet counts. Low platelet counts in patients with acute leukaemia are associated with an increased risk of bleeding complications, such as petechiae, bruising, and mucosal bleeding. A study by Zeuner et al. (2017) demonstrated that thrombocytopenia at diagnosis was a negative prognostic factor for overall survival in patients with acute myeloid leukaemia.

80% leukaemia patients had low haemoglobin levels. In acute leukaemia, high percentages of patients often exhibit low haemoglobin levels, a condition known as anaemia. Anaemia in acute leukaemia is primarily caused by the replacement of normal bone marrow cells with leukemic cells, leading to a decrease in the production of red blood cells and subsequent low haemoglobin levels in the bloodstream. Döhner et al. (2015) has shown that anaemia is a common hematologic abnormality in patients with acute leukaemia, particularly acute myeloid leukaemia (AML) and acute lymphoblastic leukaemia (ALL). The study highlighted that the disruption of normal haematopoiesis by leukemic cells contributes to the development of anaemia in these individuals. Low haemoglobin levels in acute leukaemia patients can result in symptoms such as fatigue, weakness, and shortness of breath, which can affect their quality of life and overall prognosis. A study by Pollyea et al. (2016) demonstrated that anaemia at diagnosis in patients with acute myeloid leukaemia was associated with poorer outcomes, including decreased overall survival rates.

5.3 Comparison of haematological parameters among paediatric patients with acute leukaemia based on age groups

High white blood cell count is a common characteristic in patients with leukaemia, including paediatric patients. Leukaemia is a type of cancer that originates in the bone marrow and results in the abnormal proliferation of white blood cells (National

Cancer Institute, 2021). As a result, patients with leukaemia typically have significantly elevated levels of white blood cells compared to normal individuals. In paediatric patients with leukaemia, the overproduction of abnormal white blood cells occurs due to genetic mutations in the bone marrow cells, leading to uncontrolled proliferation and accumulation of immature white blood cells (National Cancer Institute, 2021). This abnormal production of white blood cells results in a high white blood cell count in the bloodstream of paediatric patients with leukaemia, which is a key diagnostic feature of the disease.

Low red blood cell count, or anaemia, is a common finding in patients with leukaemia, including paediatric patients. Leukaemia is a type of cancer that affects the bone marrow, leading to the overproduction of abnormal white blood cells at the expense of other blood cell types, including red blood cells (National Cancer Institute, 2021). As a result, patients with leukaemia often present with low red blood cell counts. The presence of low red blood cell count in paediatric patients with leukaemia can be attributed to several factors. Firstly, the abnormal proliferation of white blood cells in the bone marrow crowds out normal blood cell production, including red blood cells. This disrupts the normal process of red blood cell formation, leading to decreased haemoglobin levels and anaemia in these patients. Leukaemia can cause bleeding and bone marrow suppression, further contributing to the development of anaemia in affected individuals. Bleeding may occur due to the presence of abnormal blood vessels in the body or as a side effect of chemotherapy treatment for leukaemia. Bone marrow suppression, a common complication of leukaemia, impairs the production of red blood cells, leading to low red blood cell counts.

Low platelet count, or thrombocytopenia, is a common feature in patients with leukaemia, including paediatric patients. Leukaemia is a type of cancer that

originates in the bone marrow, leading to the abnormal proliferation of white blood cells at the expense of other blood cell types, including platelets (National Cancer Institute, 2021). The disrupted balance of blood cell production in leukaemia can result in low platelet levels in affected individuals.

In paediatric patients with leukaemia, the decreased platelet count can be attributed to several factors. Firstly, the abnormal proliferation of white blood cells in the bone marrow can suppress the production of other blood cell types, including platelets. Platelets play a crucial role in blood clotting and preventing bleeding, and their deficiency can lead to an increased risk of bleeding and bruising in patients with leukaemia. Certain types of leukaemia, such as acute myeloid leukaemia, can directly infiltrate the bone marrow and impair the production of platelets (American Cancer Society, 2021). The infiltration of malignant cells in the bone marrow disrupts the normal process of platelet production, leading to thrombocytopenia in paediatric patients with leukaemia. Chemotherapy and radiation treatment, commonly used in the management of leukaemia, can suppress bone marrow function and further contribute to low platelet counts in affected individuals. The myelosuppressive effects of these treatments can lead to a temporary decrease in platelet production, resulting in thrombocytopenia.

Low haemoglobin levels, or anaemia, are frequently observed in patients with leukaemia, including paediatric patients. Leukaemia is a type of cancer that affects the bone marrow, leading to the overproduction of abnormal white blood cells at the expense of other blood cell types, including red blood cells (National Cancer Institute, 2021). The disrupted balance of blood cell production in leukaemia can result in low haemoglobin levels in affected individuals.

In paediatric patients with leukaemia, the lowered haemoglobin levels can be attributable to various factors. Firstly, the abnormal proliferation of white blood cells in the bone marrow can crowd out the normal production of red blood cells, leading to anaemia. Red blood cells are responsible for carrying oxygen throughout the body, and their deficiency can result in tiredness, weakness, and other symptoms associated with anemia.the infiltration of malignant cells in the bone marrow in certain types of leukaemia, such as acute myeloid leukaemia, can directly interfere with the production of red blood cells, further contributing to anaemia in paediatric patients with leukaemia (American Cancer Society, 2021). The disruption of normal blood cell production and bone marrow function by leukaemia cells can lead to reduced haemoglobin levels and anaemia in affected individuals. Treatments such as chemotherapy and radiation therapy commonly used in the management of leukaemia can also suppress bone marrow function, leading to decreased red blood cell production and worsening anaemia in paediatric patients with leukaemia. The myelosuppressive effects of these treatments can exacerbate existing anaemia or contribute to the development of anaemia in patients undergoing therapy.

While there are some differences in the incidence and types of leukaemia seen in different age groups, the association between haematological parameters and the age of paediatric patients with acute leukaemia is not typically significant. Haematological parameters such as white blood cell count, red blood cell count, platelet count, and haemoglobin levels are more closely linked to the specific type of leukaemia and disease progression rather than the age of the paediatric patient. Morando et al. (2016) involving paediatric patients with acute leukaemia, the researchers found that the haematological parameters were primarily associated with the specific subtype of leukaemia and disease status rather than the age of the

patient. The study concluded that biomarkers related to leukaemia subtypes were more informative in predicting prognosis and guiding treatment decisions than age alone. Steliarova-Foucher et al. (2018) on haematological malignancies in children highlighted the importance of disease-specific factors in determining haematological parameters and treatment outcomes. The review emphasized that while age can impact the incidence and outcome of leukaemia, it is not a direct determinant of haematological parameters.

5.4 The comparison of haematological parameters among paediatric patients with acute leukaemia based on sex

When it comes to haematological parameters in paediatric patients with acute leukaemia, there is typically no significant association with gender. Haematological parameters such as white blood cell count, red blood cell count, platelet count, and haemoglobin levels are more closely related to the specific subtype of leukaemia and disease characteristics rather than the gender of the paediatric patient. Gaieski et al. (2019) that explored the impact of gender on haematological parameters in paediatric patients with acute leukaemia, the researchers found no significant association between gender and haematological parameters. The study emphasized that disease-specific factors, genetic mutations, and other biological characteristics play a more critical role in determining haematological parameters in paediatric patients with acute leukaemia. Hunger et al. (2017) focused on the treatment and outcomes of paediatric acute lymphoblastic leukaemia. The review highlighted the lack of significant gender-based differences in haematological parameters and the overall treatment approach for paediatric leukaemia. The emphasis was placed on tailoring treatment based on disease subtype rather than the gender of the patient.

5.5 The comparison of haematological parameters among paediatric patients with acute leukaemia based on duration and treatment.

Chemotherapy treatment is a commonly used approach to treat acute leukaemia, a type of cancer that affects the white blood cells. While chemotherapy works by targeting and killing cancer cells, it also affects healthy cells, including white blood cells, which are an essential component of the immune system. Chemotherapy drugs can interfere with the normal production of white blood cells, leading to a decrease in their numbers. This decrease is often temporary, as the bone marrow has the ability to recover and resume white blood cell production after the completion of chemotherapy. Chemotherapy can weaken the immune system, making patients more susceptible to infections and other complications. As a result, the number of white blood cells, which are crucial for fighting off infections, may decrease during the course of chemotherapy treatment. Lyman et al. (2009) found that patients with acute leukaemia receiving chemotherapy experienced a significant drop in white blood cell counts. The study also highlighted the importance of monitoring white blood cell counts and implementing strategies to support the immune system during chemotherapy treatment.

Fluctuations in red blood cell counts during chemotherapy treatment in paediatric patients with acute leukaemia can be influenced by several factors unique to this population. Chemotherapy drugs used in the treatment of paediatric acute leukaemia can have varying effects on the bone marrow, impacting the production of red blood cells. Additionally, paediatric patients may experience growth and development-related changes in their blood cell production, which can further contribute to fluctuations in red blood cell levels during the course of treatment. Sung et al. (2018) found that paediatric patients with acute leukaemia undergoing chemotherapy often experience fluctuations in red blood cell counts. The study highlighted the

importance of closely monitoring red blood cell levels in paediatric patients, as chemotherapy-induced cytopenias, including anaemia, can impact treatment outcomes and quality of life. Pediatric patients may have different nutritional needs and challenges compared to adult patients, which can affect red blood cell production and lead to fluctuations in red blood cell counts during chemotherapy treatment. Adequate nutrition is essential for supporting red blood cell production, and paediatric patients undergoing chemotherapy may require additional support to ensure optimal nutritional status and adequate red blood cell levels.

Lower platelet counts during chemotherapy treatment in paediatric patients with acute leukaemia can be attributed to several factors. Chemotherapy drugs used in the treatment of leukaemia can have a suppressive effect on the bone marrow, where platelets are produced. This bone marrow suppression can lead to a decrease in platelet production, resulting in lower platelet counts over the course of treatment. Additionally, the cumulative effects of multiple cycles of chemotherapy can further impact bone marrow function and contribute to decreasing platelet levels. Stork et al. (2017) investigated platelet counts in paediatric patients with acute leukaemia undergoing chemotherapy and found that platelet levels often decrease during treatment. The researchers highlighted the importance of monitoring platelet counts closely in paediatric patients, as low platelet counts can increase the risk of bleeding and other complications during chemotherapy. Pediatric patients may be more susceptible to chemotherapy-induced bone marrow suppression compared to adults, which can lead to more significant decreases in platelet production. The immature nature of the paediatric bone marrow and the higher growth and metabolic rates in children may also contribute to lower platelet levels during chemotherapy treatment.

Chemotherapy drugs used in the treatment of leukaemia can lead to the suppression

of cancer cells, which may result in a reduction of tumor burden and, consequently, a decrease in the demand for nutrients and resources by the cancer cells. This reduction in nutrient competition can allow for improved red blood cell production in the bone marrow and ultimately lead to the improvement of haemoglobin levels during the course of chemotherapy. Vrooman et al. (2012) investigated haemoglobin levels in paediatric patients with acute leukaemia undergoing chemotherapy and found that haemoglobin levels showed an improvement in response to treatment. The researchers noted that as chemotherapy eliminates leukaemia cells, the bone marrow has the opportunity to recover and resume normal red blood cell production, leading to the restoration of haemoglobin levels over time. Supportive care measures such as blood transfusions and the use of erythropoiesis-stimulating agents can be implemented during chemotherapy treatment to manage anaemia and support red blood cell production, which can contribute to the improvement of haemoglobin levels in paediatric patients.

The impact of duration and timing on haematological parameters in paediatric patients with acute leukaemia can be significant and multifaceted. Chemotherapy treatment for acute leukaemia typically involves cycles of treatment over a specified duration, with each cycle having a specific timing. These treatment regimens can have varying effects on haematological parameters, such as white blood cell counts, red blood cell counts, platelet levels, and haemoglobin levels.

A study by Inaba et al. (2014) investigated the impact of treatment duration and timing on haematological parameters in paediatric patients with acute leukaemia. The researchers found that the timing of chemotherapy cycles, as well as the

duration of treatment, could influence haematological parameters. For example, certain chemotherapy drugs used in the induction phase of treatment may lead to bone marrow suppression and a decrease in white blood cell counts, while supportive care measures during the maintenance phase may help improve red blood cell production and haemoglobin levels.

The duration of treatment can also affect haematological parameters in paediatric patients with acute leukaemia. Prolonged exposure to chemotherapy drugs can lead to cumulative bone marrow suppression, resulting in lower white blood cell counts, platelet levels, and haemoglobin levels. Conversely, shorter treatment duration or more spaced-out chemotherapy cycles may allow for recovery periods for the bone marrow to regenerate, leading to improvements in haematological parameters over time. The timing of specific interventions, such as blood transfusions or administration of growth factors, can impact haematological parameters and support the management of anaemia, neutropenia, and thrombocytopenia in paediatric patients undergoing leukaemia treatment. Incorporating individualized treatment plans that consider the impact of duration and timing on haematological parameters is crucial in optimizing outcomes for paediatric patients with acute leukaemia. Regular monitoring of haematological parameters throughout treatment, adjusting chemotherapy regimens based on patient response, and providing supportive care measures when necessary are essential components of managing haematological changes in paediatric patients with acute leukaemia.

5.6 Conclusion

The study showed that the socio-demographic and clinical characteristic that are critical in paediatric patients with leukaemia are age, sex, genetic factors(down

syndrome and neurofibromatosis), clinical characteristics(high white blood cell count and low levels of MRD. However, there is generally high white blood cell count, low red blood cell count, low platelets, and low levels of haemoglobin for paediatric patients with acute leukaemia. There is no association between the haematological parameters and age group of the paediatric patients with acute leukaemia. Also there is no association between the haematological parameters and the gender of paediatric patients with acute leukaemia. However, there is an influence between the haematological parameters and the duration and treatment of the paediatric patients. This was showed by the fluctuations of white blood cells and improvement of red blood cells and haemoglobin, as well as the decrease of platelets with time during treatment.

5.7 Recommendations

- Parirenyatwa Group of Hospitals should be equipped to do the tests for the haematological parameters such as red and white blood cell count, platelets, and haemoglobin level tests timeously and affordable.
- Paediatric patients with acute Leukaemia should be regularly tested for the other factors that associate with the disease other than haematological parameters but others like racial influence and genetic predisposition.

5.8 Areas of further studies

A comprehensive study on the impact of white blood cells, red blood cells, platelets and haemoglobin levels on the different acute leukaemia should be explored.

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APPENDIX 1

DATA COLLECTION TOOL

PATIENT ID	AGE AT DIAGNOSIS	SEX	IN . LAB FEAT	RE.LAB FEAT	TYPE OF LUEKAEMIA
E.G A001		M/F	WBC HB	WBC HB	ALL/ AML

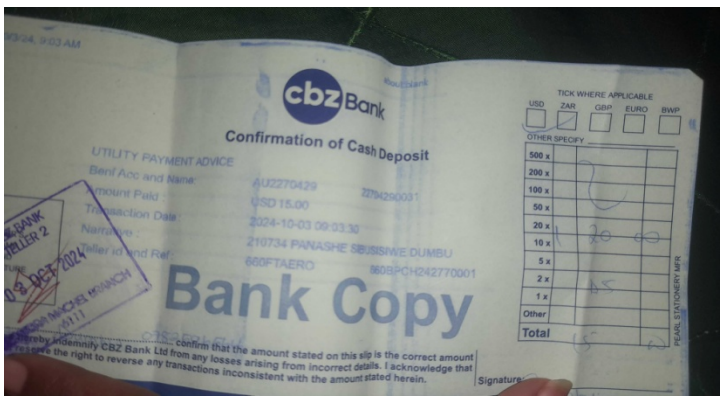
APPENDIX 2

BUDGET AND TIMELINE

ACTIVITY	AMOUNT(USD)
STATIONERY	$10
TRANSPORT	$15
LUNCH	$15
TOTAL	$40

APPENDIX 3

PROOF OF PAYMENT



APPENDIX 4

SUPERVISOR'S PERMISSION LETTER

Department of Biomedical and Medical Laboratory Science,

Africa University,

Zimbabwe.

27th September, 2024.

The AUREC Administrator

Africa University,

Zimbabwe.

Dear Sir/Madam,

RE: PERMISSION TO SUBMIT TO AUREC FOR PANASHE, SIBUSISISWE DUMBU

Programme: HBMLS

This letter serves to confirm the above-mentioned student has satisfied all the requirements of the faculty in developing the dissertation proposal and is ready for assessment.

Your facilitation for review of the proposal is greatly appreciated.

Thak you

Sincerely,

Prof. Emmanuel Obeagu