

BALANCE IN CHILDREN WITH ACUTE LYMPHOBLASTIC LEUKEMIA: A REVIEW

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Background

Acute Lymphoblastic Leukemia (ALL) is the most common type of pediatric cancer and its incidence is steadily increasing. Since the survival rate has increased significantly, now more attention is shifted toward alleviating treatment side effects. One of the less investigated side effects is balance impairment. It has been demonstrated that chemotherapy can impact balance by different mechanisms, including peripheral neuropathy, interruption between spinal cord and cortical areas, cognitive impairment, and reduced muscle strength and flexibility. Considering the important role of balance in child psychomotor development and the typical early onset of ALL, children with ALL are at high risk for developing other motor impairments which can further impact the child's quality of life.

Purpose

A review conducted to investigate the effects of cancer treatment on balance performance in children with ALL both during and after the completion of chemotherapy.

Methodology

Search engines: Medline, Cochrane, CINAHL, PsycINFO, Embase and PEDro

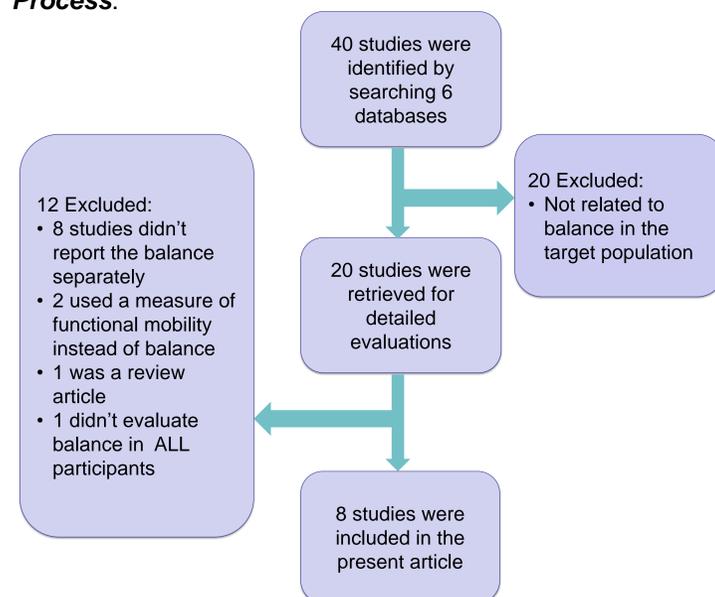
Time frame: Articles published between January 1994 to May 2014

Search terms: Acute Lymphoblastic Leukemia, Neoplasms, Child, Adolescent, Childhood Leukemia, Gross Motor Skills, Motor Performance, Motor Skills, Physical Fitness, Postural Equilibrium, Postural Balance and Postural Stability.

To be included studies should:

- 1) Be an original research article
- 2) Have a full text version available in English
- 3) Have measured balance as a primary or secondary outcome during or after treatment for pediatric ALL
- 4) Have reported the results of balance assessment

Process:



Article	Study Group	Control Group	Outcomes	Design	Major Findings
Wright, et al. 1998	<ul style="list-style-type: none"> n=36 (M^a=25) Median: 9.3 y Range: 5.5-14.5 y Survivors off therapy at least for 1 year Risk for relapse: <ul style="list-style-type: none"> -Standard: n=20 -High: n=16 	Yes n=36 Matched for age and gender	BOTMP ^b	Cross-sectional Case-Control	<ul style="list-style-type: none"> Balance significantly lower in ALL group No sex difference in balance Standard risk group performed better than high risk (except balance)
Reinders-Messelink, et al. 1999	<ul style="list-style-type: none"> n=17(M=11) Median age: 5.10 y Range: 4-12.7 y Patients under treatment 	Yes n=10 (M=7)	MABC ^c	Descriptive, Longitudinal evaluation at five points during treatment	<ul style="list-style-type: none"> Balance significantly lower in ALL group Balance deficits most pronounced at end of induction phase 6 mos. after reinduction phase, problems with balance decreased Females performed significantly better than males in balance tests
Galea, et al. 2004	<ul style="list-style-type: none"> n=79 (M=42) Median: 11.3 y Range: 5.7-25.2 y Survivors off therapy at least for 1 year 	Yes n=83 (M=38)	Force platform In 6 different conditions: <ul style="list-style-type: none"> • NEO^d • REC^e • NEC^e • FEO^h • REO^f • FECⁱ 	Cross-sectional Case-Control	<ul style="list-style-type: none"> Balance in ALL group was poorer in proprioceptively attenuated and visually denied condition (FEC) Balance in 2 groups were comparable in NEO and REQ conditions No sex effect No cranial irradiation effect
Wright, et al. 2005	<ul style="list-style-type: none"> n=99 (M=55) Mean=12.1 y Range : 5.1-25.2 y Survivors off therapy at least for 1 year 	Yes n=89 (M=44)	BOTMP	Cross-sectional Case-Control	<ul style="list-style-type: none"> Balance significantly lower in ALL group Effect of sex on balance was not reported Cranial irradiation and being overweight were significant predictors of impaired balance
van Brussel, et al. 2006	<ul style="list-style-type: none"> n=13 (M=6) Mean: 15.5 y Range: 8.6-23.7 y Survivors off therapy for 5-6 years 	No	MABC	Descriptive	<ul style="list-style-type: none"> 1 of 13 was at risk for impaired balance 12 of 13 scored within normal range No examination of predictors
Ness, et al. 2012	<ul style="list-style-type: none"> n=415 (M=203) Median age: 35.6 y Range: 21.9-52.3 y Survivors more than 10 years from diagnosis 	No	Computerized Dynamic Posturography (SOT ^j)	Cross sectional	<ul style="list-style-type: none"> Impaired balance in 15.4% of survivors Mean score on SOT was similar to that of 60-69 y people. In those with limited balance, scores deteriorated with each added balance challenge. Females were 2.5 times more likely to experience balance problems
De Luca, et al. 2013	<ul style="list-style-type: none"> n=37 (M=16) Range: 5-12.1 y Children diagnosed between 3-5 y, divided to 3 groups according to months after completion: (1) 0-12, (2) 13-24, and (3) 25-60 	No Results compared to normative data	MABC-II ^k	Cross sectional	<ul style="list-style-type: none"> No significant difference in balance between groups or with test norms. 10% of participants in group 1, 30% in group 2 and 0% in group 3, obtained a score in the impaired range on the balance subtest. Females performed significantly better than males in balance tests
Leone, et al. 2014	<ul style="list-style-type: none"> n=20 (M=10) Mean age: 10.56 y Range: 9-11 y Survivors off therapy at least for 1 year 	No Sample of healthy children from population based study	UQAC-UQAM ^l test battery: <ul style="list-style-type: none"> • Eyes open, one-foot on beam • Eyes closed, one-foot 	Cross sectional	<ul style="list-style-type: none"> Balance significantly lower in ALL Females were more severely affected with about 70% of the cases below the 15th percentile (considering all motor skills together)

Note: a: Male, b: Bruininks-Oseretsky Test of Motor Proficiency, c: Movement Assessment Battery for children, d: Normal Surface with eyes open, e: Normal surface with eyes closed, f: Romberg test with eyes open, g: Romberg test with eyes closed, h: Foam surface with eyes open, i: Foam surface with eyes closed, j: Sensory Organization Test, k: Movement Assessment Battery for children, second version, l: University of Québec in Chicoutimi and University of Québec in Montréal

Conclusions

- The differences in age at diagnosis, age at time of evaluation, treatment, evaluation time (during or after end of treatment) and methods of quantifying balance make it difficult to reach a single conclusion.
- 5 out of 8 included studies identified significant balance problems in children with ALL during or after treatment.
- The effect of sex and other potential predictors on balance in children with ALL need to be further elucidated.
- There is evidence to suggest that survivors of ALL may experience short and long term balance difficulties, however more longitudinal studies with larger sample sizes are needed to determine the impact of treatment on balance.
- Identifying the presence and severity of balance impairment can help in clinical decision making. Addressing balance impairment may positively impact the activity and participation level and improve child's quality of life.
- Based on the results of this review, balance evaluation is recommended for all ALL patients and survivors.

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