Child Development

CHILD DEVELOPMENT

EMPIRICAL ARTICLE

Childcare Center Attendance During the Covid-19 Pandemic: Boosting Cognitive and Language Development

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ABSTRACT

The Covid-19 pandemic underscored the significance of early childhood education and care (ECEC) for children's development. We investigated the impact of attendance at ECEC programs following a closure period due to the pandemic. We used linear regression with a lagged dependent variable to examine assessments of children's cognitive and receptive language based on a sample of Chilean children ($N = 809$; age = 41.3 months in 2021). Results show that children who attended center-based care for more than 20 h a week demonstrated higher cognitive and receptive language levels than those who did not attend (3.2 and 2.9 points higher, respectively). Furthermore, our results highlight the importance of the intensity of attendance at ECEC programs for children's development.

High-quality center-based childcare provided during a child's initial 4 years of life yields substantial benefits for their overall development, such as language, numeracy, and social skills (Barnes and Melhuish 2017; Van Huizen and Plantenga 2018). These advantages extend to later life outcomes, such as a reduced likelihood of grade retention and an increased probability of high school graduation rates (McCoy et al. 2017). The degree of these positive effects correlates with the amount of attendance, with a particularly strong correlation found between high levels of attendance and enhanced child language and cognitive development (Barnes and Melhuish 2017; Sylva et al. 2011).

The response to the Covid-19 pandemic in most nations resulted in the closure of schools, impacting an unprecedented 95% of the global student population—marking the most significant educational disruption in history (United Nations 2020). In developing countries, pre-primary students bore the brunt of this disruption, facing an average loss of 106 days of in-person instruction in 2020, a more significant setback than other educational levels (Nugroho et al. 2021). The shutdown of center-based care facilities meant a lack of cognitive stimulation that could substantially influence children's future learning trajectories. Indeed, historical precedent suggests that large-scale sociohistorical events can wield enduring effects on development, particularly when experienced during early childhood (Benner and Mistry 2020).

Our investigation explores the question between attendance at childcare centers—following the pandemic-related school closures—and the developmental outcomes of children, with a particular focus on the intensity (quantity) of attendance in this context. This study is anchored in Bronfenbrenner's ecological theory (Bronfenbrenner and Morris 2006). This conceptual framework underscores the dynamic interplay between individuals and their environment as it evolves over time. The theory comprises multiple nested systems that exert influence on

human development. Central to Bronfenbrenner's theory are the microsystem, mesosystem, exosystem, macrosystem, and the chronosystem. These systems encompass distinct environmental influences on an individual from direct impacts to broader societal and cultural effects. Bronfenbrenner's ecological theory accentuates the intricate interactions among various tiers of systems and their collective impact on human development. It highlights the bidirectional nature of these influences, wherein individuals not only receive input from their surroundings but also actively contribute to shaping them.

Hence, considering that the educational childcare center constitutes a pivotal element within the child's microsystem, fostering their cognitive and socio-emotional growth. The closure of these centers amid the Covid-19 pandemic—part of the broader chronosystem—interrupted the proximal processes intertwined with children's families and their early childhood education and care (ECEC). Research has shown that prolonged disruptions to early learning environments can lead to cognitive and social development delays, particularly in children from disadvantaged backgrounds (Yoshikawa et al. 2020). Furthermore, studies highlight that the absence of structured early childhood programs increased parental stress and reduced opportunities for critical developmental interactions (Bullinger et al. 2021; Del Boca et al. 2020). Consequently, the absence of this crucial system had the potential to impact parents and children's cognitive and language development, a focal point of interest in this study.

This study's contribution is twofold. First, we add to the existing body of knowledge regarding the impact of childcare attendance intensity on children's development, particularly in a Latin American context where such evidence is limited and absent for the specific case of Chile. A cultural approach that recognizes how a child's community shapes their development (Rogoff 2016; Weisner 2002), we focus on Chile—a country with a unique cultural setting—a with a very recent immigration from South, widespread coverage of childcare, but low attendance rates within this specific age group. Additionally, Chile experienced a particularly strict and prolonged lockdown during the pandemic (Irarrazaval et al. 2021). These factors make Chile an especially interesting context for exploring the question at hand.

Second, we leverage an extensive longitudinal dataset affording us the ability to account for numerous variables, including cognitive and language scores from the pre-Covid period and other variables related to the home environment. This robust methodology enhances the reliability of our findings because of the use of longitudinal face-to-face data, with a direct measure of children's development collected before and after the reopening of center-based care, thus allowing for comparative measures.

1 | Attendance, Quantity of ECEC, and Children's Development

Early research on the topic focused primarily on delineating developmental disparities between children who attended childcare and those who did not attend. However, subsequent research recognized the nuanced nature of childcare experiences (National Institute of Child Health and Human Development Early Child Care Research Network 2000). Considering this, studies have identified not only attendance but also the quantity of childcare experiences as crucial long-term predictors of child development (Belsky 2002). The concept of quantity pertains to the duration of time a child spends in childcare, that is, the number of hours per week and the number of weeks per year (Belsky 2002; Loeb et al. 2007).

In a comprehensive systematic review encompassing 32 studies conducted in developed countries, Burger (2010) concluded that more intensive childcare programs exhibit robust short-term effects along with comparatively modest yet enduring long-term improvements in cognitive skills. This assertion is supported by a body of evidence suggesting that both the attendance at childcare programs and a higher number of hours spent in such programs per week are closely correlated with favorable outcomes, particularly in preschool receptive vocabulary, language development, and cognitive growth. Particularly, these positive associations tend to be more pronounced when the quality of childcare is also elevated (Barnes and Melhuish 2017; NICHD Early Child Care Research Network 2004; Sylva et al. 2011).

The optimal duration of childcare attendance that yields positive impacts remains a subject of ongoing debate. Studies on this quantitative aspect are relatively limited, and the conclusions regarding the ideal number of hours are diverse and nonuniform. Loeb et al. (2007) tackled this question, indicating that attendance of at least 15 h per week significantly amplifies the positive effect of center-based care on cognitive development. Additionally, attending more than 30 h weekly also shows a positive association with cognitive skills.

With regard to the question of full versus part-time attendance, studies have revealed that, in addition to the act of attending childcare, the intensity of childcare attendance can buffer the possible negative influence of environmental factors on school readiness (Gagnon et al. 2024). Addressing the question of what level of intensity is necessary to impact child development, the meta-analysis by Van Huizen and Plantenga (2018) mentioned above also found modest evidence that higher intensity childcare (full-time vs. part-time) contributed to improved outcomes for children. However, it is important to note that due to the complexity and variability of childcare experiences and individual differences, a one-size-fits-all answer about the optimal number of hours remains elusive.

In Chile, evidence has shown a positive correlation between attendance at center-based care and enhanced cognitive and language outcomes for children (Cortázar 2015; Narea, Toppelberg, et al. 2020; Narea, Cumsille, et al. 2022). Studies demonstrate that engaging in center-based care during the initial 2 years of life yields a favorable impact on cognitive development (Narea, Arriagada, et al. 2020) and overall child development (Narea, Abufhele, et al. 2020).

Although Chilean studies have shown important differences in attendance, there remains a notable gap concerning the exploration of attendance intensity and its influence on children's

development. While existing evidence emphasizes the importance of center-based care for child development in Chile, there is a notable gap in understanding how attendance intensity influences developmental outcomes, especially for children from development contexts, indicating a need for comprehensive research to shape effective ECEC strategies.

2 | ECEC and Early Child Development During Covid-19

The repercussions of ECEC closures during the Covid-19 pandemic have been projected to be substantial and long-lasting, as evidenced by McCoy et al. (2021) through simulation techniques and pre-pandemic observational data. However, research concerning the impact of Covid-19 school closures on the development of preschool children remains limited. In this context, Abufhele et al. (2024) employed a first-difference strategy to assess the effects of the pandemic lockdowns in 2020 on children, comparing them with a similar group of Chilean children from a nationally representative study conducted in 2017. Study findings revealed a decline of 0.25 standard deviations in language ability among children during the 2020 lockdown, based on the Peabody Picture Vocabulary Test (PPVT) compared with children with similar sociodemographic characteristics in 2017.

González et al. (2022) focusing on two cohorts of 4- to 6-year-old Uruguayan children—from a control and a Covid-19 cohort—reported lower scores in motor and cognitive development, exceeding 0.20 standard deviations. These lower scores were less pronounced among children attending higher socioeconomic schools, underscoring the varying degrees of impact across different socioeconomic strata (González et al. 2022). These findings collectively shed light on the adverse consequences of Covid-19-related disruptions on preschool children's development and accentuate the significance of socioeconomic factors in influencing these outcomes.

Amid the limited research examining the correlation between center-based care attendance and child development following the pandemic, several noteworthy insights have emerged. For example, Wolf et al. (2022) conducted a longitudinal study in Ghana, analyzing the impact of attending higher quality early childhood education (ECE) programs at ages 4 or 5 on children's outcomes during the pandemic. Their findings revealed that participation in such programs did not significantly improve language, literacy, and math scores by age 10 during the Covid-19 pandemic. This result suggests that while center-based care provides foundational support during early childhood, it may not have been a sufficient protective factor against the widespread learning losses experienced during the pandemic. These findings align with broader research indicating that external shocks, such as a global pandemic, can disrupt long-term developmental trajectories, potentially mitigating prior gains from high-quality ECE programs (Kuhfeld et al. 2020; Yoshikawa et al. 2020).

Conversely, research on the benefits of returning to center-based care following the critical pandemic period offers promising insights about the positive impact on child development, although it remains sparse. Davies et al. (2021, 2024) analyzed parent-reported data from approximately 180 children in the United Kingdom and found a positive association between post-pandemic center-based care attendance and developmental outcomes. Specifically, they identified improvements in receptive vocabulary (Davies et al. 2021), while children from less advantaged backgrounds experienced significant gains in expressive vocabulary, communication, problem-solving, and personal–social development (Davies et al. 2024). These findings suggest that reengaging in structured early learning environments plays a crucial role in supporting children's recovery from pandemic-related setbacks. This result is consistent with literature emphasizing the importance of timely interventions during early childhood to mitigate the effects of educational disruptions (Duncan and Magnuson 2013; Tarricone et al. 2023).

3 | The Chilean Context

The ECEC system in Chile is tailored to accommodate children aged 84 days to 6 years, encompassing four distinct developmental stages: nursery school, center-based daycare, prekindergarten, and kindergarten. Nursery school caters to infants aged 3 months to 2 years, whereas center-based care is subdivided into nursery school (3 months to 2 years), center-based daycare (subdivided into toddler: 24–35 months, and preschool: 36–47 months), prekindergarten (48–59 months), and kindergarten (60–72 months). Kindergarten is the sole mandatory level within this framework (Organisation for Economic Co-operation and Development [OECD] 2017). This study zeroes in on center-based care attendance, an essential developmental stage within this comprehensive system.

In 2006, the Chilean government underscored the significance of an early childhood development policy, designating it as a priority and committing to providing cost-free childcare services for children from the most vulnerable households, encompassing up to 60% of Chile's early-childhood-aged children (Centro de Estudios 2014). Despite being the OECD member nation with the highest surge in ECEC enrollments for 4-year-olds and ranking third in the increase in enrollments for 3-year-olds between 2005 and 2015 (Narea and Godoy 2020), Chile's overall attendance rate remains lower than the OECD average (OECD 2017). By the year 2020, the national enrollment rate for preschool-age children stood at 51.9%, whereas only 16.8% of children under the age of 2 years were attending center-based care (Subsecretaría de Educación Parvularia 2021). These statistics highlight both the progress made and the ongoing challenges within the early education system in Chile.

The trajectory of quality in Chilean preschool education remains uncertain, despite the expansion of preschool service coverage. However, a pivotal development is the establishment of a new institutional framework wherein the Chilean Agency for Quality Education is entrusted with the assessment of ECEC centers, evaluating them against quality standards outlined by the Undersecretariat of Early Childhood Education (Subsecretaría de Educación Parvularia 2018). These institutional reforms hold the potential to positively impact the quality of preschool education in Chile, marking a significant step forward in the

nation's commitment to enhancing early childhood learning experiences.

3.1 | ECEC in Chile During the Covid-19 Pandemic

On March 16, 2020, the Chilean government enforced a nationwide compulsory closure of educational institutions in response to the Covid-19 pandemic (Chilean Ministry of Health 2021). Early childhood establishments remained shuttered for almost the entirety of that year. It was not until October 2020 that center-based care programs began to reopen, allowing for voluntary attendance. However, by the conclusion of 2020, only around 10% of center-based care facilities were offering in-person classes, and even then, attendance rates were exceedingly low (Claro et al. 2022). Then, among children below the age of 2, only one in five was able to access ECE during this period (Valenzuela et al. 2021).

On March 1, 2021, the Ministry of Education in Chile formally opened the school year, advocating for a transition to mixed (hybrid) classes. This initiative was characterized by its voluntary nature, gradual rollout, and adaptability, all while prioritizing the incorporation of stringent health and safety measures within educational institutions. An epidemiological protocol was introduced to guide these measures, aligning with guidelines from the (Chilean Ministry of Health 2021). This strategy aimed to strike a balance between facilitating educational continuity and safeguarding the well-being of students, educators, and staff members amid the ongoing pandemic context.

Throughout the second semester of 2021, from August to December, approximately half of the educational establishments resumed operations with the same schedule as observed in 2019. By the end of November, the weekly hours of children's attendance at ECE center-based care reached 81% of the hours recorded in 2019 (Claro et al. 2022). It is worth noting that despite 93% of center-based care institutions being open, the challenge of low attendance persisted (Claro et al. 2022). Over the course of 2021, attendance rates fluctuated, ranging from 34% in August to 44% in November (Claro et al. 2022).

In 2021, the enrollment figure for ECE in Chile stood at 743,000 children, reflecting a notable decline of 9.0% compared to the enrollment recorded in 2019—a reduction likely attributed to the far-reaching impacts of the Covid-19 pandemic on families (Subsecretaría de Educación Parvularia 2021). This decline underscores the complex and multifaceted ways in which the pandemic influenced various aspects of society, including educational participation among young learners.

4 | The Present Study

Relative to existing evidence about the impact of center-based care attendance on child development during Covid-19, our confirmatory study examines the association between attendance (and intensity of attendance) at center-based care after the Covid-19 lockdowns and the cognitive and language development of children between 36 and 48 months old. The effects of the pandemic on cognitive and language development and the differences between young children who attended ECEC soon after and those who did not are still unknown.

We hypothesize that attendance at center-based care plays a crucial role in child development within this context. In particular, it is essential to evaluate not only the presence or absence of child-care attendance as a binary variable but also the intensity of child-care involvement.

We hypothesize that those children who returned early to center-based care will have better language and cognitive outcomes than those who did not. Further, following the evidence, we hypothesize that a higher number of hours spent in such programs per week is positively correlated with favorable outcomes on language development and cognitive growth (Barnes and Melhuish 2017; Sylva et al. 2011).

In the context of Latin America, the region of the world with the most weeks of school closed during the pandemic (UNESCO 2020), this study focuses on understanding the experiences of attendance at ECE and its impact on children to inform policymakers, parents, and educators and promote quality early learning experiences for all children.

5 | Methods

5.1 | Participants

In the present study, we used data from the Chilean Longitudinal Study First Thousand Days (Mil Primeros Dias; MPD) conducted by Chile's Center for Advanced Studies of Educational Justice. The goal of MPD was to characterize the trajectories of types of care experienced by children, focusing on the quality of these types of care and its association with the cognitive, language, and socioemotional development of children (Narea, Abufhele, et al. 2020).

The sampling frame of MPD was built from the database of routine health check-ups of the public primary health care system. The MPD study had three waves of data collection: 2019, 2020, and 2021. For the first wave of the study, in 2019, it evaluated a sample of 1161 children and their main caregiver, with a recruitment rate of 97%. Data collected in this study are available upon request for any researcher interested in working with the Center of Educational Justice.

The universe for the present study included children between 12 and 15 months served through the public health system from the 35 municipalities of the Santiago Metropolitan area ($N = 27{,}130$). Taking into consideration the total universe of children, the target sample was 1200 children from homes with different maternal education levels and with mothers of different nationalities. We considered a stratified sampling design using the 35 municipalities of Santiago as the strata. Therefore, for participation in this study, we invited a quantity of children proportional to the number of children born in each municipality.

From the 35 municipalities invited to participate, 17 agreed. In those 17 municipalities, all primary care centers were visited

by a trained interviewer who invited the mothers who took their babies to their 12-month-old health check-up and met the selection criteria to be part of the longitudinal study. The selection criteria included mothers over the age of 18, with Spanish as their first language, children between 12 and 15 months of age at the time of the invitation, and children who were not diagnosed with any permanent difficulty in development (auditory, visual, and/or motor). Recruitment for the study was discontinued when the sample size calculated for each municipality was completed.

In the present study, the analytic sample included 809 children who participated in the first and third waves of the MPD study (2019 and 2021). The attrition rate between the first and third waves was 19% (for more information see Narea, Soto-Ramirez, et al. 2022). Only children with complete information regarding all the variables used in the model were included in the analytic sample. Children who had missing data in any of the variables used for the present research were excluded ($N = 131$), and no significant differences were detected in sociodemographic variables between the analytic sample and the third wave sample in all the variables. Likewise, no significant differences were detected in sociodemographic variables between the first wave sample ($N = 1161$) and the analytic sample ($N = 809$). Given that no notable discrepancies were identified between the children who withdrew from the study and those who remained, listwise deletion was employed, recognizing that any potential bias is often minimal, particularly in the context of multiple regression models (Graham and Donaldson 1993). The children in this sample were 41.3 months old on average in 2021, of whom 48.8% were girls. Main caregivers were mostly Chilean (83.4%) and working (51.4%). Please see Table 1 for the descriptive statistics of the analytic sample.

5.2 | Procedure

The first wave data was collected in 2019 ($N = 1161$) through in-person visits to the selected children's homes. A trained psychologist administered a battery of instruments to evaluate the selected participant's cognitive, language, social–emotional, and physical development. Also, caregiver tests and a socioeconomic survey were applied. Follow-up data (wave 2) were collected in 2020, including 84.8% (985) of the first-wave participants. Due to Covid-19 restrictions, the second wave data (2020) was collected over the telephone, and direct child development assessment was not possible. A third wave of the study was carried out between August 2021 and January 2022, including 81% (940) of the study's first-wave participants. Two types of data were gathered from this third wave based on the following: a survey that principally collected sociodemographic information over the telephone and a visit to the participant's home to collect the remaining information.

5.3 | Measures

We measured cognitive and language development as the dependent variables because these are two essential developmental outcomes during early childhood, which are proven to be correlated with other developmental outcomes over the life course (Likhar et al. 2022). Also, previous evidence has shown a positive association between ECEC attendance and child cognitive and language development in Chile (Cortázar 2015; Narea, Toppelberg, et al. 2020; Narea, Cumsille, et al. 2022).

5.3.1 | Dependent Variable: Bayley Scales of Infant and Toddler Development, Third Edition (Bayley 2006)

In the MPD study, the Bayley Scales of Infant and Toddler Development, Third Edition (Bayley-III) was used to evaluate the children's cognitive and language development. The Bayley-III is a tool used to evaluate the development of children aged 1–42 months. It assesses five domains: cognition, language (receptive and expressive communication), motor (gross and fine), social–emotional behavior, and adaptive behavior. Cognition and language (receptive and expressive) were assessed for the MPD study. The cognition scale assesses areas such as memory, attention, and visualization, while the language scale evaluates receptive and expressive communication skills, including a child's ability to recognize sounds, vocabulary, and preverbal communication. The assessment is conducted through direct observation and questionnaires completed by the primary caregiver (Bayley 2006).

We used each complete subtest as indicated in the instrument's manual (Bayley 2006). In the Bayley language domain, we concentrated on both expressive and receptive language aspects. The *Expressive Communication* subtest evaluates preverbal communication components such as babbling, gesturing, joint referencing, and turn-taking. Moreover, it assesses vocabulary development and morpho-syntactic progression, including the usage of two-word utterances, plurals, and verb tenses. The *Receptive Communication* subtest gauges preverbal behaviors, vocabulary development involving object and picture identification, morphological growth, and understanding of morphological markers. The *Cognitive Scale* assesses facets of sensorimotor development, exploration and manipulation, object relatedness, concept formation, memory, and other cognitive processes (Bayley 2006). This approach allowed the impact of ECEC attendance on the cognitive and language development domains to be thoroughly assessed.

The Spanish version of the Bayley-III was applied by trained psychologists in the presence of the primary caregiver in the children's home on wave 1 and wave 3 of the study. The score was calculated for each domain using Item Response Theory (IRT) and normalized to a standard score ($M = 100$ and $SD = 15$) for easy interpretation. The reliability coefficients for the Bayley-III subtests are 0.87 for receptive communication and 0.91 for cognition and expressive communication (Bayley 2006). For the present study, the Spanish version was piloted, and some words were adjusted for better understanding to the Chilean context. The scales show adequate reliability $\alpha = 0.82$, 0.87, and 0.93 for the cognitive, expressive, and receptive scales, respectively (Narea, Abufhele, et al. 2020).

5.3.2 | Primary Independent Variable: Childcare Center Attendance and Intensity of Attendance

Using the socio-demographic questionnaire (caregiver survey), we looked at the number of hours per week the children attended

TABLE 1 | Descriptive statistics of the analytic sample.

Variables	Total (SD) ($n = 809$)	Attended ECEC > 20 h ($n = 144$)	Attended ECEC < 20 h ($n = 149$)	Did not attend ECEC ($n = 516$)	p[a]
N days of attendance ($n = 293$)					
1 day	1.0%	0.0%	0.0%		
2 days	4.8%	0.7%	4.9%		
3 days	8.9%	2.1%	10.6%		
4 days	7.5%	3.5%	8.9%		
5 days	77.8%	93.8%	75.6%		
Child's age, mean months	41.3 (1.6)	41.3 (1.7)	41.3 (1.9)	41.3 (1.5)	0.67
Child's gender (girl), (%)	48.8%	54.2%	49.7%	47.1%	0.191
Bayley III Cognitive W1	100.31 (13.85)	100.32 (13.59)	99.13 (12.01)	100.65 (14.41)	0.36
Bayley III Receptive W1	100.01 (12.99)	101.67 (13.50)	100.54 (12.15)	99.40 (13.06)	0.07
Bayley III Expressive W1	100.19 (14.01)	100.95 (13.17)	100.41 (13.14)	99.91 (14.49)	0.46
Main caregiver age, mean years	29.4 (6.3)	29.6 (6.1)	28.5 (6.2)	29.6 (6.1)	0.39
Education of caregiver, *n* (%)					
< 12 years of education	19.7%	17.4%	15.4%	21.5%	0.04*
= 12 years of education	40.2%	38.2%	37.6%	41.5%	
> 12 years of education	40.2%	44.4%	47.0%	37.0%	
Parenting Stress Index (PSI)	100.12 (14.37)	100.90 (13.52)	102.60 (13.72)	99.19 (14.71)	0.01*
Caregiver's CES-D 10	100.03 (14.18)	99.84 (14.94)	101.87 (14.27)	99.55 (13.93)	0.20
Native-born main caregiver, %	83.4%	78.5%	81.9%	85.3%	0.06
Main caregiver working, (%)	51.4%	63.2%	49.0%	48.8%	0.05
Single mother, (%)	29.9%	34.0%	33.6%	27.7%	0.07
Grandparents in household (%)	36.8%	32.6%	34.9%	38.6%	0.18
Number of other children	2.22 (1.32)	2.22 (1.60)	2.03 (1.12)	2.28 (1.28)	0.12
Caregiver income decreased due to Covid-19, (%)	45.4%	44.4%	43.6%	46.1%	0.57
Main caregiver had a relative die due to Covid-19, (%)	38.7%	35.4%	44.6%	37.6%	0.40
Housing change due to Covid-19, (%)	22.7%	22.9%	20.1%	23.5%	0.5
Support from family and friends due to Covid-19, (%)	83.2%	79.9%	81.2%	84.5%	0.19
HOME	34.40 (5.81)	34.49 (6.01)	33.97 (5.70)	34.49 (6.01)	0.65

Note: Robust standard errors in parentheses.
Abbreviations: CES-D 10, Center for Epidemiologic Studies Depression Scale; ECEC, early childhood education and care; HOME, Home Observation for Measurement of Environment instrument; PSI, Parenting Stress Index; W1, Bayley (2006) results from Wave 1.
[a]Significance when comparing characteristics between attended > 20 and < 20 with did not attend ECEC.
*$p < 0.05$.

the childcare centers between April 2020 and December 2021, after the height of national closures due to Covid-19 restrictions. We created three different attendance variables. The first was a dichotomous variable that takes value *1* if the child attended a childcare center during 2021. The second variable is a continuous indicator of how many hours on average per week the child attended. For those that did not attend, the variable takes the value *0*. The third variable is a categorical variable with three categories considering the number of hours per week that the caregivers indicated that the children attended the childcare centers. The variable takes value *0* if the child did not attend, value *1* if the child attended less than 20 h per

week, which we label as "half-day attendance," and a value of *2* for 20 h or more labeled as "full-day attendance." We made this half-day (less than 20 h)/full-day (more than 20 h) cutoff because across OECD countries, the relationship between the intensity of weekly attendance and students' later proficiency indicates an optimal range of attendance of 20–40 h per week (Balladares and Kankaraš 2020).

5.3.3 | Covariates: Characteristics of Children, Mothers, and Physical Environment

A set of covariates commonly associated with child outcomes was taken from the caregiver survey. For the children, these included their age and gender; for the mothers, these included: nationality (native or immigrant), level of education (less than high school, high school completed, and some college or above), age, maternal mental health, and home environment. Although we acknowledge that socioeconomic status could be a potentially relevant covariate, we chose to incorporate maternal education and not income, given that income during the pandemic period was not a reliable variable (families that rely on independent workers had income equal to zero during the lockdown months). For maternal mental health, we used the *Parenting Stress Index Short Form* (PSI-SF; Abidin 1995) and the 10-item version of the *Center for Epidemiological Studies-Depression Scale* (CES-D10; Radloff 1977). The PSI was developed to measure parental stress by assessing how adults feel about their roles as caregivers (Abidin 1995). The test was validated in Chile by Aracena et al. (2016), with a reliability that ranged between $\alpha = 0.82$ and $\alpha = 0.86$ for the three different scales. For the present study, reliability for the complete scale was $\alpha = 0.91$.

The CES-D scale has been used to detect previous week depressive symptoms (Radloff 1977). The instrument was validated in Chile with an internal reliability of $\alpha = 0.89$ (Gempp et al. 2004). For the analytic sample, the internal specific reliability for CES-D was $\alpha = 0.86$. IRT was used to score both instruments' results. Later, the IRT score was normalized to a standard score ($M = 100$ and SD = 15) (Narea, Asahi, et al. 2022). For the PSI-SF and the CES-D10, higher value scores indicate higher stress levels and higher depressive symptoms, respectively.

The quality of cognitive stimulation and emotional support in the home environment was measured with the Home Observation for Measurement of Environment instrument (HOME; Caldwell and Bradley 1984; $\alpha = 0.80$). The Infant Toddler-HOME contains 45 yes/no statements scored with 1 point for YES and 0 point for NO to assess verbal and emotional/behavioral interaction in the home environment. Lower scores represent potentially inadequate environments. For the analytic sample, the internal specific reliability for HOME was $\alpha = 0.79$.

In terms of family structure, we added three covariates: child from a single mother household, a grandparent in the home, and the number of other children (under 18) living in the household. To capture the impact of the pandemic on the family, we added four binary variables: main caregiver's income decreased due to Covid-19, main caregiver had a family member die from Covid-19, housing change due to Covid-19, and support from family or friends during the Covid-19 crisis.

5.4 | Analytic Strategy

The first analysis tested for significant differences in the averages for all variables—outcomes and demographic variables—between children who attended ECEC and those who did not. To test for significant differences, we used a *t*-test for interval variables and chi-square for nominal variables. Next, two sets of calculations using a lagged dependent model were done. This method enabled the use of the longitudinal data by considering the previous scores and individual characteristics of the participants (Holm et al. 2023; Keele and Kelly 2006; Wilkins 2018). In the first set of estimations, linear regression models were used to analyze the cognitive, receptive, and expressive language test scores. The entire sample was used, and an independent variable was included to identify if the children attended childcare or not.

In the second set of estimations, the same linear regressions were calculated, but this time the amount of time the children spent in childcare was considered. Two "intensity variables" were created: one to measure hours of attendance and the other to distinguish between children who did not attend, those who attended for less than 20 h per week (half-day attendance), and those who attended for 20 h or more per week (full-day attendance).

In addition, we analyzed informal care and examined heterogeneous effects between attendance at center-based care and gender, children with native and immigrant mothers, and children with mothers having high and low maternal education levels. These additional analyses have been undertaken but have not been reported as they are beyond the scope of the current paper.

6 | Results

Table 1 shows the descriptive statistics of the analytic sample, considering children who attended ECEC in 2021 more than 20 h per week ($N = 144$; 18%), those who attended less than 20 h ($N = 149$; 18%), and children who did not attend ($N = 516$; 64%). Of the 293 children who attended ECEC during 2021, only 26% attended the same childcare center. Moreover, the maximum number of children in the same childcare center was eight. Most of the children attended the childcare center 5 days a week (78%).

The children in this sample were 41.3 months old on average in 2021 (SD = 1.6, range = 36–48 months) of whom 48.8% were girls, and on average, children in the sample had two siblings living in the same house. Main caregivers were 29.4 years old on average in 2019 (SD = 6.3, range = 18–47 years), mostly Chilean (83.4%) and working (51.4%). Almost 30% of the main caregivers reported as a single mother household, with 37% indicating that grandparents lived in the household. Concerning educational level, 19.7% of the mothers did not complete high school (i.e., < 12 years of education), 40.2% completed high school, and 40.2% had higher education studies (complete or incomplete college or vocational school). Additional information gathered showed changes due to Covid-19, including 45.4% of the caregivers who indicated their monthly income decreased with respect

to the period before the pandemic, 38.7% reported a relative died because of the Covid-19 disease, 22.7% moved to a different house during the pandemic, and 83.2% indicated they had support from family and friends during that period of time.

Table 2 shows the results based on estimating the association of ECEC attendance with cognitive development, receptive language, and expressive language. The children who attended ECEC during 2021 show a 2.1-point higher cognitive score than the children who did not attend. This result is statistically significant at the 5% level ($R^2 = 0.09$, $F(19, 789) = 3.97$, $p < 0.001$).

Attendance was not significantly associated with receptive and expressive language. For all the outcomes, girls performed better than boys, and there is a clear maternal education gradient, with children who have a more educated mother having better test scores.

Table 3 explores the association between intensity of attendance, measured as the average hours of attendance per week, and the developmental outcomes. When we explored the hours of attendance, results confirmed that attendance increased cognitive ability: one more hour of attendance per week increased the cognitive outcome by 0.086 points ($R^2 = 0.09$, $F(19, 789) = 4.07$, $p < 0.001$). We also observed that for receptive language, attending correlated positively with the test scores and was statistically significant: increasing one more hour of attendance increased the test score by 0.075 ($R^2 = 0.10$, $F(19, 789) = 4.74$, $p < 0.001$). However, intensity of attendance was not significantly associated with expressive language.

Table 4 displays the linear regression model analyses highlighting associations among intensity of attendance, children who attend half time or full time, and children's developmental outcomes. Children who attended full-day ECEC performed better on the cognitive and receptive language tests than those who did not attend ($R^2 = 0.09$, $F(20, 788) = 3.88$, $p < 0.001$; $R^2 = 0.10$, $F(20, 788) = 4.52$, $p < 0.001$, respectively). On the other hand, the children who attended for a half day did not perform differently from those who did not attend. Again, attendance was not significantly associated with expressive language.

7 | Discussion

Studies have consistently demonstrated that high-quality childcare significantly enhances children's language and cognitive abilities. In this paper, we contribute to this literature by exploring associations between attending ECEC and children's cognitive and language development. Using a linear regression model with a lagged dependent variable, we found that children who attended ECEC during 2021 showed better cognitive scores than those who did not attend. These results are in line with previous studies in both developed nations (Burger 2010; Weiland and Yoshikawa 2013) and low- to middle-income countries (Cortázar 2015; Nores et al. 2019), and also in Chile (Narea, Toppelberg, et al. 2020).

Moreover, children who attended center-based care for more than 20 h a week presented higher scores on tests of cognitive development and receptive language than those who did not. This is a novel result not only for Chile but also for other countries in the region where there is no evidence of the impact of the intensity of center-based care on child development.

To put these coefficients in context, we compared these point estimates with other studies that used the same test (Bayley-III). The association of attending full-day childcare (more than 20 h a week) with cognitive development and receptive language development found in the present study is comparable in terms of standard deviations with the effect seen in the Family, Women, and Childhood program (FAMI) described in Colombia, with a Bayley-III of 0.163 SD (Attanasio et al. 2022). In addition, the benefit in children's development found in this study is comparable to children's language decline due to the pandemic found in Chile by Abufhele et al. (2024) and the loss in cognitive development in Uruguayan children shown by González et al. (2022), although both studies used another outcome test (the PPVT test and a school readiness instrument, respectively) to measure children's development, and this does not make the results entirely comparable.

Interestingly, we found that attending center-based care had no significant influence on children's expressive language. Numerous studies conducted across Latin America have revealed that a significant portion of time within preschool classrooms lacks a clear instructional objective (Medina et al. 2014; Rolla San Francisco et al. 2006). Strasser et al. (2018) found that in Chile, teachers provide less information, offer fewer explanations, and elicit less language during noninstructional activities compared to instructional activities. In addition, children talk less during noninstructional activities than during instructional activities. For this reason, it may be that extended periods during the day are marked by language interactions that fall short of optimal for fostering language development. Endeavors to improve the reach of ECE in Chile should also focus on enhancing the quality of these language interactions.

Moreover, attendance at center-based care is markedly important for children hailing from disadvantaged backgrounds as it may provide resources and structured interactions that they might otherwise lack compared to their more advantaged peers (Geoffroy et al. 2010; Larose et al. 2021). This finding underscores the potential for center-based care to mitigate developmental disparities, a point that aligns with the outcomes of this study by highlighting the critical role of early education in fostering equity.

According to McCoy et al. (2021), long-term repercussions are expected due to the protracted period of school closures. The present research supports the Chilean policy for school reactivation after Covid-19, which has aimed to promote increased school attendance to mitigate and overcome the effects of 2 years of nonattendance. In terms of policy, the consistency of attendance and the hours of exposure to preschool and school education have garnered considerable attention as important to inform policymaking decisions that support children's early learning, especially after the pandemic. Efforts to increase children's hours of exposure in ECEC settings have been motivated, in part, by the hypothesis that expanding the length of the school day will provide children with more exposure to high-quality learning opportunities, which, in turn, will yield greater and longer lasting benefits.

TABLE 2 | Linear regression model between children's attendance to ECEC and child cognitive and receptive, and expressive language at 36–48 months.

	Cognitive	Receptive language	Expressive language
Attendance to daycare (ref. no)	2.136** (0.976)	1.622 (1.004)	0.371 (1.006)
Test score baseline	0.060* (0.035)	0.211*** (0.038)	0.159*** (0.035)
Child's age in months	0.667** (0.297)	0.613** (0.299)	0.292 (0.301)
Maternal educ. = 12 years of education	2.408* (1.289)	2.583* (1.321)	3.803*** (1.329)
Maternal educ. > 12 years of education	3.902*** (1.365)	3.016** (1.397)	4.419*** (1.407)
Main caregiver age	0.057 (0.082)	0.031 (0.084)	0.100 (0.084)
Child's gender (ref. boy)	4.822*** (0.937)	3.001*** (0.965)	4.627*** (0.968)
Foreign-born main caregiver (ref. native-born)	−0.839 (1.357)	−3.771*** (1.393)	−1.659 (1.398)
Main caregiver working (ref. no)	−0.521 (0.960)	−2.283** (0.986)	−1.306 (0.988)
Single mother household (ref. no)	0.194 (1.105)	−0.996 (1.134)	0.320 (1.139)
Grandparents living in household (ref. no)	1.479 (1.083)	0.996 (1.111)	2.611** (1.117)
Number of other children in household	−0.345 (0.369)	−0.349 (0.379)	−0.175 (0.381)
PSI IRT Std	−0.067* (0.036)	−0.034 (0.037)	−0.051 (0.037)
CES-D 10 IRT Std	0.026 (0.037)	−0.027 (0.038)	0.022 (0.038)
HOME IRT Std	0.113 (0.089)	0.044 (0.091)	0.061 (0.091)
Income decreased due to Covid-19 (ref. no)	−0.865 (0.934)	−1.362 (0.961)	−1.240 (0.963)
Relative died due to Covid-19 (ref. no)	−0.171 (0.963)	−0.899 (0.988)	0.754 (0.992)
Housing change during Covid-19 (ref. no)	1.400 (1.163)	1.569 (1.194)	1.826 (1.199)
Support from family and friends due to Covid-19 (ref. no)	1.631 (1.273)	0.688 (1.305)	0.470 (1.311)
Constant	59.210*** (13.824)	55.811*** (14.377)	64.353*** (14.366)
Observations	809	809	809
R^2	0.087	0.100	0.101

Note: Standard errors in parentheses. The cognitive, receptive, and expressive language abilities were derived from the Bayley (2006) assessment, Wave 3.
Abbreviations: CES-D 10, Center for Epidemiologic Studies Depression Scale; ECEC, early childhood education and care; HOME, Home Observation for Measurement of Environment instrument; PSI, Parenting Stress Index.
*$p < 0.1$.
**$p < 0.05$.
***$p < 0.01$.

As other international studies have shown, we found evidence of the benefits of attending center-based care and support for the assertion that full-time childcare has an important impact on children's cognitive and language development (Van Huizen and Plantenga 2018). Moreover, our study presents these findings within a specific context, focusing on a cohort who experienced lack of access to out-of-home childcare for a long time during Covid 19 in a NON-WEIRD country. In this context, our study supports the hypothesis that greater exposure to center-based care improves child development.

This is why we suggest redoubling efforts to encourage attendance at preschool education programs. Understanding why families do not send their children to center-based care is crucial; then, investing in research to understand the specific challenges faced by families in the community and tailoring interventions accordingly would be useful. Student-specific factors can include anxiety or fear associated with going to center-based care, illness, or chronic health problems (Kerr et al. 2012). Coordinating with primary care to help determine whether a child is too sick to attend could help decrease absenteeism (American Academy of Pediatrics et al. 2011). Here in Chile, coordinating with community-based family health centers to help parents identify when to keep children home would probably be most effective.

In addition, family-specific factors can include inconsistent or nonstandard work schedules, unstable housing, stressful family events, and lack of social or economic resources. When children and families lack these resources, attending school may be more challenging (Black et al. 2014). There is some evidence that educational institutions can help arrange regular transportation to help families without reliable access (Gottfried 2017) to increase attendance. Other recommendations would include Family Support Programs offered through the ECEC and Community

TABLE 3 | Linear regression model between ECEC hours of attendance and child cognitive and receptive and expressive language at 36–48 months.

	Cognitive	Receptive language	Expressive language
Hours of attendance	0.086** (0.034)	0.075** (0.035)	0.040 (0.035)
Test score baseline	0.060* (0.035)	0.210*** (0.038)	0.158*** (0.035)
Child's age in months	0.684** (0.297)	0.630** (0.299)	0.304 (0.300)
Maternal educ. = 12 years of education	2.472* (1.287)	2.628** (1.319)	3.806*** (1.327)
Maternal educ. > 12 years of education	3.971*** (1.360)	3.049** (1.393)	4.383*** (1.403)
Main caregiver age	0.053 (0.081)	0.030 (0.084)	0.102 (0.084)
Child's gender (ref. boy)	4.802*** (0.937)	2.974*** (0.964)	4.588*** (0.968)
Foreign-born main caregiver (ref. native-born)	−0.901 (1.356)	−3.844*** (1.392)	−1.738 (1.398)
Main caregiver working (ref. no)	−0.665 (0.962)	−2.421** (0.988)	−1.400 (0.991)
Single mother household (ref. no)	0.223 (1.102)	−0.995 (1.130)	0.268 (1.135)
Grandparents living in household (ref. no)	1.446 (1.080)	0.993 (1.107)	2.661** (1.113)
Number of other children in household	−0.354 (0.369)	−0.355 (0.379)	−0.175 (0.380)
PSI IRT Std	−0.065* (0.036)	−0.034 (0.037)	−0.052 (0.037)
CES-D 10 IRT Std	0.025 (0.037)	−0.027 (0.038)	0.022 (0.038)
HOME IRT Std	0.110 (0.089)	0.043 (0.091)	0.060 (0.091)
Income decreased due to Covid-19 (ref. no)	−0.857 (0.933)	−1.356 (0.960)	−1.234 (0.962)
Relative dead due to Covid-19 (ref. no)	−0.105 (0.962)	−0.847 (0.987)	0.772 (0.991)
Housing change due to Covid-19 (ref. no)	1.332 (1.160)	1.527 (1.191)	1.842 (1.196)
Support from family and friends due to Covid-19 (ref. no)	1.660 (1.272)	0.727 (1.304)	0.521 (1.310)
Constant	58.607*** (13.816)	55.259*** (14.362)	63.868*** (14.361)
Observations	809	809	809
R^2	0.089	0.102	0.102

Note: Standard errors in parentheses. The cognitive, receptive, and expressive language abilities were derived from the Bayley (2006) assessment, Wave 3.
Abbreviations: CES-D 10, Center for Epidemiologic Studies Depression Scale; ECEC, early childhood education and care; HOME, Home Observation for Measurement of Environment instrument; PSI, Parenting Stress Index.
*$p < 0.1$.
**$p < 0.05$.
***$p < 0.01$.

Outreach and Engagement programs again through the *Centros de Salud Familiar* (CESFAMs) to connect with families who are confronting challenges and provide them with information on the importance of preschool education and the support services they can access to improve ECEC attendance.

Given that center-based care attendance involves families, one crucial intervention point would be at the parental level. First, strong connections between center-based care and families may provide an opportunity for preschool teachers to better understand the challenges parents face in getting their children to center-based care and to consider ways that these challenges can be met. Second, and even more importantly, improving the attendance of very young children requires working with parental beliefs. When most parents surveyed believe that preschool attendance is not necessary when someone at home can take care of children (Arbour et al. 2023), studies like ours can provide educators and policymakers with evidence to support the long- and short-term importance of ECEC programs. A recent report revealed that informing families about the importance of attendance through messages improved attendance for children. It could be an essential tool to use at this level of education (Musaddiq et al. 2023). The empirical evidence provided in this paper should inform and support the development of policy to educate parents about the importance of consistent and intensive attendance at early childhood programs.

Despite these contributions, this paper has some limitations. First, we cannot identify a causal effect of center-based care attendance on children's development. Although we have very rich information about the families and the children and a lagged variable of the outcomes, there could be unobservable factors—such as mothers' beliefs or abilities—that cannot be controlled for in this model. Second, our data on consistency and intensity of attendance at the ECEC programs were gathered from retrospective reports by mothers. There may have been a recall bias

TABLE 4 | Linear regression model between ECEC intensity of attendance and child cognitive and receptive and expressive language at 36–48 months.

	Cognitive	Receptive language	Expressive language
Child Attended ECEC half day (ref. did not attend)	1.097 (1.227)	0.410 (1.260)	−0.639 (1.265)
Child Attended ECEC full day (ref. did not attend)	3.234** (1.254)	2.908** (1.289)	1.440 (1.292)
Test score baseline	0.059* (0.035)	0.210*** (0.038)	0.159*** (0.035)
Child's age in months	0.678** (0.297)	0.624** (0.299)	0.301 (0.300)
Maternal educ. = 12 years of education	2.456* (1.288)	2.638** (1.321)	3.849*** (1.329)
Maternal educ. > 12 years of education	3.980*** (1.365)	3.104** (1.397)	4.492*** (1.407)
Main caregiver age	0.051 (0.082)	0.025 (0.084)	0.094 (0.084)
Child's gender (ref. boy)	4.801*** (0.937)	2.978*** (0.964)	4.605*** (0.968)
Foreign-born main caregiver	−0.897 (1.357)	−3.837*** (1.393)	−1.715 (1.398)
Main caregiver working (ref. no)	−0.635 (0.963)	−2.417** (0.988)	−1.416 (0.992)
Single mother household (ref. no)	0.185 (1.105)	−1.006 (1.133)	0.311 (1.138)
Grandparents living in household (ref. no)	1.470 (1.082)	0.987 (1.110)	2.603** (1.116)
Number of other children in household	−0.369 (0.369)	−0.377 (0.379)	−0.198 (0.381)
PSI IRT Std	−0.066* (0.036)	−0.034 (0.037)	−0.050 (0.037)
CES-D 10 IRT Std	0.027 (0.037)	−0.026 (0.038)	0.024 (0.038)
HOME IRT Std	0.109 (0.089)	0.039 (0.091)	0.056 (0.091)
Income decreased due to Covid-19 (ref. no)	−0.865 (0.934)	−1.363 (0.960)	−1.240 (0.962)
Relative died due to Covid-19 (ref. no)	−0.099 (0.963)	−0.815 (0.988)	0.824 (0.993)
Housing change during Covid-19 (ref. no)	1.354 (1.163)	1.514 (1.193)	1.781 (1.199)
Support from family and friends due to Covid-19 (ref. no)	1.646 (1.272)	0.704 (1.304)	0.484 (1.311)
Constant	59.040*** (13.816)	55.666*** (14.363)	64.183*** (14.360)
Observations	809	809	809
R^2	0.090	0.103	0.103

Note: Standard errors in parentheses. The cognitive, receptive, and expressive language abilities were derived from the Bayley (2006) assessment, Wave 3.
Abbreviations: CES-D 10, Center for Epidemiologic Studies Depression Scale; ECEC, early childhood education and care; HOME, Home Observation for Measurement of Environment instrument; PSI, Parenting Stress Index.
*$p < 0.1$.
**$p < 0.05$.
***$p < 0.01$.

here; however, we are confident that in this situation the bias is small because we asked the main caregivers for the attendance information near the time in question. Third, our R squared from the models is relatively small, which should be considered when looking at the results.

Finally, Bronfenbrenner's ecological theory accentuates the intricate interactions among diverse systems and their impact on child development. From this perspective, the childcare center constitutes a pivotal element within the child's microsystem, fostering development (Khairul Amali et al. 2023; Tudge et al. 2017). Closure of these centers amid the Covid-19 pandemic—part of the broader chronosystem—interrupted the proximal processes intertwined with children's families and their ECEC; however, the early reintegration into center-based care seems to have compensated for the possible damage that the closure of the care centers could have caused, highlighting the importance of timing noted by Bronfenbrenner. It is essential to remember the fundamental role of family in children's microsystems as a necessary element supporting their attendance at care centers.

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Data Availability Statement

The data and code necessary to reproduce the analyses presented here are available from the first author upon reasonable request, as are the materials necessary to attempt to replicate the findings.

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