

Differences in psychomotor development among preschool children according to the type of early childhood education institution in Temuco, Chile

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ABSTRACT

Introduction. Psychomotor development is an essential indicator of child growth that integrates cognitive, motor, linguistic, and socio-emotional dimensions.

Objective. To evaluate the association between the type of educational institution and psychomotor development in preschoolers.

Population and methods. A cross-sectional analytical study was conducted in 2019 among children aged 2 to 4 years attending public and private preschools. Psychomotor development was assessed using the Test of Child Learning and Development (TADI, by its Spanish acronym), validated in Chile. Multinomial logistic regression was performed, adjusting for socioeconomic status, maternal education, and the child's age, sex, and nutritional status.

Results. A total of 151 children were included; 52.7% of the participants were girls, and the mean age was 40 ± 8.1 months. An association was observed between attending public facilities and a classification of risk or delay in global psychomotor development (OR = 7.34; 95%CI: 1.65-32.58; $p < 0.05$) and cognitive development (OR = 10.83; 95%CI: 1.64-71.59; $p < 0.05$), compared with private facilities. Male gender was associated with increased risk of, or delay in, global psychomotor development (OR = 6.53; 95%CI: 1.94-22.08), cognitive development (OR = 4.45; 95%CI: 1.41-13.99), and motor development (OR = 3.07; 95%CI: 1.17-8.08).

Conclusion. The type of educational setting and gender were associated with differences in psychomotor development among preschoolers. The findings should be interpreted with consideration of possible sociodemographic and contextual factors that were not fully captured.

Keywords: growth and development; neurodevelopment; preschool education; public sector; private sector.

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INTRODUCTION

Psychomotor development (PD) is a fundamental aspect of childhood growth and encompasses domains such as gross and fine motor skills, language, cognition, and socio-emotional development; it results from a complex interaction among biological, environmental, and social factors.¹ Globally, estimates of the prevalence of psychomotor developmental delays vary due to a lack of consensus regarding the instruments and criteria used for their assessment.² In Chile, according to the 2016–2017 National Health Survey, the prevalence of psychomotor developmental delays in children under five years of age was 28.2%.³

The environment plays a fundamental role in psychomotor development during the early years of life, a period when the brain exhibits greater plasticity and sensitivity to environmental stimuli.⁴ Although the home is the primary setting of influence, early childhood education settings also represent an important space for child development, given the amount of time children spend there each day.⁵

International evidence suggests that early childhood education is associated with better academic and developmental outcomes later in life.^{6,7} In Latin America, various studies have described associations between early childhood education, socioeconomic context, and child development, noting that early childhood education can promote cognitive, communication, and socio-emotional skills, especially in contexts of social vulnerability.⁸ However, access to early childhood education and care services remains uneven and stratified by socioeconomic status, leading to inequalities in educational opportunities during early childhood.⁹

In Chile, early childhood education is provided in public, subsidized private, and private schools. Approximately 11% of these schools are in the private sector. In contrast, public schools primarily serve vulnerable families with children aged 0 to 6.¹⁰ International studies have shown that children from families with greater socioeconomic advantages tend to attend private institutions. In contrast, those in more vulnerable circumstances attend public institutions more frequently.¹¹ It has been documented that attendance in early childhood education can promote child development, especially among children from low socioeconomic backgrounds,¹² who exhibit better psychomotor development than those who do not attend early childhood education,¹³ and that the

quality of the educational process is associated with better outcomes in cognitive, behavioral, and socioemotional development.¹⁴

Although international evidence highlights the positive impact of early childhood education on child development, in Chile, few studies directly compare psychomotor development across types of educational institutions. Understanding how this factor is associated with child development is important for guiding early childhood support strategies. Therefore, the objective of this study was to evaluate the association between the type of early childhood education setting and preschoolers' psychomotor development in Temuco, Chile.

POPULATION AND METHODS

Study design and participants

A cross-sectional analytical study conducted in 2019 on a sample of preschoolers aged 2 to 4 years from six early childhood education centers—three public and three private—in the city of Temuco, Chile. Non-probabilistic convenience sampling was used to select the centers, considering accessibility and willingness to participate. At the selected schools, children deemed potentially eligible were invited to participate. Preschoolers who regularly attended the schools were included, while those with prior diagnoses of neurological or developmental disorders or sensory deficits that could affect psychomotor development were excluded.

Psychomotor development

The Child Learning and Development Test is a standardized, valid, and low-cost instrument developed in Chile that assesses the development of children aged 3 months to 6 years through direct observation and caregiver interviews.^{15–17} It assesses four domains (cognition, motor skills, language, and socioemotional development) across 13 age ranges and takes 20–30 minutes to administer. Raw scores are converted into age-standardized T-scores, which allow for the classification of development (both overall and by domain) into five categories: advanced (≥ 60), normal (40–59), normal at risk (normal overall, but with at least one domain at risk or delayed), at risk (30–39), or delayed (< 29).¹⁸

The instrument was administered directly to the child by trained evaluators using standardized tasks, while the reporting component was completed by the teacher in charge. The evaluations were conducted individually at the schools under appropriate conditions.

Type of educational institution

Information on the type of early childhood education setting (public or private) was obtained through a structured survey designed for this study and administered to the children's primary caregivers. In this study, the term "type of early childhood education setting" refers to a classification based on funding and administrative structure, distinguishing between public (state-funded) and private (self-funded) settings.

Covariates

The covariates considered in this study were socioeconomic status, the child's age, nutritional status, the mother's educational level, and maternal age, all of which were obtained through a questionnaire.

Socioeconomic status

Socioeconomic status was determined based on the categories proposed by the Chilean Association of Market and Public Opinion Researchers (AIM-Chile, by its Spanish acronym), which classifies the population into the following groups: AB, C1a, C1b, C2, C3, D, and E.¹⁹

Nutritional status

Nutritional status was determined using the World Health Organization (WHO) sex-specific growth reference curves. For weight and height, a vertical scale (Seca 700™) and a stadiometer (Seca 213™) were used. Based on the weight-for-height (W/H) ratio, participants were classified according to their Z-score as normal weight (≥ -2 standard deviations [SD] and $< +1$ SD), overweight ($\geq +1$ SD and $< +2$ SD), and obese ($\geq +2$ SD).²⁰

Statistical analysis

A descriptive analysis was performed using absolute and relative frequencies for categorical variables, and measures of central tendency (mean or median) and dispersion (standard deviation or interquartile range) for continuous variables, based on their distribution as assessed by the Shapiro-Wilk test. To analyze the association between facility type and psychomotor development, multinomial logistic regression was used. Although the dependent variable was ordinal, the ordinal model did not meet the assumption of proportional odds, despite having lower Akaike information criterion (AIC) and Bayesian information criterion (BIC) values; therefore, the multinomial model was chosen, as it showed a better fit based on the log-likelihood. The

models were adjusted for socioeconomic status, nutritional status, educational level, maternal age, and the child's age and sex. For the analysis of global psychomotor development, the categories "at risk or delayed," "normal with risk," and "advanced" were used, with normal psychomotor development serving as the reference category. For the analysis by dimension, the "at risk" and "delay" categories were grouped into a single category ("at risk or delay"), while the "advanced" category was retained; the "normal" category was also used as the reference in the multinomial models. The presence of multicollinearity among the independent variables was assessed using the variance inflation factor (VIF), and no values indicative of significant multicollinearity were observed.

Ethical considerations

The project was approved by the Scientific Ethics Committee of the Universidad de La Frontera (July 11, 2019, No. 076_19), in accordance with the ethical principles of the Declaration of Helsinki. Written informed consent was obtained from the parents or guardians of all participants.

RESULTS

Of the 210 children invited to participate, 156 accepted; 5 children were excluded. The final analysis included 151 participants.

The average age was 40 ± 8.14 months; 52.7% of the participants were girls. The characteristics of the participants, by type of educational institution, are presented in *Table 1*. Regarding overall psychomotor development, 59.6% of the children showed normal development; 15.5% were classified as normal with risk; 14.9% as at risk or delayed; and 9.9% as advanced. In the dimensions of psychomotor development, the frequency of children classified as at risk or delayed was 14.9% in cognition, 17.4% in motor skills, 15.5% in the socioemotional domain, and 13.7% in language. Significant differences were observed in maternal education level, maternal age, and socioeconomic status. In private schools, there was a higher proportion of mothers with higher education and a higher average age (35 ± 4.8 years). Nearly 58% of children from low or very low socioeconomic backgrounds attended public schools ($p < 0.001$). There were no differences in age, sex, or nutritional status.

Table 2 shows that an association was observed between attending public schools and

TABLE 1. Sociodemographic characteristics by type of educational institution

Variables	Educational institution		p- value
	Public	Private	
	N (%)	N (%)	
Participants (total)	86 (57)	65 (43)	
Gender			
Female	48 (55.8)	30 (46.2)	0.24
Male	38 (44.2)	35 (53.8)	
Age (months), X ± SD	39.9 ± 8.37	41.81 ± 8.06	0.16
Mother's educational level, X ± SD			
Elementary-middle school	44 (52.4)	4 (6.2)	<0.001*
High school	21 (25)	4 (6.1)	
Postgraduate	19 (22.6)	57 (87.7)	
Maternal age, years, X ± SD	31 ± 6.72	35 ± 4.80	<0.001*
Socioeconomic status			
Very low	28 (32.6)	1 (1.5)	<0.001*
Low	22 (25.6)	1 (1.5)	
Medium	26 (30.2)	12 (18.8)	
High	10 (11.6)	50 (78.2)	
Nutritional status			
Normal weight	35 (40)	29 (44.6)	0.58
Overweight/obese	51 (60)	36 (55.4)	

Values are expressed as mean ± standard deviation (X ± SD) or n (%). P-values were obtained using Student's t-test for continuous variables and the chi-square test for categorical variables. An asterisk indicates statistical significance (*p < 0.001).

being classified as at risk or having a delay in overall psychomotor development (OR = 7.34; 95%CI: 1.65-32.58; $p < 0.05$) and in the cognitive domain (OR = 10.83; 95%CI: 1.64-71.59; $p < 0.05$) (Table 3), compared with attending private facilities. All analyses were adjusted for socioeconomic status, child's age, educational level, maternal age, and nutritional status.

Similarly, an association was observed between male sex and the classification of risk

or delay in overall psychomotor development (OR = 6.53; 95%CI: 1.94-22.08; $p < 0.05$), as well as with the category of normal psychomotor development with overall risk (OR = 4.45; 95%CI: 1.44-11.77; $p < 0.05$), compared with girls (Table 2). Similarly, an association was observed between male sex and risk or delay in the cognitive (OR = 4.45; 95%CI: 1.41-13.99; $p < 0.05$) and motor (OR = 3.07; 95%CI: 1.17-8.08; $p < 0.05$) (Table 3), after adjusting for the same covariates.

TABLE 2. Coefficients (95% confidence interval) from the multinomial regression for overall psychomotor development

	Risk of or delay in psychomotor development			Normal psychomotor at risk			Advanced psychomotor development		
	OR	95%CI	p- value	OR	95%CI	p- value	OR	95%CI	p- value
Facility									
Private (Ref.)									
Public	7.34	1.65-32.58	<0.05*	0.56	0.13-2.34	0.431	0.61	0.11-3.49	0.578
Gender									
Female (Ref.)									
Male	6.53	1.94-22.08	<0.05*	4.13	1.44-11.77	<0.05*	0.87	0.25-2.97	0.820

OR: odds ratio, CI: confidence interval, Ref.: reference category (normal psychomotor development).

All models were adjusted for socioeconomic status, education, maternal age, child age, and nutritional status. An asterisk indicates statistical significance (*p < 0.05).

TABLE 3. Coefficients (95% confidence interval) from the multinomial regression for psychomotor development dimensions

Dimension		Risk of or delay in psychomotor development		Advanced psychomotor development	
		OR (95%CI)	p-value	OR (95%CI)	p-value
Social	Public (Ref.: Private)	2.65 (0.57-13.08)	0.229	0.58 (0.17-1.99)	0.391
	Male (Ref.: Female)	1.59 (0.54-4.44)	0.370	0.45 (0.18-1.13)	0.092
Cognitive	Public (Ref.: Private)	10.83 (1.64-71.59)	<0.05*	2.10 (0.58-7.59)	<0.05*
	Male (Ref.: Female)	4.45 (1.41-13.99)	0.254	1.12 (0.462-69)	0.792
Motor	Public (Ref.: Private)	0.87 (0.20-3.30)	0.844	0.59 (0.11-3.14)	<0.05*
	Male (Ref.: Female)	3.07 (1.17-8.08)	0.549	0.59 (0.16-2.22)	0.436
Language	Public (Ref.: Private)	5.10 (0.87-22.54)	0.068	0.70 (0.15-2.70)	0.613
	Male (Ref.: Female)	2.49 (0.82-7.44)	0.104	0.42 (0.18-1.13)	0.088

OR: odds ratio, CI: confidence interval, Ref.: reference category.

Models adjusted for socioeconomic status, education, maternal age, child's age, and nutritional status. Significant associations are indicated by an asterisk (*p <0.05)

DISCUSSION

Our findings suggest an association between the type of early childhood education setting and psychomotor development in the study population: children attending public schools were more likely to be classified as delayed or at risk in both overall psychomotor development and the cognitive domain. These results are consistent with those reported in a study conducted in Brazil among children aged 13 to 41 months, in which those attending public early childhood education settings performed worse on measures of cognitive, fine motor, and gross motor skills compared to those attending private preschools, even when they belonged to a similar socioeconomic level.²¹ Although our analysis focused on the type of early childhood education setting, similar inequities have been described in the health care system, as reported by Bedregal et al. (2016) in a study conducted in preschool settings, it was observed that children attending public health centers had higher rates of developmental delays in the areas of communication, motor skills, personal-social development, and cognition, compared to their peers attending private centers, regardless of socioeconomic status.²² In contrast, a systematic review comparing the quality of public versus private early childhood education settings reported mixed and inconclusive results.²³

These findings can be explained by the close association between educational institution type and socioeconomic status, as children from lower socioeconomic backgrounds tend to attend public schools. In contrast, those from higher socioeconomic backgrounds tend to

attend private schools.^{24,25} Evidence shows that children from low socioeconomic backgrounds are at greater risk of psychomotor developmental disorders, especially in the cognitive domain.²⁶ In this context, early childhood education institutions serve as important settings for implementing strategies aimed at promoting child development, particularly among the most vulnerable populations.

The mother's educational level was associated with the type of school the children attended: mothers with higher levels of education chose private schools. In comparison, those with lower levels of education chose public schools. This is consistent with the findings of Narea et al. (2022), who describe an association between higher maternal education, higher early access to early childhood education, and better child development,²⁷ acting as a protective factor due to its association with more stimulating family environments and more supportive caregiving practices.²⁸ In contrast, a lower level of maternal education has been associated with delays in psychomotor development, particularly in the motor and cognitive domains.²⁹

The results suggest an association between male gender and a higher prevalence of risk or delay in overall psychomotor development, as well as in the cognitive and motor domains. These findings are consistent with previous studies showing that boys are more vulnerable to developmental delays and that girls have higher psychomotor development scores during the preschool years;^{30,31} however, these differences tend to diminish by school age.³² About motor

development, some studies have reported that girls perform better in locomotor skills and boys in object manipulation skills.³³ Evidence on early cognitive development consistently shows that girls tend to score higher than boys during the preschool years.³⁴ This difference could be explained by socioeconomic context, as boys appear to be more vulnerable to environmental influences.³⁵

The main limitation of this study is its cross-sectional design, which precludes establishing causality. Furthermore, the sample size, convenience sampling, and the low representation of children from low socioeconomic backgrounds in private schools limit the generalizability of the results. Furthermore, some models had wide confidence intervals, possibly due to the small number of participants in certain outcome categories, indicating imprecise estimates. However, the observed associations were consistent across the adjusted models. The close relationship between facility type and socioeconomic status makes it difficult to interpret the facility's independent effect, despite the statistical adjustment performed. Furthermore, family and psychosocial variables—such as parenting practices or home stimulation—were not considered, and they could act as residual confounders. Finally, the classification of facilities was based solely on their funding, without considering variables such as educational quality or pedagogical characteristics that may be relevant to psychomotor development.

Among the study's main strengths is the use of a standardized, culturally validated instrument to assess psychomotor development, thereby enhancing the reliability and comparability of the results. In addition, the assessments were conducted by trained professionals and were not based solely on parental reports. Finally, the study provides evidence on psychomotor development in children attending public and private schools, which is useful for guiding future interventions in education and public health.

CONCLUSION

Gender and type of educational institution were associated with psychomotor development among the preschoolers studied. Male children and those attending public schools were more likely to be at risk of, or to exhibit, developmental delays.

Although the cross-sectional design does not allow for the establishment of causality, the

findings highlight the importance of educational and sociodemographic contexts and the need for support strategies in early childhood education, especially among vulnerable populations. Future longitudinal studies should explore these associations in greater depth and incorporate environmental factors and institutional quality. ■

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