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Diagnosis and management of neuropsychological sequelae in pediatric cancer survivors: a multicenter survey of healthcare professionals in Spain (SENECA-PED)

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Abstract

Purpose

Neuropsychological sequelae are increasingly recognized as relevant late effects among pediatric cancer survivors; however, their diagnosis and management remain inadequately standardized. This study assessed healthcare professionals' perceptions of these sequelae and evaluated routine practice, perceived barriers, and resource availability.

Methods

SENECA-PED was a national multicenter, cross-sectional study based on an anonymous online survey distributed through the Spanish Society of Pediatric Hematology and Oncology to professionals involved in pediatric cancer survivorship care. Descriptive and exploratory analyses were performed.

Results

Professionals from 32 hospitals in 14 autonomous communities completed the survey, out of a total of 46 departments of Pediatric Hemato-Oncology in Spain, representing a response rate of about 70% among Spanish departments. Specifically, seventy professionals participated, 65 of whom were pediatric hemato-oncologists. Neuropsychological sequelae were rated as highly or very highly important by 70.0% of respondents. However, only 28.6% reported high confidence in recognizing or assessing them, and 31.4% frequently identified these difficulties in routine practice. School performance was the area most often perceived as highly or very highly affected (61.4%). Only 28.6% reported a structured referral pathway, 48.6% access to a neuropsychologist dedicated to pediatric oncology, and 20.0% cognitive rehabilitation programs. Main barriers were lack of specialized professionals (77.1%), limited intervention resources (67.1%), absence of protocols (57.1%), and insufficient training (54.3%).

Conclusions

Spanish pediatric hemato-oncology professionals recognize neuropsychological sequelae as clinically relevant, but management remains heterogeneous and constrained by center-specific resources, protocols, and experience.

Implications for Cancer Survivors

Survivorship programs should incorporate risk stratification, brief patient- and family-reported screening, school input, and clear referral pathways to improve early detection and equitable access to neuropsychological assessment and rehabilitation.

2 Introduction

In recent decades, advances in pediatric oncology have significantly improved survival rates for pediatric cancers, making many of these conditions curable or manageable in the long term. Following these

improvements, the focus of healthcare has shifted beyond cure, placing greater emphasis on long-term outcomes and patients' quality of life. Among the long-term adverse effects associated with cancer and its treatments, neurocognitive sequelae are one of the most common and disabling complications. In this regard, a meta-analysis of pediatric brain tumor survivors revealed significant impairment across various neuropsychological domains, highlighting the magnitude of the problem in this population (1).

Initially, most research on treatment-related neurocognitive dysfunction focused on central nervous system tumors and cranial irradiation. However, over time it became evident that neurocognitive changes could also appear in patients without direct CNS involvement. The term cancer-related cognitive impairment (CRCI), commonly referred to as "chemobrain," is now widely used to describe neurocognitive difficulties occurring during or after cancer treatment (2). Problems involving attention, memory, executive functioning, and processing speed are among the alterations most frequently described. Similar concerns have also been raised in hematological malignancies, where chemotherapy-related neuropsychological dysfunction is increasingly recognized despite its heterogeneous clinical presentation (3). Experimental data suggest that several biological mechanisms may contribute to these changes, including inflammatory pathways, oxidative stress, and alterations in neuronal repair and neurogenesis (4).

In adults treated for cancer, neurocognitive impairment in various domains has been observed in performance-based measures after chemotherapy exposure (5). Nevertheless, the consequences are often more evident in everyday life than during formal testing. Survivors frequently describe difficulties concentrating, organizing tasks, multitasking, or maintaining work performance after treatment (6). Some patients report that these symptoms persist for years and feel that cognitive complaints are not always adequately explored during follow-up consultations (7). This discrepancy between patient experience and clinical recognition has become a recurring issue in survivorship research.

In pediatric patients, the situation may be particularly complex because treatment occurs during periods of active brain development. Even relatively subtle deficits may interfere with learning processes, school performance and integration, emotional regulation, and social relationships. Previous reviews in pediatric oncology have consistently pointed out that neurocognitive impairment may affect academic achievement and adaptive functioning long after treatment has ended (8). Moreover, qualitative studies conducted in childhood cancer survivors also suggest that these difficulties extend beyond the classroom and may influence social participation and daily functioning and autonomy (9). Families are often directly affected as well. In particular, parents of children with cognitive difficulties frequently describe uncertainty regarding prognosis, frustration related to school performance, and limited access to specialized support resources (10).

Although awareness of CRCI has clearly increased in recent years, routine neurocognitive assessment and follow-up is still far from standardized. Recommendations regarding its assessment and management exist, but their application in real-world clinical settings appears variable between institutions and healthcare systems (2). Supportive interventions have also received growing attention.

In pediatric oncology populations, psychological and play-based interventions have shown benefits in emotional well-being and symptom burden during hospitalization (11). Nevertheless, structured pathways specifically focused on neurocognitive screening, formal assessment and rehabilitation are not consistently available in many centers.

Another issue that deserves attention is the perspective of healthcare professionals themselves. Globally, studies performed in adult oncology settings have shown marked variability in clinicians' awareness and knowledge regarding chemotherapy-induced cognitive impairment (12). Differences have also been described in the way these symptoms are discussed with patients and in the degree of confidence professionals have when evaluating cognitive complaints. Similar findings were reported among Australian oncology professionals, where heterogeneity was observed not only in clinical practice, but also in familiarity with assessment tools and available referral resources (13). Altogether, these studies suggest that recognition of CRCI in scientific literature has not necessarily translated into standardized clinical management.

At the same time, discordance between clinicians' and patients' perceptions of neuropsychological impairment may complicate communication and decision-making during survivorship care (14). Research exploring literacy and understanding of cancer-related complications further supports the idea that awareness itself can influence how symptoms are interpreted and managed in clinical practice (15). Despite growing international interest in CRCI, information regarding how neurocognitive sequelae are currently approached in pediatric oncology settings remains limited, especially at a national level.

Therefore, the SENECA-PED study was designed to evaluate current practices related to the recognition, diagnosis, and management of neuropsychological sequelae in pediatric cancer survivors in Spain. Through a multicenter survey addressed to healthcare professionals involved in pediatric oncology care, this study aimed to explore perceptions regarding CRCI, available institutional resources, and the strategies currently used for neurocognitive assessment and follow-up.

3 Methods and analysis

3.1 Study design

SENECA-PED is a multicenter, cross-sectional study based on an anonymous online survey distributed among healthcare professionals involved in pediatric oncology care in Spain. This study focused on exploring how neuropsychological sequelae are currently recognized and managed in clinical practice, as well as identifying available resources and perceived limitations across different Spanish healthcare centers.

The survey remained open for approximately three months (February to April 2026). During this period, reminder emails were circulated monthly through the usual communication channels of the Spanish Society of Pediatric Hematology and Oncology (SEHOP) in order to encourage participation. From the second month onward, to increase the response rate, an email reminder was sent to the heads of

Pediatric Hematology-Oncology departments in most Spanish hospitals. Responses were anonymous, and participants were able to complete the questionnaire only once. No restrictions were established regarding the number of professionals participating from the same center.

3.2 Study objectives

3.2.1 Primary objectives

The primary objectives of the study were:

a. To evaluate healthcare professionals' perception of the frequency and clinical relevance of neuropsychological sequelae in pediatric cancer survivors.

b. To assess the recognition of affected neuropsychological domains and the importance attributed to neuropsychological sequelae in routine clinical follow-up.

c. To describe current practices related to the diagnosis and initial assessment of neuropsychological sequelae in pediatric oncology settings.

3.2.2 Secondary objectives

Secondary objectives included:

a. To describe the diagnostic pathways, criteria for referral, and tools used for neuropsychological assessment.

b. To analyze the management strategies and interventions available for patients with identified neuropsychological sequelae.

c. To evaluate the availability of specialized resources and multidisciplinary support across centers.

d. To identify perceived barriers and unmet needs in the care of neuropsychological sequelae.

e. To explore differences in clinical practice and perceptions according to professional role, experience, and center characteristics.

3.3 Trial population

Eligible participants were healthcare professionals involved in the care of children and adolescents with cancer in Spanish hospitals. The survey was distributed through the SEHOP and was open to physicians,

psychologists, neuropsychologists, nurses, and other professionals participating in pediatric oncology care.

Participation was voluntary and anonymous. No identifying personal information was collected, and no patient-level clinical data was included in the study.

3.4 Variables and instruments

Data was collected using a structured questionnaire specifically developed for this study. The survey included the following groups of variables:

- Professional and center characteristics: type of hospital, region, professional role, years of experience, and approximate patient volume.

- Perception and recognition variables: estimated frequency of neuropsychological sequelae, perceived importance, confidence in recognition, and identification of affected cognitive domains.

- Diagnostic practices: existence of protocols, timing of assessment, referral criteria, tools used, responsible professionals, and waiting times.

- Management and follow-up: types of interventions offered, follow-up strategies and perceived adequacy of resources.

- Center resources and barriers: availability of specialized services and knowledge of guidelines.

Most items were assessed using closed-ended questions, including multiple-choice questions and five-point Likert scales.

3.5 Statistical methods

A descriptive and exploratory statistical analysis was performed. Categorical variables were summarized using absolute frequencies and percentages, while ordinal variables were described using medians and interquartile ranges, as well as category distributions.

Bivariate analyses were conducted to explore associations between key outcomes (e.g., recognition, perceived importance, availability of protocols) and professional or center characteristics. Chi-square or Fisher's exact tests were used for categorical variables, and Mann–Whitney U or Kruskal–Wallis tests for ordinal variables, as appropriate. Statistical significance was set at $p < 0.05$.

Where relevant, composite descriptive indices (e.g., recognition of neuropsychological domains or resource availability) were constructed for exploratory purposes. All statistical analyses were performed using IBM SPSS Statistics for Windows, version 30.0 (IBM Corp., Armonk, NY, USA).

3.6 Ethics and dissemination

The study was considered low risk given its observational nature and the absence of patient-related information. Therefore, the approval of a local Ethics Committee was not required. Participation in the survey was voluntary, and completion of the questionnaire was considered to imply consent to participate.

All responses were collected anonymously and analyzed in aggregated form. Data handling complied with current regulations regarding confidentiality and data protection.

The results of the study are intended for dissemination through scientific meetings and peer-reviewed publications, with the aim of improving understanding of current neuropsychological follow-up practices in pediatric oncology and identifying potential areas for future development.

4 Results

Seventy healthcare professionals participated in the survey. Responses were received from 32 hospitals located in 14 different Spanish autonomous communities, out of a total of 46 departments of Pediatric Hemato-Oncology in Spain, representing a response rate of 69,5% among Spanish departments. Most participants worked in tertiary hospitals with dedicated pediatric hemato-oncology units (66/70, 94.3%). The sample mainly consisted of physicians involved in pediatric oncology care (65/70, 92.8%), although psychologists, nurses, and other professionals also completed the questionnaire. Based on the 284 pediatric hemato-oncologists registered as members of the SEHOP, the estimated participation rate among pediatric hemato-oncologists was 22.9% (65/284). Most participants had more than 10 years of experience in pediatric oncology (47/70, 67.1%), and nearly all reported routinely seeing pediatric cancer survivors (69/70, 98.6%).

There was considerable variability in how participants perceived the frequency of neuropsychological sequelae after chemotherapy and/or radiotherapy. The most frequent estimate was a prevalence between 25% and 50% (33/70, 47.1%). Another 21 respondents considered these complications to affect more than half of survivors, whereas 11 participants (15.7%) believed they occurred in fewer than 25% of cases.

Most professionals regarded neuropsychological sequelae as clinically relevant. In fact, 49 respondents (70.0%) rated their importance as high or very high. Nevertheless, confidence in recognizing these problems appeared lower. Only 20 participants (28.6%) reported feeling highly confident when assessing neuropsychological complaints, and fewer than one-third (22/70, 31.4%) stated that they frequently identified these difficulties during routine follow-up visits.

Attention and concentration were almost universally recognized as potentially affected domains (68/70: 97.1%). Memory impairment, processing speed, and executive functioning were also commonly selected, all by more than 80% of respondents. Emotional regulation difficulties and socialization problems were

reported less consistently, although still by a substantial proportion of participants. Only three respondents considered neuropsychological sequelae to be of little relevance in this clinical population.

When participants were asked about the consequences of these sequelae in everyday life, school performance was the area most frequently perceived as affected. Forty-three respondents (61.4%) rated the impact on academic performance as high or very high. The perceived effect on family and social quality of life was somewhat lower but still substantial (33/70: 47.1%). In comparison, fewer participants considered that neuropsychological sequelae had a marked impact on autonomy or daily functioning (27/70: 38.6%).

Interestingly, despite acknowledging the relevance of these complications, many professionals felt that neuropsychological sequelae still receive relatively limited attention compared with other long-term adverse effects in survivorship care. Forty respondents (57.1%) rated their current priority as low or very low, whereas only 11 (15.7%) considered them a high-priority issue during routine follow-up.

Approaches to neuropsychological assessment differed considerably between centers. Twenty respondents (28.6%) reported having a structured and well-established referral pathway in their institution. More commonly, participants described informal or non-standardized approaches (33/70: 47.1%). Fifteen professionals (21.4%) stated that no specific pathway was available in their center.

Neuropsychological assessment was most often considered during long-term follow-up (57.1%), at diagnosis (48.6%), or during treatment when clinically suspected (48.6%). The main triggers for referral were school difficulties or notification from school (80.0%), central nervous system tumors (74.3%), cranial radiotherapy (72.9%), and neurotoxic chemotherapy (61.4%). A smaller number of respondents reported evaluating patients who had received a hematopoietic stem cell transplant (28.57%) or CAR-T cell therapy (5.71%), and 5 participants (7.14%) stated that they evaluated all patients who had received any type of chemotherapy. Five participants (7.14%) reported not performing neuropsychological evaluations in their centers.

Regarding management strategies, the interventions most frequently described were school-oriented reports or recommendations (48/70, 68.6%), coordination with educational services (43/70, 61.4%), and psychoeducational support for patients and families (42/70, 60.0%). Access to formal neuropsychological rehabilitation programs appeared less common and was reported by 32 participants (45.7%). Follow-up practices showed substantial variability. Half of the respondents (35/70: 50.0%) described scheduled reassessment after identification of persistent neuropsychological difficulties. In contrast, 14 professionals (20.0%) reported that no specific follow-up was routinely performed once these sequelae had been detected.

The availability of specialized resources also differed notably between centers. Only 34 respondents (48.6%) reported access to a neuropsychologist specifically dedicated to pediatric oncology patients. Neurocognitive rehabilitation programs were available according to 14 participants (20.0%), whereas 36 (51.4%) stated that these resources were not available in their institution. Overall, the adequacy of

available resources was generally perceived as limited. Forty-one respondents (58.6%) rated institutional resources as poor or absent, while only eight (11.4%) considered them adequate or highly adequate.

Lack of specialized professionals was identified as the main barrier to adequate neuropsychological care (54/70, 77.1%). Other frequently mentioned limitations included restricted access to intervention resources (47/70, 67.1%), absence of structured clinical protocols (40/70, 57.1%), and insufficient specific training (38/70, 54.3%).

Finally, in exploratory bivariate analyses, professionals with more than 10 years of experience perceived available resources as less adequate than those with 10 years or less (median 2 vs 3; $p = 0.024$). No other statistically significant differences were observed in the exploratory comparisons by professional role, experience, or annual patient volume.

5 Discussion

The SENECA-PED study provides a national overview of how healthcare professionals involved in pediatric oncology care approach neuropsychological sequelae among childhood cancer survivors in Spain. Our results indicate that professionals recognize the high clinical relevance of these sequelae, as well as their important impact, particularly regarding the academic performance. However, there is a clear gap between this perception and other aspects of clinical practice: limited confidence in recognizing and managing these complications, low priority compared with other late effects, scarcity of clinical protocols, and restricted availability of resources.

In this study, 47.1% of respondents estimated that neuropsychological sequelae affect between 25% and 50% of pediatric cancer survivors treated with chemotherapy and/or radiotherapy, while 30.0% believed that more than half may be affected. These figures are not far from what has been described in the literature, although prevalence is difficult to compare across studies because definitions, clinical populations, and assessment methods vary widely. In particular, neuropsychological impairment has been most consistently reported in survivors of pediatric brain tumors (1), but it is also well recognized as a relevant late effect in broader childhood cancer survivor populations, particularly after central nervous system–directed therapy (16). Moreover, in acute lymphoblastic leukemia, cognitive late effects have been described even after chemotherapy-only approaches, especially in relation to methotrexate exposure, with attention, processing speed, executive functions, and academic skills frequently affected (17). More recent data also suggest that survivors of extracranial tumors may present neuropsychological and biopsychosocial difficulties. For example, in rhabdomyosarcoma survivors, impairment was reported in 21.1% for task efficiency, 19.3% for memory, and 16.7% for emotional regulation (18). Also, the RISK-N study found mostly preserved global intellectual functioning but more frequent executive, attentional, fatigue-related, and quality-of-life difficulties in children and adolescents treated for extracranial solid tumors and lymphomas (19). In this regard, qualitative studies further supports the impact of these difficulties on social, academic, and daily living skills (9). Overall, the estimates reported by healthcare professionals in SENECA-PED project appear clinically plausible,

although these also highlight why neuropsychological morbidity in pediatric oncology cannot be reduced to a single prevalence figure.

The findings of this study are consistent with previous reports in the literature, which identify attention, memory, processing speed, and executive functions as especially impaired domains (1). In addition, the fact that academic performance emerged as the main area affected is coherent with the neurodevelopmental stages of pediatric population, whereas in adults the impact is often particularly evident in the labor setting (6). These sequelae have been especially detected or studied in brain tumors and hematological malignancies. Nevertheless, an increasing number of studies suggest that survivors of extracranial solid tumors, such as sarcomas or lymphomas, may also present neuropsychological impairment (18, 19)

Interestingly, one of the most striking findings was the disparity between respondents' answers. Although 70% emphasized the high or very high importance of neuropsychological sequelae in this clinical population, only 31.4% reported identifying it frequently, 28.6% reported high confidence in its detection and management, and 57.1% considered its priority to be low or very low compared with other long-term adverse effects. This gap does not seem to reflect a complete lack of awareness, but rather a combination of limited experience, lack of practical tools, and poor integration into routine clinical care. Other studies, particularly in adult oncology, report similar perceptions. A recent qualitative study with French oncologists described neurocognitive complaints as a "grey area" in oncology, often addressed only when patients explicitly raise the issue (20). Another study observed that professionals' experience and perceptions may influence the importance they attribute to this problem and, consequently, the way they address it with patients (13). This may partly explain why, in our study, more experienced professionals more frequently perceived available resources as insufficient.

Our results also show substantial heterogeneity in diagnostic pathways and a lack of clear clinical management protocols. Only 28.6% of respondents reported having a structured and well-known pathway. Moreover, in most cases, referrals depended on the appearance of school-related difficulties and was often limited to patients with central nervous system tumors or those who had received cranial radiotherapy. Reliance on clinical or educational problems may delay an early detection, and restricting assessment to a single oncological diagnosis or treatment type may be insufficient. The absence of established pathways, also recognized in similar studies (15, 21), may generate inequities between centers. Recent guidelines and consensus statements propose systematic screening, or at least structured procedures. In this regard, European Delphi-based recommendations for the management of cancer-related neurocognitive impairment propose a stepwise approach including screening, brief objective assessment, comprehensive evaluation in persistent cases, and interventions such as neuropsychological rehabilitation, physical activity, or multimodal approaches (22). Spanish guidelines for the management of long-term toxicities in adolescents and young adults recommend neuropsychological assessment 6 months after treatment completion and annually for 5 years in all patients who have received cranial radiotherapy, although they do not specify recommendations for other patient groups (23).

In Spain, the need for neuropsychological assessment and rehabilitation in pediatric oncology was already raised more than two decades ago. Bernabeu et al. described the importance of assessing and rehabilitating neuropsychological alterations in pediatric oncology patients, emphasizing the need for early identification and for interventions adapted to the child and their environment (24). However, resource availability remains very limited and heterogeneous. Most participants perceived available resources as scarce or absent. Fewer than half reported access to neuropsychology with specific dedication to pediatric oncology, and only one-fifth reported neurocognitive rehabilitation programs in their center. The most frequently reported actions were school reports and recommendations, coordination with educational services, and psychoeducational guidance for families. These measures are essential and should probably represent the first level of response, but they may be insufficient for patients with persistent or complex neuropsychological difficulties.

The barriers identified in our study may help guide strategies to improve care pathways. The main limitation reported was the lack of specialized professionals, followed by limited intervention resources, absence of protocols, and lack of specific training. These findings suggest that improving neuropsychological care does not depend solely on increasing professional awareness. Teams of neuropsychologists, screening tools, shared referral criteria, interdisciplinary pathways, and accessible intervention and follow-up resources are needed.

Another implication of our findings is the need to incorporate patient-reported outcome measures (PROMs) or parent/teacher-reported measures into neuropsychological surveillance. During survivorship follow-up, mild cognitive difficulties can be difficult to detect in the clinical setting, particularly when their consequences are mainly academic, emotional, task-related, or reflected at home. For this reason, a brief questionnaire completed by parents or by the patient, especially in adolescents, and ideally also by the school, could help identify those cases requiring a more comprehensive and formal neuropsychological evaluation. This would not replace formal assessment, but it could represent a first step in healthcare centers, particularly in those without easy access to neuropsychological care.

In this sense, we propose a pragmatic screening algorithm based on risk factors and on the perspective of patients and families (Fig. 1). First, pediatric cancer survivors should undergo risk stratification at the end of oncological treatment or during follow-up. Patients would be considered high risk if they had a central nervous system (CNS) tumor; had received cranial radiotherapy, hematopoietic stem cell transplantation, cellular therapy, or neurotoxic chemotherapy; were diagnosed at an early age; or had neurodevelopmental or academic difficulties before cancer diagnosis. We define early age as younger than 6 years. Although other chemotherapy treatments may also cause CRCI, we considered chemotherapy with neurotoxic potential to include intrathecal or intraventricular chemotherapy, as well as high-dose methotrexate and high-dose cytarabine. Second, high-risk patients, or those for whom there is concern from the own patient, family, school environment, or clinicians, should undergo a brief screening. However, our findings also highlight the need to standardize new screening instruments specifically adapted to the pediatric cancer survivor population. These tools should be brief, feasible for use in routine clinical practice, and able to incorporate both patient- and parent-reported perspectives. In

this context, the PROMIS Pediatric Short Form v1.0 – Cognitive Function 7a (25, 26), as a self-reported measure for children and adolescents aged 8 to 17, and the PROMIS Parent Proxy Bank v1.1 – Cognitive Function (27, 28), for reporting about their children between the ages of 8 and 17, may represent useful candidate instruments for initial screening, particularly because they can capture perceived cognitive difficulties from both the child/adolescent and caregiver perspectives. Third, screen-positive results, or persistent concern from parents, patients, or school, should prompt referral for formal neuropsychological assessment. Finally, the results of this assessment should lead to an individualized care plan including academic recommendations, family support, neuropsychological rehabilitation when available, and specific follow-ups with reassessment when needed.

Beyond diagnosis and referral, an additional challenge is to develop neuropsychological interventions that children and adolescents are willing and able to use over time. Technology-based approaches, including game-based cognitive training, may offer an attractive framework because they can combine repeated practice with motivational elements and flexible delivery. Current evidence in pediatric oncology is still preliminary, but eHealth and mHealth interventions appear feasible and acceptable in this population (29), and serious videogames have shown positive effects on behavioral outcomes and self-efficacy in adolescents and young adults with cancer (30). These data justify further research into digital and game-based rehabilitation strategies aimed specifically at neuropsychological sequelae in childhood cancer survivors (31).

Taken together, these findings support a scalable call to action. At a minimum, pediatric oncology survivorship programs should be able to identify patients at risk, apply brief family- or patient-reported screening tools, and define a referral pathway for comprehensive neuropsychological assessment. Centers with greater resources should move toward integrated neuropsychology-led follow-up and access to neurocognitive rehabilitation. At a national level, shared screening tools, common referral criteria, professional training, and coordination with educational services could reduce variability between centers and improve equity of care.

This study has several strengths. First, it provides a national multicenter approach to a relatively underexplored aspect of pediatric cancer survivorship from the perspective of healthcare professionals. Second, it includes participants from multiple regions and healthcare centers involved in pediatric oncology care, allowing us to identify common patterns in some areas and heterogeneity in others. In addition, this study addresses professional perceptions, diagnostic pathways, available interventions, resources, and barriers in an integrated manner. Therefore, this work provides a broad view of the problem.

Some limitations should also be acknowledged. Participation was voluntary, so selection bias toward professionals particularly interested or sensitized to the topic cannot be excluded. The vast majority of respondents were physicians, resulting in limited representation of other professionals such as neuropsychologists or nurses. In addition, the data reflects self-reported perceptions and practices, rather than an objective assessment of resources and care pathways. As the number of responses per

center was not restricted, some hospitals may have been represented by more than one professional, potentially leading to institutional overrepresentation. Finally, the sample size limits the interpretation of comparative analyses, which should be considered exploratory.

Overall, the results of SENECA-PED project show that neuropsychological sequelae are recognized by professionals as a relevant complication in pediatric cancer survivors, but their management remains variable and strongly influenced by the availability of resources, pathways, and training. These findings support the need to move toward national strategies that facilitate early detection, structured referral, and equitable access to neuropsychological and educational interventions. Moving from recognition of the problem to an integrated healthcare response should be considered a priority within follow-up programs for pediatric cancer survivors in Spain.

6 Conclusions

The SENECA-PED study highlights a critical point: Spanish healthcare professionals are clearly aware of the substantial impact of neuropsychological sequelae in pediatric cancer survivors. These are not minor difficulties, but frequent and deeply disruptive deficits that affect both academic performance and patients' overall development and quality of life.

The fundamental challenge, however, lies in the marked gap between recognition of these deficits and its actual clinical management. In particular, many clinicians openly report limited confidence in detecting or managing these neuropsychological deficits. Even more importantly, specific care pathways and protocols remain scarce or difficult to access, limiting children's access to neuropsychological assessment and cognitive rehabilitation, thereby contributing to inequities in care across centers.

Moving forward, neuropsychological surveillance should no longer be overlooked; it should be formally integrated into pediatric cancer survivorship care protocols. Addressing this gap will require practical screening tools, shared assessment criteria, effective coordination between healthcare professionals, hospitals and schools, and feasible, evidence-based neuropsychological rehabilitation programs.

Declarations

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Author Contribution

C.G.-P. and E.F.-J. contributed equally to this work and share first authorship. C.G.-P., E.F.-J., and A.P.-M. conceived the study. C.G.-P. designed the survey, under the supervision of E.F.-J. and A.P.-M., and coordinated data collection. C.G.-P. and E.F.-J. performed the statistical analysis. C.G.-P., E.F.-J., and A.P.-

M. interpreted the results. C.G.-P. and E.F.-J. developed the proposed screening algorithm. C.G.-P. wrote the first draft of the manuscript. E.M., H.M., M.A.P., E.F.-J., and A.P.-M. critically reviewed the manuscript and contributed important intellectual content. E.M. and M.A.P. provided institutional support through Fundación Juegaterapia. E.F.-J. and A.P.-M. supervised the study. All authors reviewed and approved the final version of the manuscript.

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Data Availability

All data supporting the findings of this study are available within the paper and its Supplementary Information.

Associated Data

All data supporting the findings of this study are available within the paper and its Supplementary Information.

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Figures

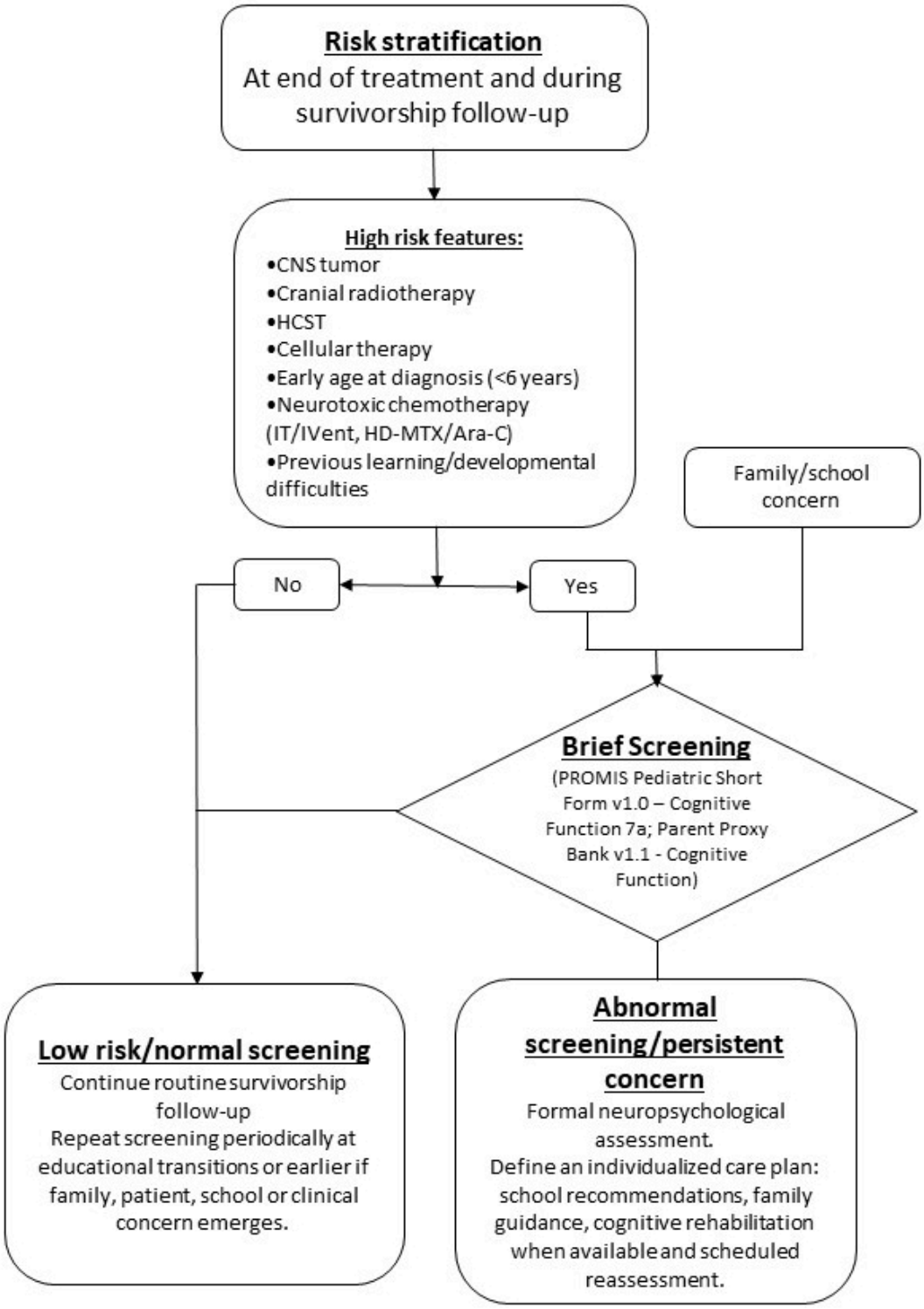


Figure 1

Proposed pragmatic neurocognitive screening algorithm for pediatric cancer survivors. CNS, central nervous system; HSCT, hematopoietic stem cell transplantation; IT, intrathecal; IVent, intraventricular; HD-MTX, high-dose methotrexate; Ara-C, cytarabine; PROMIS, Patient-Reported Outcomes Measurement Information System.

Supplementary Files

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- S1.Table1.Surveyresults.docx
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- S3.SurveyTranslatedEnglish.pdf