

# Pediatric and adolescent cancer in a national referral hospital in Peru in 2024: Epidemiological profile and public health challenges

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## Abstract

**Background:** Pediatric cancer remains a significant cause of morbidity and mortality in low- and middle-income countries. In Peru, structural barriers limit timely diagnosis, comprehensive treatment, and proper epidemiological registration. This study aims to characterize the epidemiological and clinical profile of the pediatric cancer population at INSN-Breña in 2024.

**Methods:** A retrospective, observational, and descriptive study based on the 2024 institutional cancer registry from the Instituto Nacional de Salud del Niño (INSN) using the national epidemiological surveillance guideline.

**Results:** One hundred seventy-five cases of pediatric cancer were registered, of which 121 (69.1%) were malignant. Most patients came from Lima (56.2%). The most affected age group was 5–9 years (34.7%). The average diagnostic delay was 69 days. Histological confirmation was achieved in 97.7% of cases. Ten children died (8%) and 87.3% were referred to another institution for treatment.

**Conclusions:** Peru faces critical delays in childhood cancer diagnosis and inequities in access to care. National reforms are needed to decentralize services, improve early detection, and ensure integrated oncologic treatment.

**Keywords:** Childhood neoplasms, Diagnostic delay, Epidemiology, Health services accessibility, Medical oncology, Peru, Public health

## Background

Childhood and adolescent cancer is increasingly a public health priority, particularly in low- and middle-income countries (LMICs), where the structural limitations of the health systems make timely diagnosis and treatment more difficult [1,2]. Globally, there are over 400,000 new cases each year in individuals younger than 19 years of age [3,4]; however, in certain areas (i.e. Latin America), out-of-date cancer registries and limited coverage for early diagnosis contribute to significant underreporting of incidence as well as poor clinical outcomes [5,6].

In Peru, cancer is the second leading cause of death (after injuries) in children aged 5–14 years [7]. Although nationwide information is still sparse, a multicenter study in public pediatric hospitals that included Lima, Trujillo, and Arequipa reported that leukemias (39.4%), central nervous system tumors (15.7%) and lymphomas (10.5%) were the most common malignancies among children [8].

Another retrospective study that used diagnostic information from another cancer center and a random selection of regional hospitals (with a focus on specialized hospitals) found some significant shortcomings in terms of delays in diagnosis and differences in access to specialized care between regions [9].

Reports from the National Institute of Child Health (INSN-Breña) indicate that many of the pediatric oncology patients originate from outside of Lima, have late referrals, incomplete staging, and inadequate follow-up because of deficiencies in cancer management at a decentralized approach [10]. Further, a Peruvian study reported that diagnostic delay in acute lymphoblastic leukemia considerably affected treatment outcomes, especially for patients from highland and jungle regions [11]. There are also considerations based on international studies, for example, the GICC (Global Initiative for Childhood Cancer), or programs that are specific to regions, such as the one being developed in Peru, that suggest the existence of no functioning national pediatric cancer registries, which are again a challenge for monitoring trends and survival rates [1,12,13]. Such challenges highlight the pressing need for institutional knowledge to help plan for future policies and allocations.

Despite recent global initiatives and the gradual development of regional strategies, the absence of a unified national pediatric cancer registry in Peru represents a critical barrier to effective surveillance [13–16]. Without reliable, standardized, and comprehensive data, it is difficult to accurately estimate incidence, evaluate survival trends, or identify disparities between geographic regions [17,18]. This limitation also undermines the capacity of health authorities to design evidence-based interventions, allocate resources efficiently, and measure the impact of ongoing programs [19–21]. Furthermore, fragmented reporting across institutions leads to underestimation of disease burden, masking the true scale of the problem and delaying the implementation of coordinated national policies [22–24].

This study aims to characterize the epidemiological and clinical profile of the pediatric cancer population at INSN-Breña in 2024. The results will be used to create clinical, regulatory, and public policy benchmarks [25].

## Methodology

### Study design

Descriptive, retrospective, observational study describing important clinical and epidemiological variables of childhood cancers in a national referral institution between January 1 and December 31, 2024 [5,7,20].

A descriptive study design choice was made due to the lack of recently updated epidemiological data related to pediatric and adolescent cancer in Peru. Without a cohesive national cancer registry and limited regional reporting, the descriptive study will provide foundational information about types of tumors, demographics of patients, diagnostic delays and referral practices. These results will be necessary for future analytic studies, public health policy and clinical decision-making in pediatric oncology [8,26,27].

As this was a descriptive study without hypothesis testing, no sample size calculation was performed. This census approach ensures exhaustive data collection and valid descriptive estimates for the study population.

### Setting

National Institute of Child Health - Breña (INSN-Breña), a public tertiary pediatric hospital at the national level [10,13].

### Inclusion criteria

Patients aged 0–17 years with a diagnosis of malignant neoplasm confirmed by histopathology and/or consistent clinical–radiological criteria, admitted for inpatient care at INSN-Breña between January 1 and December 31, 2024 [3]. Benign tumors and non-malignant conditions were not included.

### Exclusion criteria

Patients who had an unconfirmed diagnosis, cases identified as duplicates, or incomplete clinical information. Other referred patients from different health institutions who do not have clinical follow-up in the INSN-Breña cannot be included due to lack of data.

### Data sources:

- NotiWeb Platform - INSN-Breña
- Physical and electronic medical records
- Registries from the Hemato-Oncology service, Surgical Oncology service, and the Neurosurgery service (10)

### Data quality assurance

To ensure data accuracy and completeness, patient records from the NotiWeb platform were cross-validated with physical and electronic medical records, as well as with registries from the Hemato-Oncology, Surgical Oncology, and Neurosurgery services. Inconsistencies or missing values were verified against the original medical charts whenever available. Duplicate cases were identified and removed. Data extraction was performed independently by two trained researchers, and discrepancies were resolved through consensus [20,21].

### Definitions

Malignancies were classified based on the International Classification of Childhood Cancer (ICCC-3) [3]. Diagnostic delay was defined as the time in days from the first symptom reported by the caregiver to the date of definitive cancer diagnosis [7,11,20]. Referral status referred to whether the patient was initially evaluated at another healthcare facility prior to admission at INSN-Breña.

### Variables

Variables include age, sex, region of origin, type of tumor, anatomical location of the tumor, diagnostic delay, institutional referral, clinical outcome, and type of surgical treatment (**Table 1**).

**Table 1.** Variables analyzed in the study.

Category	Variables
Sociodemographic	Age, sex, region of origin
Clinical	Tumor type, anatomical site, diagnostic delay, referral status
Treatment	Type of surgical treatment
Outcomes	Clinical outcome (alive, deceased, ongoing treatment, lost to follow-up)

### Statistical analysis

Data were analyzed using Microsoft Excel 365 (Microsoft Corporation, USA) and IBM SPSS Statistics version 25 (IBM Corporation, USA). Quantitative variables are presented as mean  $\pm$  standard deviation or as median with interquartile range, depending on data distribution. Qualitative variables are reported as absolute frequencies and percentages. As this was a purely descriptive study aimed at characterizing epidemiological and clinical features rather than testing hypotheses, no inferential statistical analyses were performed [28–30].

### Ethical considerations

Approved by the Institutional Ethics Committee of INSN-Breña. Data confidentiality and anonymization were strictly adhered to [2].

## Results

During 2024, a total of 175 cases of pediatric and adolescent tumors were recorded at the National Institute of Child Health - Breña. Of these, 121 (69.1%) were confirmed as malignant, forming the focus of this analysis. The remaining 54 cases included benign tumors or conditions still under observation [5,10].

### Age and sex distribution

The children affected by cancer had a median age of 8 years, ranging from infants to adolescents approaching adulthood. The age group with the highest number of cases was 5 to 9 years, which accounted for over a third of all diagnoses [6]. There was no significant difference between males and females, as both sexes were affected in nearly equal proportions (Table 2) [7,10].

### Geographical origin and referral pathways

More than four out of every ten children treated came from regions outside Lima, including La Libertad, Junín, Áncash,

Cajamarca, and Cusco [8,13]. In most of these cases, families had to travel long distances to reach INSN-Breña for specialized care, often after being referred from regional hospitals that lacked pediatric oncology services [14,21]. This reality reflects the ongoing challenge of centralized care, where most complex cancer treatments remain concentrated in the capital [9,22,31].

### Types of cancer diagnosed

Among the malignant cases, the most common diagnosis was leukemia, particularly acute lymphoblastic leukemia, affecting nearly 4 in every 10 children [8,11]. Brain tumors followed, representing 19% of cases, and were often located in the cerebellum or brainstem [19]. Other solid tumors included soft tissue sarcomas, renal tumors like Wilms tumor, and hepatic tumors, mainly hepatoblastoma [6,29]. A small but significant number of patients were also diagnosed with lymphomas, germ cell tumors, and bone tumors [7,30].

In total, more than 90% of children required some form of surgery, either to confirm the diagnosis or to remove part or all of the tumor. This underscores the institution's important surgical role in cancer care (Table 3) [10,13].

### Delays in diagnosis

One of the most concerning findings was the median delay of 69 days between the onset of symptoms and a confirmed diagnosis (Table 4). Diagnostic delay was calculated from caregiver-reported symptom onset in medical records or interviews to confirmed diagnosis. This is more than double the recommended time [7,11,20]. While leukemia cases were diagnosed more promptly, often within 30 days, solid tumors, especially brain and kidney cancer, saw longer delays, sometimes taking over two months [11,20,21]. These delays are often due to subtle symptoms, lack of early suspicion, or the need for complex imaging or biopsies that are not readily available in all regions [22,30].

Table 2. Distribution by age group and sex.

Age group	Total n (%)	Male n (%)	Female n (%)
1–4 years	38 (31.4%)	20 (16.5%)	18 (14.9%)
5–9 years	42 (34.7%)	21 (17.4%)	21 (17.4%)
10–14 years	34 (28.1%)	17 (14.0%)	17 (14.0%)
15–17 years	7 (5.8%)	3 (2.5%)	4 (3.3%)
<b>Total</b>	<b>121 (100%)</b>	<b>61 (50.4%)</b>	<b>60 (49.6%)</b>

Table 3. Delay in diagnosis by tumor type (Mediana y RIC).

Tumor Type	n (de 175)	Media (días)	Mediana (Q1–Q3)
Leukemias	70 (40%)	30	25 (16–38)
CNS tumors	33 (19%)	57	47 (31–71)
Renal tumors	15 (9%)	77	63 (41–97)
Hepatic tumors	9 (5%)	46	38 (25–58)
Soft tissue sarcomas	18 (10%)	58	48 (31–73)
Others*	30 (17%)	—	—

Note: Others include heterogeneous tumors (e.g., germ cells, bone) with insufficient sample size for a meaningful average delay

**Table 4.** Key epidemiological indicators.

Indicator	Value	National Standard
Histological confirmation	97.7%	≥90%
Pediatric oncological mortality	8%	—
Referral to another institution	87.3%	—
Average diagnostic delay	69 days	<30 days
Oncological or neurological surgery	90.4%	—

### Outcomes and mortality

Despite the challenges, most children (88%) were able to start comprehensive treatment at INSN-Breña, which included chemotherapy, surgery, and supportive care [10,15]. Unfortunately, 8% of the patients died, with most of these children presenting at advanced stages of disease. The highest mortality was seen in those with brain tumors and liver cancer two conditions often diagnosed late due to nonspecific symptoms and barriers to imaging [19,21,32].

### Diagnostic capacity

Encouragingly, 97.7% of the malignant tumors had histological confirmation, reflecting the solid capacity of the hospital's diagnostic services and pathology teams [3,10,13]. However, while diagnosis was well established, the long-term follow-up and survival data across the country remain fragmented due to the absence of a national pediatric cancer registry [13,14,25].

### Continuity of care and follow-up

At the end of 2024, more than half of the patients (58.7%) remained under active follow-up, while 32.2% were still receiving treatment within the institution. A total of 10 children (8%) had died, with the highest mortality observed among brain and hepatic tumors [19,32]. Notably, several cases, particularly leukemias and selected renal tumors, were referred to specialized centers for chemotherapy and radiotherapy, reflecting the limitations of local comprehensive oncological care [13,21,30].

## Discussion

### Tumor distribution

This study provides a national pediatric referral hospital a snapshot of childhood and adolescent cancer epidemiology, and has reflected regional epidemiology [5,6], while revealing remaining gaps in the Peruvian health system [10,30]. The most common tumor types were consistent with what has been described for Latin America: acute leukemias, CNS tumors, and sarcomas [3,6,7,33].

### Age and sex patterns

We found that the main age group that was affected by cancer was 5 to 9 years old, which is similar to multicenter studies and to the age of onset of acute lymphoblastic leukemia [8,28]. The sex distribution in this study was equal, and different from some international series which reported a slight predominance of males, especially in leukemias [10,28].

### Diagnostic delays

We are concerned that the average time from the first clinical symptom to diagnosis was 69 days, which is more than double the national and international standard [7,11,20]. There was a longer

delay in solid tumors, namely renal tumors and CNS tumors, which is probably due to the clinician not having a clinical suspicion, and limited access to imaging and weaknesses in the referral system [7,11,22]. Other studies have shown that having a diagnostic delay greatly impacts survival and costs, and that shortening the diagnostic delay improves them both [9,21,30].

### Centralization and health system challenges

We acknowledge that the referral of 87.3% to a center for comprehensive treatment illustrates excessive centralization [8,10,14]. Most regions do not have a complete pediatric oncology unit, so patients must travel to Lima, which creates inequity, and a very high number of referrals overwhelm referral centers [13,22,31]. Progressive decentralization, regional capacity building, and integrated care networks are urgently required [14–16,33,34].

### Histologic confirmation and follow-up

The high histologic confirmation rate (97.7%) indicates adequate installed capacity; however, the same cannot be said for longitudinal clinical follow-up nor for a long-term analysis of survival at the national level [5,10,30]. This study highlights the urgent need to strengthen epidemiological surveillance through a digital, interoperable, and accessible national registry to follow cases from clinical suspicion through to therapeutic outcomes [1,2,13,25,26].

### Implications for clinical practice

It is critical to implement continuous medical education for primary care providers, especially in rural areas, to highlight warning signs, referral protocols, and to facilitate timely follow-up [5,8,22,23].

### Study limitations

This study has several limitations. Being a retrospective single-institution study, the results cannot be generalized to the entire country. Furthermore, no multivariate analysis was performed to explore the association of risk factors with diagnostic delay or tumor types. In addition, survival outcomes, treatment abandonment, and long-term follow-up data were not available, limiting the ability to assess prognosis and comprehensive care trajectories [20,23,24]. As a single-institution study at INSN-Breña, findings may not fully represent pediatric cancer epidemiology across Peru.

## Conclusion

Peru's healthcare system continues to face significant challenges in delivering timely and comprehensive pediatric cancer care. The implementation of epidemiological surveillance has been instrumental in highlighting the burden of childhood cancer. However, urgent reforms are required to strengthen equity in access and improve survival outcomes. Future efforts should focus

on establishing a national pediatric cancer strategy, expanding access to specialized care, and fostering multicenter research to generate robust local data. Strengthening collaborations between hospitals, policymakers, and academic institutions will be essential to guide evidence-based decision-making and ensure sustainable improvements in pediatric oncology [35].

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## Conflicts of Interest

The authors declare no conflict of interest.

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