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Disparities in pediatric leukemia early survival in Argentina: a population-based study

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ABSTRACT

Objective. *To identify disparities—using recursive partitioning (RP)—in early survival for children with leukemias treated in Argentina, and to depict the main characteristics of the most vulnerable groups.*

Methods. *This secondary data analysis evaluated 12-month survival (12-ms) in 3 987 children diagnosed between 2000 and 2008 with lymphoid leukemia (LL) and myeloid leukemia (ML) and registered in Argentina's population-based oncopediatric registry. Prognostic groups based on age at diagnosis, gender, socioeconomic index of the province of residence, and migration to a different province to receive health care were identified using the RP method.*

Results. *Overall 12-ms for LL and ML cases was 83.7% and 59.9% respectively. RP detected major gaps in 12-ms. Among 1–10-year-old LL patients from poorer provinces, 12-ms for those who did and did not migrate was 87.0% and 78.2% respectively. Survival of ML patients < 2 years old from provinces with a low/medium socioeconomic index was 38.9% compared to 62.1% for those in the same age group from richer provinces. For 2–14-year-old ML patients living in poor provinces, patient migration was associated with a 30% increase in 12-ms.*

Conclusions. *Major disparities in leukemia survival among Argentine children were found. Patient migration and socioeconomic index of residence province were associated with survival. The RP method was instrumental in identifying and characterizing vulnerable groups.*

Key words Healthcare disparities; leukemia; child; developing countries; survival analysis; Argentina.

Leukemia comprises about 30% of all cancer cases occurring in children younger than 15 years old in resource-rich countries. Advances in treatment have markedly improved survival. In countries with highly developed health services, five-year survival rates for children with acute lymphoid leukemia and acute non-lymphocytic leukemia are approximately 80% and 50% respectively (1, 2). While outcomes in countries with limited resources are less well known, because of the scarcity of population-based cancer registries (3), reports suggest that three-year survival in that setting is worse, and can be as low as 54.2% for acute lymphoid leukemia (4, 5). The poorer outcomes are generally attributed to restricted availability of health services, delayed diagnosis, lack of therapeutic strategies, treatment abandonment, and inadequate supportive care (4, 6, 7).

One of the few pediatric cancer registries in Latin America is the Argentine Hospital Oncopediatric Registry (*Registro Oncopediátrico Hospitalario Argentino*, ROHA). This population-based registry was created in the year 2000 and has reached an estimated coverage of 92%; ROHA's incidence and survival data have helped to inform health policies and drive the development of a national pediatric cancer program (8, 9).

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Data from ROHA indicate that in Argentina the rates for three-year survival of lymphoid leukemia (LL) and myeloid leukemia (ML) were 69% and 40% respectively, with significant variations (of up to 15 points) across the country (10). These differences arise within a context of apparent uniformity. In this upper-middle–income country, cancer treatment is provided free of charge and is highly centralized: 85% of children with cancer receive care in public institutions and 47% are treated in one of three tertiary-level pediatric hospitals (10). All centers use the same treatment protocol. About 49% of patients need to migrate to another province for diagnosis and therapy (10). Moving and lodging expenses are usually covered by the province of residence or through health insurance. Once a child is transferred to a specialized institution, all therapy is usually administered by the new institution. Consequently, many patients spend long periods (up to two years) away from their homes (11, 12).

Identification of the most vulnerable groups of pediatric cancer patients in terms of their survival is necessary to further develop the national pediatric cancer program and to reduce cancer-related disparities within the country. Argentina's high-quality registry allows for this type of analysis.

Recursive partitioning (RP) is a statistical method ideally suited for splitting the study population into different groups by patient survival rates, and for identifying prognostic factors related to the course of disease. Breiman et al. (13) established the theoretical and practical framework of RP methods within the specific context of classification and regression trees. Early adaptation of RP methods to health science data was carried out by Gordon & Olshen (14) and Ciampi et al. (15). Zhang & Singer (16) provide a comprehensive list of references about RP in health sciences. Unlike the Cox proportional hazards model traditionally used to analyze survival data, the RP method is a non-parametric approach that does not rely on assumptions about the survival function. In addition, the RP splitting algorithm allows for identification of the most relevant prognostic factors for a given subset of subjects, rather than estimating effects across all subjects, as in the Cox model.

Survival throughout the 12-month period after diagnosis depends primarily on the health system's ability to provide rapid diagnosis and adequate supportive care. Therefore, mortality during this period can be avoided by improving infrastructure, equipment, and training of personnel at the treating institutions, or by developing good referral policies. The goal of this study is to identify disparities—using RP—in early survival for children with leukemias treated in Argentina, and to depict the main characteristics of the most vulnerable groups.

MATERIALS AND METHODS

This is a secondary data analysis using data from Argentina's population-based oncopediatric registry, the ROHA.

Data

ROHA registers all cancer cases diagnosed in children and adolescents 0–19 years old and living in Argentina. To date, more than 14 000 cases have been registered. Cases are collected through a network of centers that covers the entire country. Vital status is updated by the centers on an annual basis and supplemented with death certificate information. A detailed description of ROHA data acquisition strategies and registry quality has been described elsewhere (8). ROHA records type of tumor; gender; birth, diagnosis, death, and last contact date; diagnosing institution; referral hospital; and province of residence. Classification of type of tumor is based on the International Classification of Disease for Oncology (17) and the International Classification of Childhood Cancer (18). To protect patient confidentiality, the databases were de-identified for this analysis.

Children diagnosed between 2000 and 2008 with LL or ML, before age 15, were included in this study. Cases identified by death certificates only were excluded.

The study outcome was the time from diagnosis to death from any cause. Patients who lost contact with the clinical center were classified as lost to follow-up; for these patients, the study outcome was the duration of observation from diagnosis to last contact. Survival at 12 months after diagnosis was evaluated in relation to age at diagnosis, gender, socioeconomic index of the province of residence, and cancer-related migration. The Extended Human Development Index (EHDI) for the year 2006, which combines health, education, and living standards information, was used as a socioeconomic index for each of the 23 provinces and the capital city of Buenos Aires (19, 20). The EHDI uses values between 0 and 1, with lower values corresponding to lower socioeconomic status. A dichotomous variable called "patient migration" was defined as "Yes" if the child was referred to a hospital in a province different from his/her residence and "No" if he/she was not.

Statistical methods

Cox proportional hazards models were fitted to evaluate each of the four factors studied as prognostic indicators of 12-month survival (12-ms): 1) age in years at time of diagnosis (0, 1–4, 5–9, and 10–14); 2) gender; 3) patient migration ("Yes" or "No); and 4) EHDI for the province of residence, analyzed as a continuous variable.

The RP algorithm was used to split the study population into subgroups by survival experience and characterize them. The analysis was based on the approach proposed by Therneau & Atkinson (21). The response variable considered was survival in the first 12 months after diagnosis. The predictor variables were the same as those described for the Cox models, except for age (in years), which was entered as a continuous variable. In the first step of the process, RP divides the whole set of patients into two subgroups based on responses to a question involving one of the explanatory variables (e.g., "Is age at diagnosis 1 year or more?"). Allowable questions involve one predictor (x): if x is ordered, the question is "Is $x \geq c$?" for a given value c; if x is categorical, the question is "Is x in S?" where S is any subset of categories of x. The question that defines the partition is automatically selected among all allowable questions based on a rule that maximizes a measure of the improvement caused by the new partition. In this study, the reduction in the deviance was used as the measure of improvement. This process was repeated in each subgroup until the subgroups reached a minimum size. Each step resulted in subgroups that were more homogeneous in terms of survival experience than the groups at the previous step. In the last step of the RP algorithm ("pruning"), an appropriate tree size was selected (21). The resulting model can be represented as a binary tree whose leaves or terminal

nodes correspond to the partition of the data. The RP strategy creates groups of observations with survival experiences that are considered similar and can thus be summarized by the Kaplan–Meier estimator. For each subgroup identified by the RP method, the Kaplan–Meier curve and estimated survival at 12 months (plus the corresponding 95% confidence intervals (CIs)) were reported.

The final tree may contain terminal nodes with similar survival experience, which can be combined or amalgamated to form the final groups (13, 16, 21). This additional step was carried out by creating a categorical variable with categories corresponding to the nodes of the tree and using RP again, on just that variable, to define terminal nodes with distinct survival experiences.

All analyses were performed with the R-2.14.2 package (22). RP was carried out using *rpart* 3.1-50 (23).

RESULTS

Between 2000–2008 there were 3 337 LL and 832 ML cases reported to ROHA. Of those, 125 (3.7%) LL and 57 (6.9%) ML cases identified only through death certificates were excluded, leaving 3 212 LL and 775 ML patients as the final study sample. The median follow-up time was 35.3 months among children with LL and 15.8 months for those with ML. Events occurring after one year of diagnosis were not taken into consideration in the analysis. A total of 204 (6%) LL patients and 33 (4%) ML patients lost contact with the clinical center within one year of their diagnosis. Distribution of losses was similar by gender and age groups; no apparent pattern was found in relation to EHDI.

Patient characteristics are presented in Table 1. The EHDI of Argentine provinces ranged between 0.554 and 0.867 (Figure 1). In Table 1, the province EHDI is classified in three categories: low, medium, and high (tertiles). The city of Buenos Aires (*Ciudad Autónoma de Buenos Aires* or CABA, as shown in Figure 1) had the highest concentration of both specialized oncologists and tertiary-level centers.

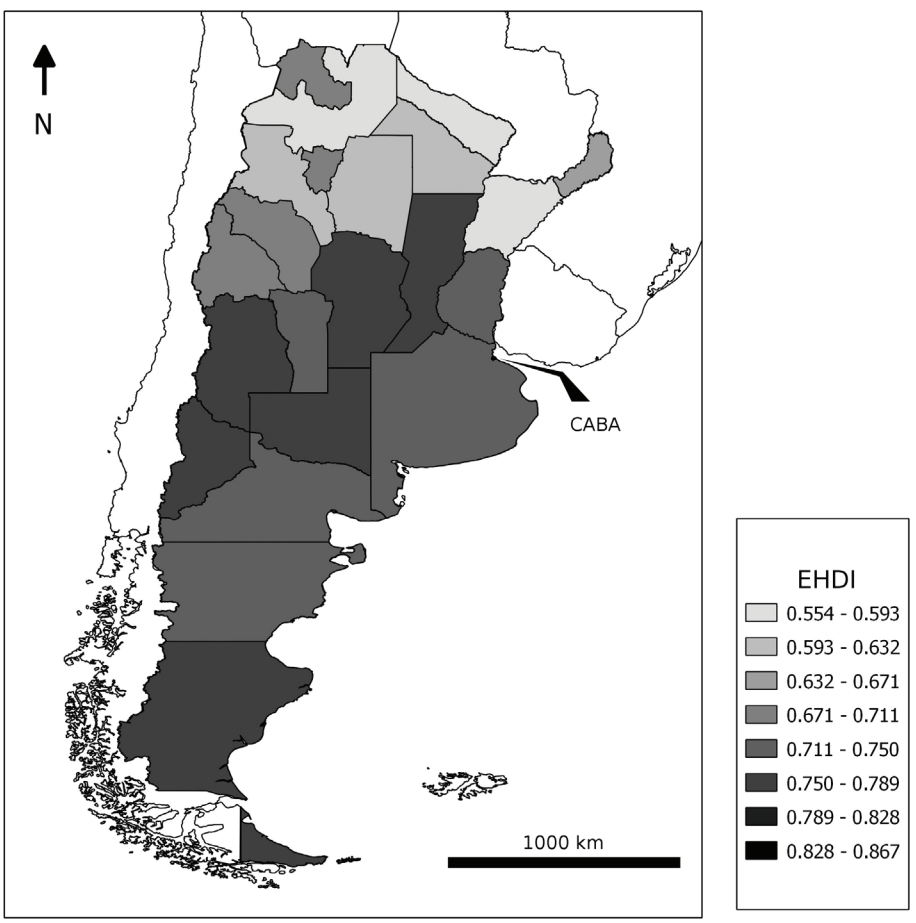
The estimated Kaplan–Meier 12-ms and 95% CIs were 83.7% (95% CI: 82.4%, 85.0%) for children diagnosed with LL, and 59.9% (95% CI: 56.5%, 63.5%) for those with ML. Table 2 presents hazard rate ratios from univariate Cox proportional hazards models of the variables studied. For LL patients, age and EHDI were the only factors significantly associated with early survival. Their hazard of death decreased by 19% ((1–0.81)×100) as EHDI increased by 0.1, resulting in a 47% (95% CI: 22%, 65%) decrease in hazard between the province with the low-

TABLE 1. Characteristics of children diagnosed with lymphoid leukemia (LL) and myeloid leukemia (ML), Argentina, 2000–2008

Characteristic	LL (n = 3 212) No. (%)	ML (n = 775) No. (%)
Age at diagnosis (years)		
0	117 (4)	97 (13)
1–4	1 403 (44)	241 (31)
5–9	950 (30)	188 (24)
10–14	742 (23)	249 (32)
Male	1 752 (55)	403 (52)
Patient migration	1 120 (35)	330 (43)
EHDI[a] of the province of residence		
Low (EHDI ≤ 0.672)	668 (21)	154 (20)
Medium (0.672 < EHDI ≤ 0.75)	1 647 (51)	409 (53)
High (EHDI > 0.75)	897 (28)	212 (27)
Lost to follow-up in < 12 months	204 (6)	33 (4)
Alive 12 months after diagnosis	2 704 (84)	472 (61)

[a] EHDI: Extended Human Development Index for 2006 (19, 20).

FIGURE 1. Extended Human Development Index (EHDI) for provinces, Argentina, 2006



Source: (19, 20).
CABA: Ciudad Autónoma de Buenos Aires (Argentina's capital city).

TABLE 2. Hazard rate ratios (HRR) for lymphoid leukemia (LL) and myeloid leukemia (ML) in children based on univariate Cox proportional models, Argentina, 2000–2008

Characteristic	LL (n = 3 212)	ML (n = 775)
	HRR (95% CI[a])	
Age at diagnosis (in years; reference = 10–14)		
0	3.05 (2.27, 4.09)	2.12 (1.51, 2.98)
1–4	0.46 (0.37, 0.58)	1.29 (0.96, 1.74)
5–9	0.61 (0.48, 0.76)	1.16 (0.84, 1.60)
Gender (reference = female)	0.96 (0.80, 1.14)	0.91 (0.72, 1.14)
Patient migration (reference = "No")	0.94 (0.78, 1.13)	0.76 (0.60, 0.96)
EHDI of the province of residence[b]	0.81 (0.72, 0.92)	0.84 (0.71, 0.99)

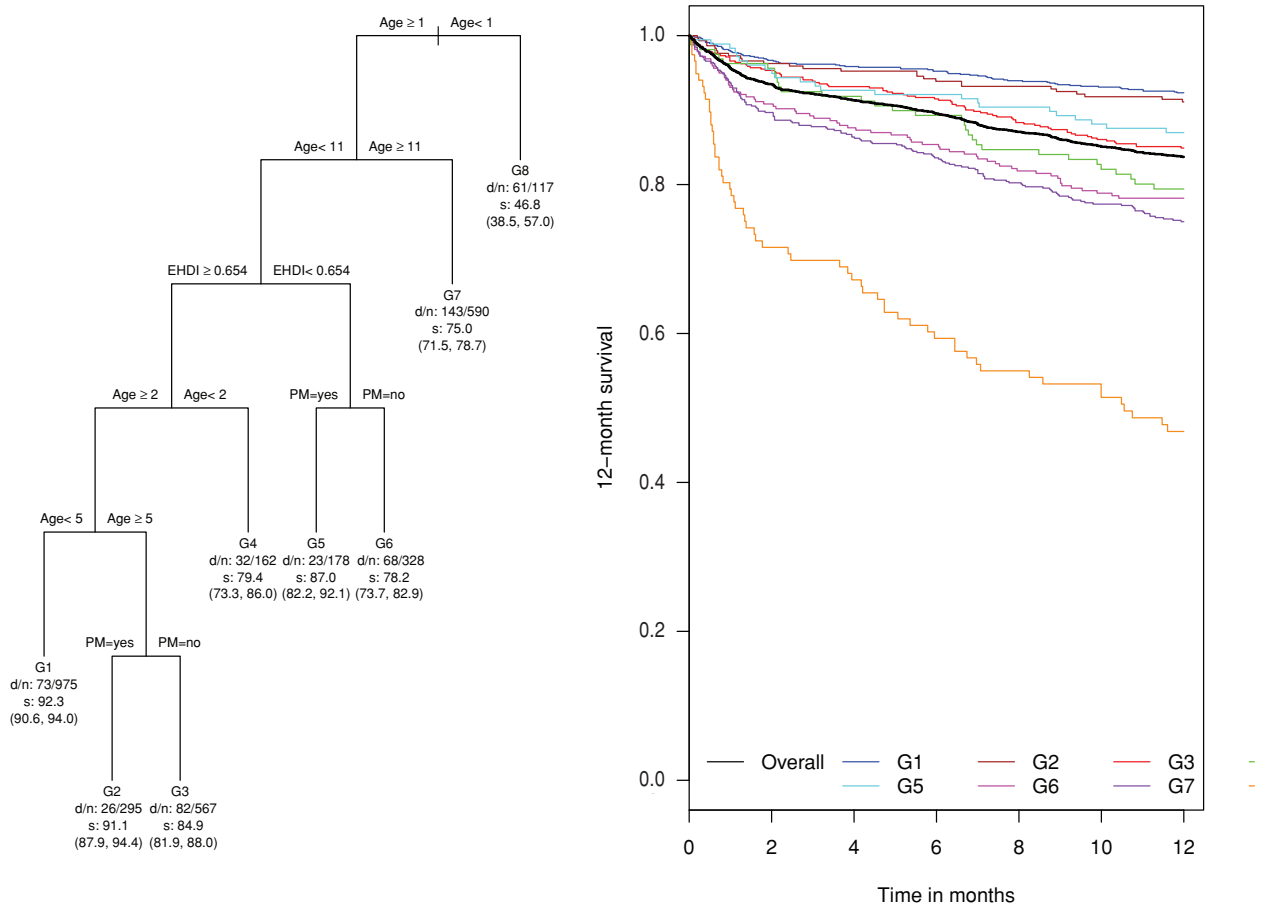
[a] CI: confidence interval.
[b] Extended Human Development Index (EDHI) for 2006 (19, 20). The HRR represents variation caused by an increase of 0.1 in the EDHI.

est EHDI and the one with the highest EHDI. ML patients' early survival was significantly associated with age, patient migration, and EHDI. Their hazard of death decreased by 16% ((1–0.84)×100) as EHDI increased by 0.1, resulting in a 43% (95% CI: 3%, 66%) decrease in hazard between the province with the lowest EHDI and the one with the highest EHDI.

Recursive partitioning

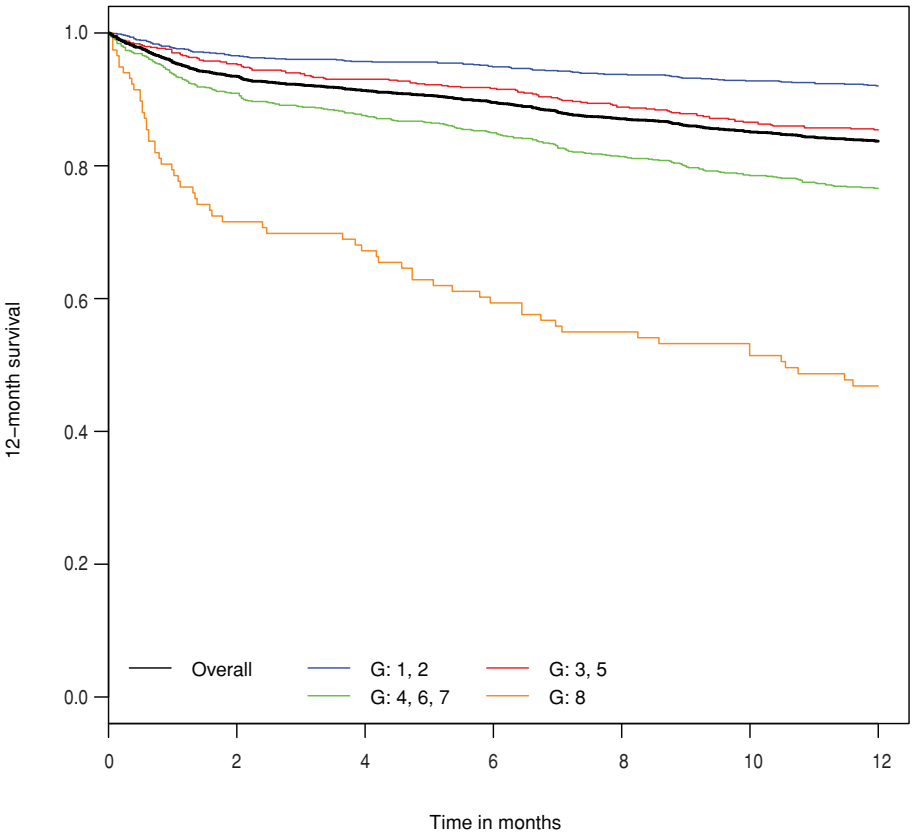
Lymphoid leukemia. Figure 2 shows a summary of the analysis for LL patients, including the analysis tree and the estimated 12-ms curves for the eight terminal nodes, and the one for all LL patients. As shown in the analysis tree, the first split was based on age (0 versus 1–14 years). Children < 1 year old formed a particularly poor prognostic group; estimated 12-ms was 46.8% (Group 8 (G8)). The group of older children was subdivided further by age: 1–10 years versus 11–14 years. Estimated 12-ms for children 11–14 years old was 75.0% (G7). The 1–10-year-old group was subdivided in the next step based on

FIGURE 2. Recursive partitioning (RP) analysis for patients diagnosed with lymphoid leukemia: RP tree[a,b] (left) and 12-month Kaplan–Meier survival curves for groups defined by terminal nodes of RP algorithm[c] (right), Argentina, 2000–2008



[a] G: group; d/n: number of deaths / sample size; s: Kaplan–Meier 12-month survival estimate; EHDI: Extended Human Development Index for 2006 (19, 20); PM: patient migration.
[b] Including 95% confidence intervals.
[c] Overall: overall 12-month survival curve.

FIGURE 3. Twelve-month Kaplan–Meier survival curves for groups of lymphoid leukemia patients obtained after applying the amalgamation algorithm, Argentina, 2000–2008[a]



[a] Overall: overall 12-month survival curve; G1–G8: groups of lymphoid leukemia patients based on terminal nodes of RP algorithm.

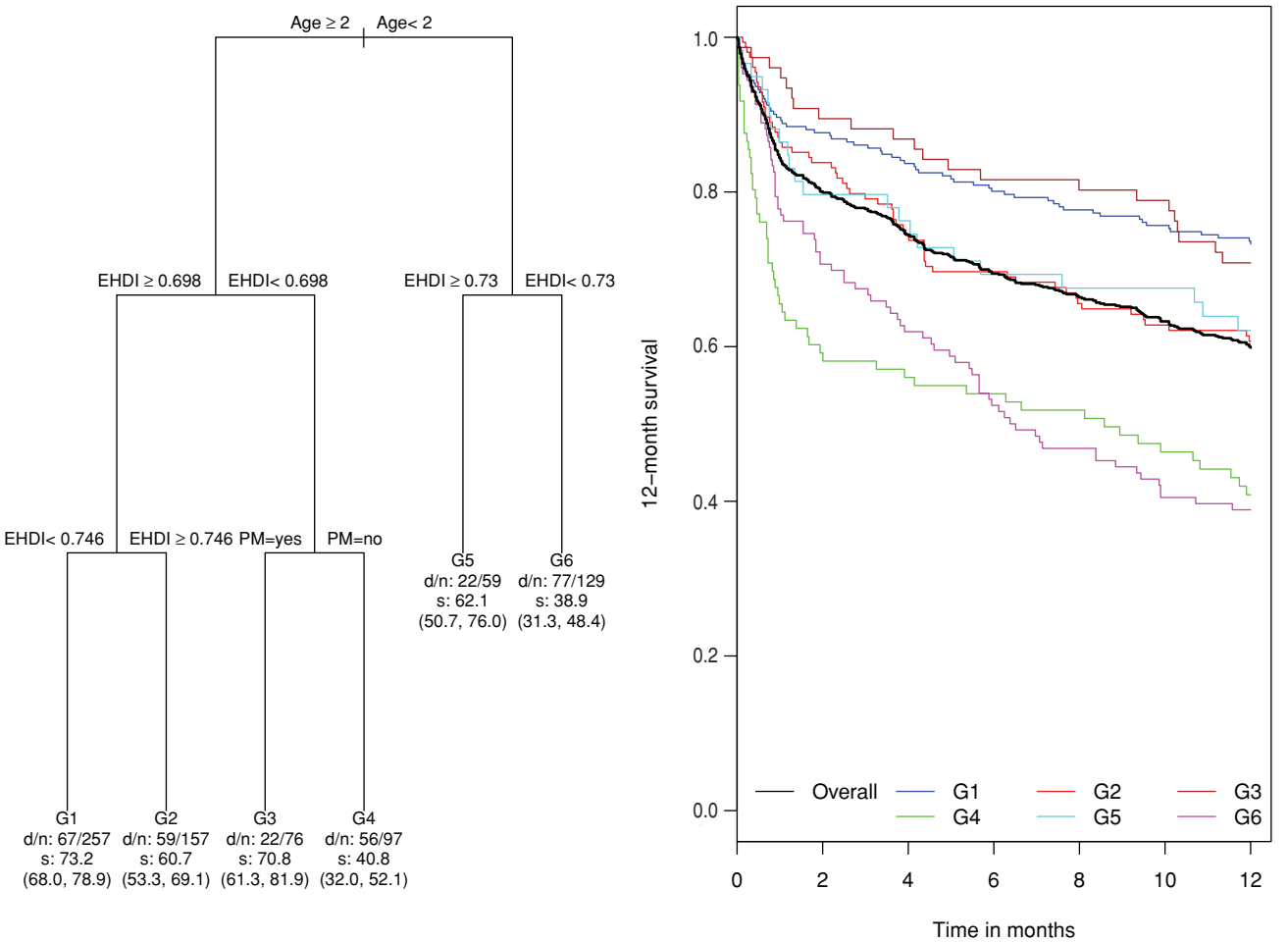
EHDI. The group of children 1–10 years old living in the poorer provinces (EHDI < 0.654) was subdivided by whether they migrated or not (G5 and G6). Those who did not migrate (G5) had a lower estimated 12-ms than those who migrated (G6)—78.2% compared to 87.0%. The 1–10-year-old group living in provinces with EHDI ≥ 0.654 was subdivided according to age in three groups: 1 year old (G4, 12-ms 79.4%); 2–4 years old (G1, 12-ms 92.3%); and 5–10 years old; the latter group had 91.1% or 84.9% 12-ms depending on whether they migrated or not (G2 or G3 respectively). The main gap in 12-ms for LL identified by the RP method (an 8.8% difference) was associated with non-migration versus migration for care—groups G5 and G6 respectively.

As shown in Figure 2, some of the survival curves appeared to be similar. Therefore, the amalgamation algorithm to merge nodes with similar prognosis was run. The four survival curves obtained after amalgamation are shown in Figure 3. The worst prognosis was for children < 1 year old (G8). The other group with prognosis below average and an estimated 12-ms of 76.6% (95% CI: 74.1, 79.2) resulted from the aggregation of three clusters: 1-year-old children from provinces with EHDI ≥ 0.65 (G4), children 1–10 years old from poor provinces (EHDI < 0.65) who did not migrate (G6), and patients 11–14 years old (G7).

Myeloid leukemia. The result of the RP approach for ML patients is represented in Figure 4; overall 12-ms was 59.9%. The EHDI of the province of residence played an important role in ML early survival. Two particularly poor prognostic groups were identified: the first (G6) was composed of children < 2 years old from provinces with EHDI < 0.73; estimated 12-ms was 38.9%. The second (G4) was composed of children 2–14 years old from provinces with EHDI ≤ 0.70 who did not migrate; estimated 12-ms was 40.8%. Therefore, RP identified two major gaps in the 12-ms experience. The first was between G5 and G6 and was associated with poverty (62.1% versus 38.9%). The second was between G3 and G4 and was associated with patient migration (70.8% versus 40.8%).

The amalgamation process resulted in three prognostic groups. The group with the worst prognosis had a 12-ms of 39.7% (95% CI: 33.8, 46.8) and included the two poor prognostic groups mentioned above (G4 and G6). The intermediate group included those diagnosed at < 2 years old from provinces with EHDI ≥ 0.73 (G5) and those diagnosed at 2–14 years old from provinces with EHDI ≥ 0.75 (G2); 12-ms was 61.1% (95% CI: 54.8, 68.1). Children diagnosed at 2–14 years old from provinces with EHDI between 0.7 and 0.75 (G1) and those from provinces with EHDI < 0.7 that migrated (G3) exhibited the best survival experience—12-ms of 72.7% (95% CI: 68.0, 77.7).

FIGURE 4. Recursive partitioning (RP) analysis for patients diagnosed with myeloid leukemia: RP tree[a,b] (left) and 12-month Kaplan–Meier survival curves for groups defined by terminal nodes of RP algorithm[c] (right), Argentina, 2000–2008



[a] G: group; d/n: number of deaths / sample size; s: Kaplan–Meier 12-month survival estimate; EHDI: Extended Human Development Index for 2006 (19, 20); PM: patient migration.
[b] Including 95% confidence intervals.
[c] Overall: overall 12-month survival curve.

DISCUSSION

This study provides population-based estimates on pediatric leukemia early survival in a Latin American country. Major gaps in 12-ms for leukemia cancer among Argentine children were revealed using the RP approach. Beyond the already-established relationship between age and LL survival—which is one of the grounds for classifying LL as standard-risk (1–9 years of age) or high-risk (older children and infants) (24)—the RP analysis identified an additional vulnerable group among the standard risk group: children from poorer provinces (EHDI < 0.65) who received treatment in their province had a 9% reduction in 12-ms compared to those who migrated for treatment. Interestingly, survival of those who migrated was similar to those from richer provinces. A similar relationship was observed for ML cases. Among ML patients diagnosed at < 2 years old, RP identified a large early survival gap: children from provinces with EHDI ≥ 0.73 had a 12-ms 60% higher than those living in poorer provinces. For ML patients 2–14 years old living in poor provinces (EHDI < 0.698), patient migration was associated with a 30% increase in 12-ms.

While the univariate Cox analysis also showed that EHDI was significantly associated with survival, the result of the RP analysis allows for a more precise identification of the subpopulations with larger survival gaps. Further, patient migration, which the RP approach identified as an important prognostic factor, did not appear as a relevant factor in the Cox analysis when considering the population as a whole. The RP approach automatically categorizes EHDI, age at diagnosis, and other explanatory variables into groups, guaranteeing that the survival pattern for a specific group of patients will be homogeneous within that group. This is advantageous compared to the traditional Cox model approach, in which categorization has to be decided a priori by the investigator and there is no guarantee of homogeneity within the class. In addition, the recursive nature of the RP method allows for the identification of prognostic factors that exert their influence in subsets of

subjects rather than across all subjects, as in the Cox model. In the current study, age at diagnosis was included in the analysis as a numerical variable measured in years. The strata defined by the RP technique were similar to those commonly used in pediatric oncology.

The current findings are similar to those in the existing literature. Regional differences in survival patterns for childhood cancers have also been documented in European populations (25, 26) and attributed to differences in access to and quality of health care. Valsecchi et al. (4), in a multi-center retrospective study of hospital admitted patients, found significant differences in three-year overall pediatric cancer survival across several Central America and Caribbean countries, largely due to treatment abandonment.

In Argentina, the lower survival rates observed in the poorer provinces may have less to do with treatment abandonment, which is not a significant problem in the country, and more to do with differences in the availability of supportive care services. This claim would be supported by the observation of better survival among those who migrate for treatment. Despite the fact that all treatment centers use the same protocols, hospitals in provinces with low EHDI are ill-equipped in terms of infrastructure, equipment, and trained providers. This disparity becomes particularly relevant in the early treatment period, the focus of the analysis reported here, given that initial leukemia treatments are intensive and much of their success depends on the provision of adequate supportive care.

The positive effect of migration on early survival was only observed among the groups with more favorable prognosis for both LL and ML. This result was difficult to interpret based on the information available for this study. The ROHA records did not include information such as prognostic factors other than age; clinical status at the time of the referral; and other possible reasons for the referral.

As most provinces in Argentina lack formal referral polices, patients can be referred to other health facilities for a myriad of reasons ranging from official recommendations for special procedures (e.g., stem cell transplants) to families' decision to migrate for treatment (which may have to do with their socioeconomic status, another factor affecting survival). Therefore, the effects of migration on survival may be related to complex interactions that could not be explored in this study. Further research is warranted to confirm the results reported here and to understand the phenomena.

In the meantime, the current findings may be used to guide targeted interventions for determining preestablished criteria for patient transfers to high-complexity hospitals, developing regional centers and networks, and improving infrastructure and training to help ensure adequate supportive care. These types of interventions may help narrow the gap of inequality between richer and poorer regions.

The evidence suggests that great progress can be made toward reducing the health gap by improving prevention, early detection, treatment, and palliative care (27, 28). In the United States, awareness of cancer disparities has stimulated the creation and strengthening of federal programs to decrease inequalities in cancer burden (29, 30). In Latin America, the implementation of pediatric cancer programs in several areas with limited economic resources has resulted in improved outcomes (7, 28, 31). Targeting the largest contributors to the overall burden of mortality, such as late diagnosis, inadequate support of treatment, and treatment abandonment, will do the most to reduce inequalities among Argentina's population. In recent years, workshops, twinning programs, and publications to improve early detection of pediatric cancer patients and build local capacity have been developed in Argentina (32, 33). In this regard, RP could become a useful tool for defining vulnerable subgroups of patients that may be particularly benefited by improvements in both short- and long-term policies.

Strengths and limitations

To the best of the authors' knowledge, this is the first population-based study reporting on survival of Latin American children diagnosed with leukemia. Nevertheless, the study has a number of limitations. First, although the completeness and quality of the ROHA data is high, the registry only includes a limited number of data items. Some important determinants of cancer survival, such as late diagnosis, clinical stage at diagnosis, treatment abandonment, and immunological subtype, are not available in the ROHA records, which limited the richness of the conclusions of this study. Despite these constraints, this study 1) highlights important gaps in leukemia survival in Argentine patients and 2) provides evidence of the usefulness of the RP strategy to identify inequalities. It is evident that with a database including a larger number of variables this methodology could contribute to a more accurate understanding of factors associated with disparities in this population. Second, this study lacked socioeconomic information at the family level. Therefore, the 2006 EHDI for the province of residence was used. The authors consider this aggregated socioeconomic measure an acceptable proxy for level of care of the health system. As mentioned above, the quality of pediatric oncology diagnosis and care available in a poor province is, in general, well below the top-level care accessible in richer provinces.

Conclusions

This study found important disparities in leukemia survival among Argentine children. The findings point to patient migration as one of the factors benefiting 1–10-year-old LL patients and 2–14-year-old ML patients living in poor areas. A low-cost, simple measure, such as implementing a protocol for referring patients to highly specialized health centers, may help reduce this gap. Actions allowing patients to complete treatment in their home province, resulting in a reduction of the time spent by the child and the family far from their home, would also be beneficial.

This study also 1) shows that the RP methodology is a valuable tool for evaluating health inequalities and 2) highlights the fact that population-based registries are indispensable for guiding decision-making in cancer care.

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Conflicts of interest. None.

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Disparidades en la supervivencia temprana a la leucemia infantil en Argentina: un estudio poblacional

RESUMEN

Objetivo. Determinar mediante particionamiento recursivo las disparidades en la supervivencia temprana de los niños con leucemia tratados en Argentina, y presentar las características principales de los grupos más vulnerables.

Métodos. Análisis de datos secundarios en el que se evaluó la supervivencia a los 12 meses de 3 987 niños diagnosticados entre el 2000 y el 2008 de leucemia linfoide (LL) y leucemia mieloide (LM), e inscritos en el registro oncopediátrico poblacional de Argentina. Mediante el método de particionamiento recursivo se determinaron los grupos pronósticos con base en la edad en el momento del diagnóstico, el sexo, el índice socioeconómico de la provincia de residencia y la migración a una provincia diferente para recibir atención de salud.

Resultados. La supervivencia global a los 12 meses correspondiente a los casos de LL y LM fue de 83,7 y 59,9%, respectivamente, y el método detectó brechas importantes en la supervivencia. Entre los pacientes de 1 a 10 años con LL de las provincias más pobres la supervivencia a los 12 meses de los que migraron y de los que no lo hicieron fue de 87,0 y 78,2%, respectivamente. La supervivencia de los pacientes con LM menores de dos años que residían en las provincias con un índice socioeconómico bajo o medio fue de 38,9%, en comparación con 62,1% en los pacientes del mismo grupo etario que residían en las provincias más ricas. En los pacientes con LM de 2 a 14 años de edad que residían en las provincias pobres, la migración se asoció con un aumento de 30% en la supervivencia a los 12 meses.

Conclusiones. Se observaron importantes disparidades en la supervivencia de los niños argentinos con leucemia. La supervivencia se asoció con la migración y el índice socioeconómico de la provincia de residencia. El método de particionamiento recursivo contribuyó a la determinación y caracterización de los grupos vulnerables.

Palabras clave Disparidades en atención de salud; leucemia; niño; países en desarrollo; análisis de supervivencia; Argentina.