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ARTICLE

Living the first years in a pandemic: children's linguistic development and related factors in and out of the COVID-19 lockdowns

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Abstract

This retrospective study provides insights on linguistic development in exceptional circumstances assessing 378 children (between 2;6 and 3;6) who lived their first years during the COVID-19 pandemic and comparing it with normative data collected before this period (*CDI-III-PT*; Cadime et al., 2021). It investigates the extent to which linguistic development was modulated by a complex set of factors, including sex, maternal education, book reading, language-promoting practices, COVID-19 infection, parental stress and sleeping problems, considering three periods (during lockdowns, out of lockdowns and at present). The results show a substantial negative effect of the pandemic on both lexical and syntactic development. Considering individual variation, structural equation modelling unveiled a complex scenario in which age, sex, book reading, language-promoting practices, sleeping problems and COVID-19 infection showed a direct effect on linguistic development. Maternal education and parental stress had an indirect effect on children's language, mediated by book reading and sleeping problems, respectively.

Keywords: language development; shared book reading; perceived parental stress; child sleep quality; COVID-19 pandemic

Introduction

The first years of life are crucial for linguistic development. Considering the existence of individual differences, several factors have been explored as a source of variation. One common finding is that girls usually outperform boys in vocabulary size and sentence production during the first years (Eriksson et al., 2011; Silva et al., 2017). Another

important trend in research explores factors that have effect on the quantity and quality of input. It has been shown that the quality of the input provided by parents, understood as vocabulary diversity and syntactic complexity, positively contributes to early linguistic development, even more robustly than quantity of input (see the recent meta-analysis of Anderson et al., 2021; also Hirsh-Pasek et al., 2015, considering a broader definition of input quality and focusing early communication). The present study explored the influence of different variables during a period in which the effects of the home environment were maximized, since families were confined. It is part of a larger research that intends to investigate how the various dynamics introduced by the measures adopted against COVID-19 shaped family practices at different levels during the pandemic and how these could have influenced early language development. In this study, we focus on family language and literacy practices, sociodemographic variables whose influence on language development has been widely documented in the literature, as well as the role of parental stress as a risk variable for family functioning and sleeping problems as a variable more generally involved in the quality of learning.

Early language development and the COVID-19 pandemic

The COVID-19 pandemic created a situation in which the environment for language development radically changed. In the case of Portugal, lockdowns were enacted by the government between March 2020 and May 2020, and between January 2021 and March 2021 (Alves et al., 2022). Additionally, in the periods when there was no lockdown, the reduction of contacts outside of the household was recommended and there were epidemic control measures implemented so that infected individuals and their close contacts had mandatory isolation or quarantine (for example, when a child in a daycare center tested positive for COVID-19, the whole class was sent home and isolated). The use of masks in schools and daycare centers was mandatory until April 2022 and the major restrictions related to COVID-19 were only lifted by the Portuguese government in the last months of that same year. This type of context, wherein the families were at home, with adults splitting their time between house chores (and in several cases, working at distance) and attending to children's needs, may have impacted the frequency and/or effectiveness of children's social interaction, a factor known to be crucial for language development (Kuhl, 2003). Moreover, a general decrease in opportunities for language use, coupled with a reduction in the number of people with whom children interacted, inevitably modified, if not the quantity, at least the quality of the input – in studies dealing with bilingual development, the number of different speakers providing input has been identified as a factor determining the quality of input (see Place & Hoff, 2011, 2016). In the circumstances created by the COVID-19 pandemic, the effect of the conditions of language exposure in the household could be expected to be exacerbated, since this was often the primary (and sometimes only) context in which linguistic interaction took place. This includes possible effects of families' socioeconomic status (SES), to the extent that the influence of schooling, which may play the role of a leveraging factor, was absent or radically reduced.

The effects of the pandemic on linguistic development in the early years have now started to be explored in some studies, using a variety of approaches, and yielding diverse results. For example, in a study targeting various aspects of development, Imboden et al. (2022) compared pre-pandemic data from 2018-2019 with pandemic data collected from October 2020 to January 2021 in the region of Illinois and reported a slight decrease in communication scores among 6- and 12-month-old children. As the authors

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acknowledge, variables such as SES, educational status or parenting practices were not explored in the study.

Kartushina et al. (2022) reported the results of a large-scale study evaluating the vocabulary (word comprehension and production) of 1742 children between 8 and 36 months across 13 countries and 12 languages and using data collected at the beginning and after the first lockdown in 2020. Three main results of this study should be highlighted: first, the children under study, who have gone through a lockdown, gained more vocabulary than expected according to normative data (pre-pandemic); second, less passive screen exposure and more shared reading activities correlated with faster lexical development; third, even though maternal education did not correlate with lexical development (contrary to the authors' predictions), maternal education positively correlated with time spent on shared reading activities and negatively correlated with children's passive screen exposure. However, this study had a major limitation related to sampling, as the participants mainly came from households with high SES: only 14% of the comprehension data and 10% of the production data corresponded to children belonging to families characterized by maternal education below a bachelor's degree, whereas 51.5% of mothers held a MA degree. As Kartushina et al. (2022) acknowledge, it remains to be determined the extent to which these findings generalize to families with lower SES.

A more recent study by Murillo et al. (2023) compared lexical and morphosyntactic development in two small groups of children between 18 and 31 months, one assessed before the pandemic (82 children), and the other born during the pandemic and assessed after this period, at the end of the 2021/2022 academic year (71 children). The groups were matched by age and maternal education. The results revealed that lexical and morphosyntactic development, as measured by the MacArthur-Bates Communicative Development Inventory (CDI) for this age group, was lower in the group tested after the pandemic. This suggests a negative impact of the COVID-19 control and mitigation measures during this period on children under 3 years of age. In this study, most of the mothers had a university degree, and the families could be classified as middle-class, although the group tested after the pandemic had significantly higher income.

A similar study was performed by Feijoo et al. (2023), where the linguistic development, as measured by the CDI, of 41 children born in 2019-2020 (post-COVID group, assessed in June-July 2021) was compared with that of 41 children born before 2012 (pre-COVID group), all aged between 8 and 30 months at the time of assessment. The mean for productive vocabulary was lower for the post-COVID group, but the difference between both groups did not reach statistical significance, probably due to the small sample size. Furthermore, when classifying groups based on percentiles as low versus high vocabulary, the pre-COVID group had more children with high vocabulary, whereas the post-COVID group had more children with low vocabulary. Additionally, in the post-COVID group, the children's diversity of communicative interaction (i.e., interlocutor variability) was a strong predictor of their productive vocabulary, independently of the use of face masks by adults.

Frota et al. (2022) compared 7 to 9-months-old children tested in a pre-COVID study to children in the same age range tested post-COVID. They identified lower scores on a scale measuring communication and symbolic behavior (CSBS scale) in the post-COVID group but found no differences in the scores obtained using a short version of the CDI, which measures word comprehension and production in this age range. In addition, the comparison of the experimental results obtained in this study with pre-pandemic results from a previous study suggested a delay in the development of segmentation abilities in the post-pandemic group. This study also suggested that infants paid less attention to

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language when it was produced with a mask. However, this does not necessarily mean that mask use had a detrimental effect on child's language development, as research has suggested that, in the presence of a face mask, speakers frequently use compensatory strategies such as increasing speech quality, as well as alternative communication strategies like gestures (Crimon et al., 2022; Pycha et al., 2022), and these strategies could eventually minimize the effects of mask use on communication.

Research has not only focused on the changes introduced by the pandemic in children's language development, but also the changes in home language and literacy practices conducted by families. Read et al. (2022) performed a study with the parents of 85 children aged between 2 and 5 years old, exploring the frequency of shared reading in February and October 2020. The results indicated no significant changes in the frequency of reading between both time points. However, this finding contrasts with those obtained by Lin et al. (2023), who conducted a study with families of 47 preschool children aged around 5 years old, assessed right before COVID-19 and one year later (during COVID-19). Their results indicated a decrease in the frequency of book reading, storytelling, writing and playing games with children.

Variables associated to early language development

As described above, some of these studies on the impact of the COVID-19 pandemic on children's language development considered the family's SES, whereas others did not. SES is a complex variable which comprises, among other factors, income and education level (Letourneau et al., 2013), with maternal education being the most commonly used indicator to determine SES in child development studies (Hoff, 2006). It has been argued that higher SES predicts faster linguistic development (Arriaga et al., 1998; Betancourt et al., 2015; Hoff, 2013), and the effect of SES and maternal education has not only been documented for lexical development (Andonova, 2015; Cadime et al., 2018; McGillion et al., 2017), but also for syntactic development (Huttenlocher et al., 2010; Leech et al., 2017). Schwab and Lew-Williams (2016) presented a review of literature discussing the relation between family SES and the quantity and quality of input, reaching two main conclusions: family SES predicts differences in both language input and child linguistic development; however, within different SES groups, important differences in the quality and quantity of input are also found (see also Hirsh-Pasek et al., 2015). It is still not clear whether this relationship is direct or mediated by other variables (e.g., maternal linguistic skills, or the type of activities in which families engage with their children and their consequences for the quantity and quality of input). For example, the positive effect of shared book reading on children's linguistic development has been consistently documented in meta-analyses (e.g., Mol et al., 2008; Noble et al., 2019). This positive effect is not limited to older children, as research has shown that shared book reading predicts later linguistic development even with preverbal infants (Muhinyi & Rowe, 2019). However, shared book reading at home also seems to be influenced by maternal education: mothers with higher educational levels not only read more frequently to their children, but they also use more diverse vocabulary and more complex sentences during book reading (Leech et al., 2022; McNally et al., 2023; Muhinyi & Rowe, 2019).

More recently, sleep consolidation and sleep quality have been associated with better linguistic outcomes in the early infancy (Knowland et al., 2022; Turnbull et al., 2022). A bedtime routine seems to be one of the main predictors of sleep consolidation and sleep quality (Mindell & Williamson, 2018). This routine may include several activities, but

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those related to feeding and hygiene, as well as book/story reading, are the most prevalent (Hall et al., 2018; Staples et al., 2015). As for the impact of the COVID-19 pandemic on sleep quality, a systematic review and meta-analysis on sleep in children (6 months to 6 years old) and adolescents showed alarming sleeping disturbances during this period, with the exception of preschool children, who did not show significant differences compared to the pre-pandemic period (Sharma et al., 2021). Sharma et al. (2021) offer several explanations for this finding: unlike older children, those up to the age of 6 years old typically spend more time at home, benefit from family time, have no large groups of friends at school, and do not yet understand the effects of an emergency state. All these factors could have contributed to the absence of significant changes in sleeping problems among younger children. However, none of the five studies focusing on preschool children identified in the review and meta-analysis conducted by Sharma et al. (2021) addressed the relationship between parental stress and the sleeping problems shown by children during the pandemic.

A more recent study (Barata & Acar, 2024) involving mothers of children aged between 16 and 84 months reported a negative association between parental stress and children's sleep quality during the pandemic. Barata and Acar (2024) summarize the underlying mechanisms of this relationship stating that an increase in parents' stress can lead to greater irritability, inconsistent bedtime routines, less attention to children's bedtime needs, and the allowance of overstimulating activities right before bedtime, which, in turn, may negatively affect children's sleep.

Family stress has also been associated to children's linguistic development (Noel et al., 2008). The mechanisms underlying this relationship may be diverse. High levels of parental stress, particularly among mothers, have been linked to decreased verbal interaction with children (Repetti & Wood, 1997), which is essential for language development. Parents experiencing stress may also provide fewer opportunities for language stimulation, such as reading books, singing songs, or engaging in play, and this reduced exposure to rich environments could hinder children's linguistic development.

The COVID-19 pandemic increased the stress levels among families (Gniewosz, 2023; Li et al., 2022; Prokupek et al., 2023), and this seems to have had an effect on family practices involving children. A study conducted in Germany during the first wave of the COVID-19 pandemic pointed to parental stress as a key factor in the frequency of home learning activities (e.g., book reading, puzzle assembling) carried with children aged 1-6 years old: although, on average, parents increased the frequency of these activities during the lockdown compared to the preceding period, in the households where parents experienced extremely high levels of stress, the frequency of these activities decreased (Oppermann et al., 2021). A negative relationship between parental stress and the frequency of learning activities was also found in a study conducted in China in the Spring of 2020 (Zhang et al., 2021).

The present study

The COVID-19 pandemic introduced several changes in society in general, and family settings in particular, resulting in a reduction in social interactions during that period. As outlined in the preceding section, previous research suggests a negative effect of the pandemic events on children's early language development (Feijoo et al., 2023; Frota et al., 2022; Imboden et al., 2022; Murillo et al., 2023). However, most of these studies were conducted with small sample sizes. Kartushina et al.'s larger-scale study (2022) yielded a discrepant result, indicating positive effects, but this study only assessed the effects of a

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very limited lockdown period, and the sample was biased due to an extremely high percentage of families from high SES. We hypothesize that the general gain in lexical development found in this study among children who went through the first lockdown would possibly not be found if a more socioeconomically diverse population was considered, and the effects of a more extended period of pandemic-related mitigation measures were analyzed. Research on variables associated with better or worse linguistic outcomes in children that underwent the pandemic during their three first years of life is thus still scarce, and the observation by Lukić et al. (2022) concerning the limited number of studies assessing the effects of the pandemic on linguistic development remains valid. Therefore, this study addressed the following research questions:

1. Did parental stress, children's sleep problems, and household practices, such as book reading or other language-promoting activities, change during periods of mandatory lockdowns, quarantines, and isolation compared to periods when these measures were not in place?
2. How does the linguistic development of the children who underwent the pandemic during their first three years of life compare to the linguistic development of reference samples collected before the pandemic?
3. To what extent are individual and environmental factors related to children's current linguistic development?

Regarding question 3, we considered a large set of variables, including sociodemographic variables (such as child's age, sex, birth order position, family SES as expressed by maternal education), factors influencing learning (such as child's sleeping problems), daily family-functioning related variables (such as parental stress), home literacy practices (like shared book reading), home language-promoting practices (such as singing, play), and pandemic-related factors (like mask use, COVID-19 infection). Although shared book reading is also a language-promoting practice, we decided to analyze it separately from the remaining practices since it has been separately studied in vast research, as can be seen in reviews and meta-analyses (e.g., Mol et al., 2008; Noble et al., 2019). On the other hand, besides enhancing oral language, shared book reading also promotes children's emergent literacy dimensions, such as print knowledge (e.g., Dicataldo et al., 2022).

Considering the existing literature, we expected a direct effect of sociodemographic variables, child's sleeping problems, parental stress, shared book reading, and home language-promoting practices on children's linguistic development. We also expected that maternal education would not only be connected to children's linguistic skills, but also to the shared book reading and language-promoting practices conducted within the household. Regarding pandemic-related factors (such as infection by COVID-19 and mask use), we did not make any predictions due to limited research on the topic, although we examine their direct effect on children's linguistic development. Given that parental stress can be associated to difficulties in implementing a bedtime routine, we also predicted a relationship between parental stress and both children's sleeping problems and shared book reading.

Method

Participants

The following exclusion criteria were established for this study: (a) the child has been born before 9 months weighing less than 1500 grams; (b) the child has a developmental

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disorder; (c) the child's parents (both) only speak a language other than Portuguese with the child at home.

Data were collected retrospectively and currently from 402 parents of children aged 2;6 to 3;6 in March-April 2023. The data from 24 questionnaires were discarded for this study because the information provided by the caregivers regarding the production of word combinations – which in these cases was reported to be non-existent, with the child's age being equal to or greater than 30 months – could be a sign of language disorder (Mariscal, 2020). Therefore, the final sample consisted of 378 Portuguese children born between 2019 and 2020 and their families. Table 1 summarizes the main demographic and socioeconomic characteristics of the sample, as well as the characteristics of the sample used in the validation study of the CDI-III for European Portuguese, for comparison purposes.

Measures

MacArthur-Bates Communicative Development Inventory III, Portuguese version (CDI-III-PT; Cadime et al., 2021)

This is a parental report inventory built to assess the communicative development of children between 30 and 48 months of age. It consists of two subscales: vocabulary and syntactic complexity. In the vocabulary subscale, a checklist of 166 words is presented to parents, who must mark the words that their child spontaneously produces. The words in this checklist are divided into four lexical categories: (1) body parts and related words (34 words); (2) food and related words (37 words); (3) mental terms (45 words); and (4) emotions and related words (50 words). The syntactic complexity subscale consists of a 26-item checklist that presents different types of syntactic structures that children between two and a half and four years of age are expected to produce in their daily lives. For each item, parents must indicate whether the child produces the target structure (yes/no). One or more example sentences are presented for each item, with the words that signal the structure highlighted in bold.

This instrument has been validated for the Portuguese population ($N = 739$), showing high internal consistency values for both vocabulary (KR-20 = .981) and syntactic complexity subscales (KR-20 = .911). The correlation between different informants in each of the subscales, as well as the correlation between the CDI-III scores and the scores in a standardized and direct measure of children's language is high (> .50), providing evidence of validity for the measure (Cadime et al., 2021). The instrument offers percentile scores (P10, P25, P50, P75, P90) for each month of age. The total scores obtained in these two subscales, which are based on the sum of all the affirmative responses, were used as measures of expressive vocabulary and syntactic production, respectively. Regarding reliability for the current sample ($N = 378$), the KR-20 was .986 for vocabulary and .940 for syntactic complexity.

Sociodemographic questionnaire

In the initial section of the sociodemographic questionnaire, parents were asked about the presence of exclusion criteria, the child's characteristics (e.g., age, sex) and the characteristics of the household (e.g., composition of the household, area of the country where the family lives, birth order of the child, parents' level of education). In a second section of the questionnaire, questions focused on aspects related to the COVID-19 pandemic,

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Table 1. Descriptive statistics for demographic and socioeconomic characteristics of the sample

Characteristics	*N* = 378	*Study of validation of the CDI-III (Cadime et al., 2021; N = 739)*
Child's age (in months)	35.46 (3.55) [30–41]	38.51 (4.72) [30–48]
Child's sex		
Female	195 (51.6)	337 (45.6)
Male	183 (48.4)	397 (53.7)
No information	–	5 (0.7)
Respondent's relationship to child		
Mother	258 (68.2)	654 (88.5)
Father	117 (31.0)	47 (6.4)
Other	3 (0.8)	36 (4.8)
Socioeconomic status		
Low (monthly family income up to 1000€)	47 (12.4)	
Medium (between 1000 and 2000€)	175 (46.3)	
High (between 2000 and 3000€)	112 (29.6)	
Very high (above 3000€)	44 (11.6)	
Mother's educational level		
Upper secondary or below (≤12 years)	142 (37.6)	343 (46.4)
Post–secondary or above (>12 years)	236 (62.4)	391 (52.9)
No information	–	5 (0.7)
Father's educational level		
Upper secondary or below (≤12 years)	208 (55.0)	
Post–secondary or above (>12 years)	170 (45.0)	
Area of the country		
North	128 (33.9)	
Central area	93 (24.6)	
Lisbon	123 (32.5)	
Alentejo	18 (4.8)	
Algarve	13 (3.4)	
Azores	1 (0.3)	
Madeira	2 (0.5)	
Family type		
Living with parents	343 (90.7)	
Living mainly with mother	26 (6.9)	
Living mainly with father	2 (0.5)	
Living in joint custody	2 (0.5)	

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Table 1. *(Continued)*

Characteristics	*N* = 378	*Study of validation of the CDI-III (Cadime et al., 2021; N = 739)*
Not living with parents	5 (1.3)	
Child's birth order position		
First–child or only–child	239 (63.2)	408 (55.2)
Other positions	139 (36.8)	303 (41.0)
No information	–	28 (3.8)
Mother–to–child language		
Only Portuguese	332 (87.8)	
Portuguese plus another language	46 (12.2)	
Hours a day using that other language	3.13 (4.67) [1–24]	
Father–to–child language		
Only Portuguese	350 (92.6)	
Portuguese plus another language	28 (7.4)	
Hours a day using that other language	3.32 (4.88) [1–24]	
Enrolled in nursery or pre–school		
No	66 (17.5)	
Yes	312 (82.5)	
Entry age (in months)	12.29 (9.01) [1–36]	
Child with confirmed diagnosis of COVID–19		
No	183 (48.4)	
Yes	195 (51.6)	

Note: Data expressed as mean (standard deviation) [maximum-minimum] for continuous variables, and frequencies (percentages) for categorical variables.

including the child's infection with COVID-19 or the use of masks by part of the child's caregivers. Regarding COVID-19 infection, parents were asked to indicate whether their child had been infected at least once, with confirmation of infection obtained through laboratory PCR testing, antigen testing, or self-testing methods.

Questionnaire on language-promoting practices

This questionnaire was constructed for the purpose of this study. It includes eight questions about a set of practices that the literature has pointed out as being associated with language development. The first five questions explore whether household members perform the following practices with the child: sing to the child, play games with sounds, play symbolic game, play with didactic toys/games, and play interactive games. The three remaining questions explore the practices that the child can also perform alone – play games with sounds, play symbolic game, and play with didactic toys/games. Families were asked to report the frequency of each practice in three periods of time: (a) during periods of lockdown, quarantine, or isolation; (b) during periods of the pandemic when they were not

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in lockdown, quarantine, or isolation; and (c) currently, considering the 30 days preceding questionnaire completion. Parents indicated the frequency of these practices for each of the three periods using a six-point scale: (1) never; (2) 1-3 times a week; (3) 4-6 times a week; (4) 7-9 times a week; (5) 10-12 times a week, and (6) more than 12 times a week.

Measure of shared book reading

Shared book reading was assessed with one question on the frequency with which parents read to their children, using the same six-point scale employed for assessing language-promoting practices and encompassed the same three periods as in the previous measure: (a) during periods of lockdown, quarantine, or isolation; (b) during periods of the pandemic when they were not in lockdown, quarantine, or isolation; and (c) currently, considering the 30 days prior to questionnaire completion.

Measure of perceived parental stress

Parental stress was assessed by asking parents to rate their stress levels for each of the three time periods considered in this study. Parents rated their stress levels on a scale from 1 to 10, with 1 representing the lowest level of stress and 10 representing the highest level of stress.

Measure of children's sleeping problems

Children's sleeping problems were assessed by asking parents to indicate, for each of the three time periods, whether their child had sleeping problems such as restless sleep, trouble falling asleep, nightmares, or waking up frequently during the night. Parents ranked the severity of sleeping problems for each period using a 4-point Likert scale: (1) no sleeping problems; (2) mild sleeping problems; (3) moderate sleeping problems; and (4) severe sleeping problems.

Procedure

The study was approved by the Ethics Committee for Research in Social and Human Sciences at the University of Minho (reference CEICSH 042/2023). Data collection was carried out by the company GfK metrics through an online survey directly accessed by the interviewees. Prior to accessing the survey, participants were contacted regarding the project via an email containing information about the study, as well as the link to access the survey. The survey was administered through the CAWI (Computer Assisted Web Interviewing) system. Its completion was preceded by the presentation of a free and informed consent to participate in the research, prepared in accordance with the Declaration of Helsinki and the Oviedo Convention. GfK implemented internal quality control procedures to prevent duplication of responses and guarantee data integrity. Data collection took place between March 27 and April 13, 2023.

Statistical analysis

Firstly, the dimensionality of the questionnaire on language-promoting practices was explored using the data collected for each period under consideration. To do this, a series

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of exploratory factor analyses (EFA) was performed using the FACTOR software, version 12.04.01 (Ferrando & Lorenzo-Seva, 2017). Given the ordinal nature of the data, polychoric matrices were used for these analyses. The factorability of the data matrices was assessed using the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and the Bartlett's test of sphericity (BTS), with KMO values greater than 0.60 and a significant *p*-value for Bartlett's chi-square being recommended criteria (Tabachnick & Fidell, 2013). The factor extraction was performed using a Morgana Factor Analysis. The decision on the number of factors to be retained was based on the result of the Optimal Implementation of Parallel Analysis (PA) technique (Timmerman & Lorenzo-Seva, 2011), while the closeness to unidimensionality of the instrument was assessed using three indicators: Unidimensional Congruence (UniCo), Explained Common Variance (ECV), and Mean of Item Residual Absolute Loading (MIREAL), with values of UniCo > 0.95, ECV > .85, and MIREAL < .30 suggesting that data can be treated as essentially unidimensional (Ferrando & Lorenzo-Seva, 2018). The Promax rotation was selected to continue with the exploration in case of absence of unidimensionality. Three fit indices were used to assess the goodness-of-fit of the factor solutions: Root Mean Square Error Approximation (RMSEA), Comparative Fit Index (CFI), and Goodness of Fit Index (GFI), with values less than .08 for RMSEA, and equal or greater than .90 for GFI and CFI being considered acceptable (Hair et al., 2014). Standardized Cronbach's alpha and McDonald's ordinal Omega coefficient were estimated to assess the reliability of the questionnaire scores, using a value of .70 as an acceptable lower limit (George & Mallery, 2016). The construct replicability was evaluated using the Generalized G-H index, with values greater than .80 indicating a well-defined latent variable from the observed item scores (Hancock & Mueller, 2000).

In general, a descriptive analysis of all the data was carried out using frequencies and percentages for non-normally distributed variables and means and standard deviations for continuous and ordinal variables with normal distributions. The univariate normality of the data distribution was checked examining the absolute values of skewness and kurtosis of the variables, with values within the acceptable range of ±2 indicating that a variable can be considered normally distributed (George & Mallery, 2016). Mardia's test was performed to assess the multivariate normality, with a significant *p*-value confirming the absence of multivariate normality.

To address research question 1, we investigated changes in book reading, language-promoting practices, parental stress and sleeping problems across the three time periods under consideration. Parametric and nonparametric repeated measures ANOVA were employed for continuous and ordinal variables, respectively, followed by pairwise multiple comparison tests with Bonferroni correction. Partial eta squared (η^2_p) was used to determine effect size (ES), adopting the benchmarks proposed by Cohen (1988) for the interpretation of its values: negligible ($\eta^2_p < 0.01$), small ($0.01 \leq \eta^2_p < 0.06$), moderate ($0.06 \leq \eta^2_p < 0.14$), and large ($\eta^2_p \geq 0.14$). Kendall's coefficient of concordance (W) was selected as a measure of ES in the Friedman tests, using the following cut-off values for its interpretation: negligible ($W < 0.10$), small ($0.10 \leq W < 0.29$), moderate ($0.30 \leq W < 0.49$), and large ($W \geq 0.50$).

To explore research question 2, we used the percentage of children in the sample whose scores in expressive vocabulary and syntax fell at or below the 10th percentile of CDI-III-PT normative scores. This comparison aimed to assess the early linguistic development of children who underwent the pandemic compared to a reference sample collected before the pandemic. Specifically, we used the validation sample for the CDI-III-PT, which served as the linguistic measure in the present study. Furthermore, to address research

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question 3, a series of Student's *t*-tests for independent samples was conducted to explore differences in the children's expressive linguistic skills associated with sociodemographic variables and pandemic-related factors. The magnitude of these differences was reported in terms of Cohen's *d* ES, whose values were interpreted as negligible ($d < 0.20$), small ($0.20 \leq d < 0.50$), moderate ($0.50 \leq d < 0.79$), and large ($d \geq 0.80$), following Cohen's guidelines (1988). Pearson and Spearman's correlations, depending on the variable types involved, were estimated to determine the strength and direction of the bivariate relationships between the predictor variables and the outcome measures (productive vocabulary and syntax) for each period considered. All univariate and bivariate statistical analyses were carried out with software IBM SPSS Statistic version 27. Next, structural equation modelling (SEM) was used to determine the multivariate relationships between children's linguistic development, shared book reading, family practices, parental stress, child's sleeping problems, and sociodemographic characteristics (child's age and sex, as well as maternal education). Three models were separately tested: one including the practices, parental stress, and sleeping problems during lockdown, quarantine, or isolation; another model including scores in these variables pertaining to periods out of the lockdown, quarantine, or isolation; and a third model including scores related to the moment of data collection. Linguistic development was included as a latent variable measured by two indicators (vocabulary and syntax). All other variables were included as observed indicators. A chi-square to degrees of freedom ratio ($\chi 2/df$) below 2, a Comparative Fit Index (CFI) higher than .95, as well as a Root Mean Square Error of Approximation (RMSEA) below .05 were considered indicators of a good model fit (Hu & Bentler, 1999; Marsh et al., 2004). SEM was conducted using Mplus version 7 (Muthén & Muthén, 2012) and the maximum likelihood estimator.

Results

We begin by exploring the dimensionality and reliability of the questionnaire on language-promoting practices, developed specifically for this study. Then, we examine the changes in home language-promoting practices and shared book reading, as well as the variation in parental stress and child's sleeping problems across the three time periods considered in this study. After that, we analyze the current linguistic development of the children in the sample, considering the norms established for the Portuguese version of CDI-III as well as various sociodemographic variables (child's sex, child's birth order position and maternal education) and pandemic-related factors (infection by COVID-19 and face mask use by primary caregivers). We then explore the associations between sleeping problems, parental stress, and home language and literacy practices reported for each of the three time periods studied and the children's current linguistic development. Finally, we model the effects of all these variables for each of these periods.

Home language and literacy practices across time

Regarding home language practices, EFA results can be consulted in Table I of the supplementary material. A one-factor solution was suggested by PA for data from all three periods, with explained variances ranging from 69.54 to 70.53%. The unidimensionality of the instrument was further confirmed by UniCo values (.950 to .968), ECV values (.839 to .863), and MIREAL values (.281 to .293). The unidimensional factor solution yielded acceptable levels of goodness-of-fit for data from all three periods, with

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RMSEA values close to or below .08 and CFI and GFI values exceeding .98. At the item level, factor loadings (all > .509) indicated that all of them measured the underlying construct. Furthermore, the G-H index was above .80, suggesting a well-defined latent variable, and stability could be expected across studies. Additionally, values greater than .90 for alpha and omega revealed that the reliability of the questionnaire scores was high for all the periods considered.

Statistically significant differences were found in the extent of time spent by parents engaging in shared book reading activities across each of the three time periods under study ($F_{(1.692)} = 4.232$, $p = .020$, $\eta^2_p = .011$). Specifically, families reported significantly higher frequency of reading to their children during lockdowns, quarantines, or isolations than out of them during the pandemic period ($p < .001$, IC 95% = [0.05, 0.24]). However, no significant differences in shared book reading frequency reported by parents were detected between the present and the pandemic period, both into and out of lockdowns (both *p*s > .20) (see Table 2). On the other hand, no significant differences were found among the three periods in terms of language-promoting practices (all *p*s > .05).

Parental stress across time

We found statistically significant differences in the stress reported by the parents for each moment ($F_{(1.761)} = 48.277$, $p < .001$, $\eta^2_p = .114$), with the level of stress perceived by the parents being higher during lockdowns, quarantines, or isolations than out of them ($p < .001$, IC 95% = [0.71, 1.18]), or at present ($p < .001$, IC 95% = [0.63, 1.25]) (see Table 2).

Sleeping problems across time

In relation to sleep behavior, we found significant differences in the prevalence and severity of sleeping problems reported for each period ($\chi^2_{(2)} = 24.336$, $p < .001$, W = .032). Sleeping problems were significantly more severe throughout the pandemic compared to the present moment (see Table 3), both during and out of lockdowns, quarantines, or isolations (Z = -4.409, $p < .001$ and Z = -3.380, $p < .001$, respectively). Although the

Table 2. Home language-promoting practices, shared book reading, and parental stress during and out of lockdowns, quarantines, or isolations in pandemic period (*Into* and *Out of* columns, respectively) and in the last month (*Now* column)

	Language-promoting practices			Shared book reading			Parental stress		
	Into	Out of	Now	Into	Out of	Now	Into	Out of	Now
Mean	3.56	3.50	3.57	2.92	2.78	2.88	6.02	5.08	5.09
Standard deviation	1.18	1.18	1.19	1.44	1.33	1.30	2.66	2.45	2.59
Min.–Max.	1–6	1–6	1–6	1–6	1–6	1–6	1–10	1–10	1–10
Skewness	0.27	0.31	0.32	0.68	0.87	0.89	–0.46	–0.16	–0.10
Kurtosis	–0.74	–0.76	–0.77	–0.39	0.22	0.31	–0.78	–0.90	–1.02

Note: Practices reported in terms of frequency a week using a scale of 1 to 6 in which 1 = never; 2 = 1-3 times a week; 3 = 4-6 times a week; 4 = 7-9 times a week; 5 = 10-12 times a week, and 6 = more than 12 times a week. The score in *Language-promoting practices* is based on average rating of 2 to 9 items from the Questionnaire on home language and literacy practices. Stress level reported on a scale of 1 to 10, with 10 being the highest level.

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Table 3. Parent-reported child sleep quality during and out of lockdowns, quarantines, or isolations in pandemic period (*Into* and *Out of* columns, respectively) and in the last month (*Now* column)

Child sleeping problems	*Into*	*Out of*	*Now*
No sleeping problems	238 (63.0)	244 (64.6)	258 (68.3)
Mild sleeping problems	87 (23.0)	91 (24.1)	101 (26.7)
Moderate sleeping problems	40 (10.6)	34 (9.0)	14 (3.7)
Severe sleeping problems	13 (3.4)	9 (2.4)	5 (1.3)

Note: Child sleep quality reported as frequencies (percentages) of sleeping problems.

interviewees reported more sleeping problems during lockdowns, quarantines, or isolations compared to pandemic periods without these measures in place, this difference did not reach statistical significance when applying Bonferroni's correction, considering a *p*-value of .017 (Z = -2.189, p = .029).

Early expressive language skills of children who underwent the pandemic

The analysis of the information collected on the child's communicative-linguistic development through parents or other main caregivers revealed that one third of them had a very limited expressive vocabulary, performing at or below the 10th percentile of the normative sample of the validation study of the CDI-III for European Portuguese (see Table 4). Furthermore, concerning the syntactic complexity of the produced sentences, an increase was also observed in the number of children demonstrating very low levels of performance (10th percentile or below) compared to the pre-pandemic reference sample (see Table 5).

Table 4. Child's current expressive vocabulary and performance level depending on sociodemographic variables and pandemic-related factors

		Sex		Birth order position		Maternal education		COVID-19 infection		Use of face masks[a]	
	Vocabulary	Female	Male	First	Other	≤ 12 years	> 12 years	Yes	No	Yes	No
N	378	195	183	239	139	142	236	195	183	230	136
Mean	51.21	53.36	48.91	50.21	52.93	47.87	53.21	57.11	44.92	51.55	50.34
SD	40.24	40.30	40.17	39.77	41.13	39.43	40.68	41.79	37.63	41.39	37.43
Min.-Max.	0–166	0–160	0–166	0–166	0–160	0–165	0–166	0–166	0–165	0–166	0–160
Skewness	0.75	0.62	0.91	0.77	0.73	0.68	0.79	0.55	1.00	0.76	0.74
Kurtosis	–0.21	–0.51	0.20	–0.10	–0.36	–0.28	–0.20	–0.57	0.47	–0.29	–0.14
% ≤ Pc 10	33.1	31.3	35.0	33.1	33.1	37.3	30.5	29.7	36.6	33.0	32.4
$\chi^2_{(1)}$[b]		0.581		0.000		1.861		2.012		0.018	

Note: Maximum score in vocabulary = 166.
[a]A total of 12 interviewees responded that they were not sure about this question. Values estimated for a n = 366.
[b]The chi-square test checks for differences in the proportion of cases with a performance at or below 10th percentile in the comparison groups.

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Table 5. Child's current productive syntax and performance level depending on sociodemographic variables and pandemic-related factors

		Sex		Birth order position		Maternal education		COVID-19 infection		Use of face masks[a]	
	Syntax	Female	Male	First	Other	≤ 12 years	> 12 years	Yes	No	Yes	No
N	378	195	183	239	139	142	236	195	183	230	136
Mean	17.92	18.51	17.29	18.11	17.59	18.70	17.45	19.21	16.55	17.95	17.93
SD	7.34	7.38	7.27	7.43	7.20	7.46	7.24	6.60	7.85	7.23	7.39
Min.–Max.	0–26	0–26	0–26	0–26	0–26	0–26	0–26	0–26	0–26	0–26	0–26
Skewness	–0.59	–0.75	–0.45	–0.60	–0.60	–0.85	–0.46	–0.76	–0.38	–0.56	–0.60
Kurtosis	–0.72	–0.46	–0.92	–0.77	–0.62	–0.35	–0.86	–0.40	–1.02	–0.80	–0.66
% ≤ Pc 10	14.0	12.8	15.3	13.4	15.1	15.5	13.1	8.7	19.7	13.5	14.7
$\chi^2_{(1)}$[b]		0.482		0.215		0.409		9.397**		0.107	

Note: Maximum score in syntactic complexity = 26.
**p <.01.
[a]A total of 12 interviewees responded that they were not sure about this question. Values estimated for a n = 366.
[b]The chi-square test checks for differences in the proportion of cases with a performance at or below 10th percentile in the comparison groups.

Differences in children's linguistic development as a function of sociodemographic variables

No statistically significant differences associated with sex were found ($t_{(376)}$ = 1.074, p = .284, d = .11 and $t_{(376)}$ = 1.622, p = .106, d = .17 for vocabulary and syntactic complexity, respectively), although there was a tendency for higher mean scores in girls than boys (see Tables 4 and 5). Regarding birth order position, no significant difference between children who had or not older siblings was detected, neither in vocabulary ($t_{(376)}$ = -0.634, p = .527, d = .07) nor in syntax ($t_{(376)}$ = 0.667, p = .505, d = .07). In the same way, no statistically significant differences were associated with maternal education for any of the expressive linguistic skills reported by the interviewees: vocabulary ($t_{(376)}$ = -1.250, p = .212, d = .13) and syntax ($t_{(376)}$ = 1.613, p = .108, d = .17).

Differences in children's linguistic development as a function of pandemic-related factors

The analysis of the effect of pandemic-related factors revealed that children with a confirmed diagnosis of COVID-19 were reported as having a significantly larger expressive vocabulary than children who had not been infected ($t_{(375.372)}$ = 2.983, p = .003, d = .31), as well as scoring higher in syntactic production ($t_{(356.306)}$ = 3.546, p < .001, d = .37). However, no differences in the children's productive language development were significantly associated with the use of face masks by parents or main caregivers in the child's presence, neither in vocabulary ($t_{(364)}$ = 0.280, p = .780, d = .03), nor in syntax ($t_{(364)}$ = 0.018, p = .986, d = .00).

Relationship between children's linguistic development, sleeping problems, parental stress, book reading and language-promoting practices

As can be seen in Table 6, children's expressive skills correlated positively and significantly with the child's age, as well as with book reading and language-promoting

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practices, without exception and regardless of the period considered. Thus, the higher the frequency of these practices, as reported by families, the larger the children's productive vocabulary and syntactic development.

On the other hand, when exploring the effect that sleeping problems reported for each of these moments could have had on children's productive language development, a significant association emerged only for syntactic complexity. Lower scores in the syntactic scale were associated with more reported sleeping problems across all three time periods studied ($\rho_{(378)}$ = -.106 to.129, *p*s < .05, see Table 6).

No significant association between child's expressive language skills and parental stress was found. However, parental stress did show a positive and significant correlation with child's sleeping problems, regardless of the period considered ($\rho_{(378)}$ = .200 to .236, *p*s < .001, see Table 6). In addition, it should be noted that sleeping problems were also associated with a higher frequency of shared book reading during lockdowns, quarantines, or isolations ($\rho_{(378)}$ = .145, p = .005, see Table 6).

Interrelationships among children's linguistic development and all other variables

As previously described, we tested three SEM, each corresponding to one of the three time periods considered in this study. All sociodemographic factors were tested in the models; however, birth order position showed no association with any other variable and was, therefore, removed. Children's age and sex were associated with language development, but not with sleeping problems, shared book reading, or language-promoting practices. Consequently, these latter associations were not included in the final models. Regarding pandemic-related variables, only COVID-19 infection was included in the models, given that mask use was not associated with the children's linguistic development. Model fit was good for the three models – the fit indices for each final model can be consulted in the supplementary material.

Figure 1 depicts the standardized coefficients for the models. In model 1, age, sex and COVID-19 infection had a significant effect on child's linguistic development, indicating that older children, girls, and children who were infected with COVID-19 exhibited better linguistic levels. A higher frequency of book reading and language-promoting practices during lockdown, quarantine and isolation periods was also directly associated with higher current linguistic development. Sleeping problems during that time were negatively associated with children's current linguistic development. Moreover, sleeping problems were directly predicted by the parental stress: greater parental stress was associated with more sleeping problems in children. Interestingly, children's sleeping problems were positively linked to the frequency of book reading. There was a marginally significant indirect effect of maternal education on children's linguistic development via book reading (β = .037; p = .059), but not via other language-promoting practices (β = -.002; p = .907). Furthermore, there was an indirect effect of parental stress on book reading frequency, mediated by children's sleeping problems (β = .027; p = .017), and a marginally significant and negative effect of parental stress on children's linguistic development, mediated by children's sleeping problems (β = -.029; p = .057).

In model 2, the results were quite similar to the ones obtained for model 1, with the same regression paths being significant, although with one exception: children's sleeping problems out of lockdown, quarantine or isolation were not associated with the frequency of book reading during that period. Once again, maternal education did not directly predict children's linguistic development, but it did so indirectly, via the frequency of book reading (β = .036; p = .048), but not via the remaining practices (β = .001; p = .943).

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Table 6. Relationships between expressive language skills and child's age, child's sleeping problems, parental stress, home language and literacy practices

		Into						
	Variable	1	2	3	4	5	6	7
1	Age		–.057	–.022	.014	.036	.166***	.230***
2	Sleeping problems			.200***	.145**	.058	–.014	–.112*
3	Parental stress				.032	.002	.039	–.033
4	Shared book reading					.451***	.206***	.131*
5	Language–promoting practices						.244***	.204***
6	Vocabulary							.341***
7	Syntax							
		Out of						
	Variable	1	2	3	4	5	6	7
1	Age		–.061	–.027	.075	.047	.166***	.230***
2	Sleeping problems			.203***	.068	.073	–.037	–.129*
3	Parental stress				–.061	–.129*	.010	–.045
4	Shared book reading					.379***	.207***	.143**
5	Language–promoting practices						.226***	.208***
6	Vocabulary							.341***
7	Syntax							
		Now						
	Variable	1	2	3	4	5	6	7
1	Age		–.083	–.047	–.001	–.008	.166***	.230***
2	Sleeping problems			.236***	.082	–.019	–.016	–.106*
3	Parental stress				–.036	–.074	.023	–.033
4	Shared book reading					.420***	.191***	.118*
5	Language–promoting practices						.219***	.133*
6	Vocabulary							.341***
7	Syntax							

Note: * $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$. Pearson and Spearman's correlation coefficients calculated for variables with normal and non-normal distribution, respectively.

Furthermore, parental stress did not indirectly predict the frequency of book reading in this model ($\beta = .005$; $p = .607$), but it did indirectly predict children's linguistic development via children's sleeping problems ($\beta = -.036$; $p = .023$).

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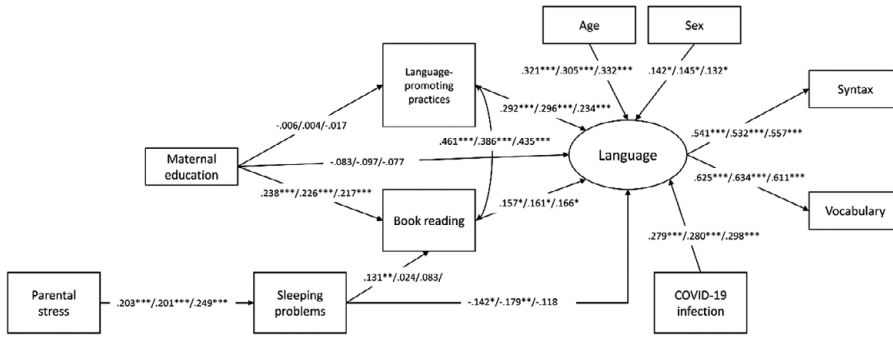

Figure 1. SEM for the relationships among children's current linguistic development, child-related variables and family-related variables

Note: Standardized coefficients are depicted. For each path, the coefficients appear in the following order: (1) model for practices, book reading, parental stress and sleeping problems during lockdowns, quarantine, or isolation (Language R^2 = .362, p < .001); (2) model for the same variables out of lockdowns, quarantine, or isolation (Language R^2 = .370, p < .001); (3) model for the same variables at the time of data collection (Language R^2 = .338, p < .001).

***p < .001; **p < .01; *p < .05

In model 3, the results closely resembled those obtained in the previous models. Once again, there was a significant indirect effect of maternal education on children's linguistic development via book reading (β = .036; p = .049), but not via other language-promoting practices (β = -.004; p = .743). However, in this model, current sleeping problems were not associated with the frequency of book reading or with the child's linguistic development. Additionally, there was also no indirect effect of parental stress on book reading (β = .021; p = .083) or on children's linguistic development (β = -.029; p = .096), mediated by children's sleeping problems.

Discussion

This study explored the linguistic development of children who underwent the pandemic during their first three years of life, as well as factors that may be associated to it. Our first research question addressed the potential variations in the frequency of shared book reading and language-promoting activities, parental stress, and children's sleeping problems across different periods in the pandemic and at present. Accordingly, our first aim was to determine whether the environment for children significantly changed in these aspects.

We begin by discussing the findings related to shared book reading practices. In contrast to previous research (Lin et al., 2023; Read et al., 2022), our study revealed a variation in the frequency of adult-child shared book reading. We found a higher frequency reported for the periods of lockdown, quarantine, and isolation compared to other periods when being housebound was not mandatory. Differences in methodology between our study and previous research may explain the apparently conflicting results. Read et al. (2022) and Lin et al. (2023) compared the frequencies before and during the pandemic without specifically querying participants about practices performed into or out of lockdowns. In fact, a higher availability of time during lockdowns and quarantines might have contributed to the heightened frequency of book reading.

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As for other variables, we found that parental stress was significantly higher during the periods of lockdown, quarantine, and isolation compared to any other period, reinforcing the idea that this was a particularly stressful period for parents with small children (Gniewosz, 2023; Li et al., 2022; Prokupek et al., 2023). Our results also indicated that children had more sleeping problems during the pandemic years compared to the current period. It appears that the routine disruption and the emotional challenges faced by families during the COVID-19 pandemic in Portugal may have contributed to an increase in sleeping problems among very young children. This finding contradicts the results of a review by Sharma et al. (2021), where no differences were identified in preschool children. However, Sharma et al. (2021) identified only five studies involving preschool children, three of which were retrospective. Our results align with findings reported for children over 6 years old in other countries (Bothe et al., 2022; Sharma et al., 2021). Even though this finding justifies further investigation, we suggest that it can be related to the fact that in Portugal, only 22.5% of children under 3 years are cared for at home (EUROCHILD, 2021). The majority of children attend formal childcare services from an early age, often on a full-time basis, as maternity/paternity leaves typically last only around 4-5 months. Consequently, a large proportion of children may have experienced disruptions to their routines during lockdowns, quarantines, and isolations, potentially resulting in slightly more sleeping problems.

Our second research question was related to how the linguistic development of the children who underwent the pandemic during their first three years of life compares to that of a reference sample collected before the pandemic. Our study's results indicate a notably higher percentage of children below the 10th percentile than expected, suggesting that after the pandemic, the number of children with very low linguistic development is much higher than before. This finding is in line with some previous research suggesting a negative effect of pandemic control and mitigation measures on children's linguistic development (Feijoo et al., 2023; Frota et al., 2022; Imboden et al., 2022; Murillo et al., 2023). It also expands the discussion carried out in previous studies that assessed the pandemic's effects on children's development during only a short period of time (Kartushina et al., 2022). Our study shows that, when considering a period of years of pandemic control and mitigation measures, the negative effects on children's linguistic development are quite substantial, with much more children with language delays than what would be expected (if the 10^{th} percentile is used as a criterion). Note that this result was observed even though our sample included a high percentage of families from high SES. In general terms, we hypothesize that the social changes imposed by control and mitigation measures during the pandemic, such as lockdowns and restrictions in social contacts, not only changed the general context for (and frequency of) social and linguistic interaction but may also have specifically changed the input to children, significantly impacting their linguistic development. More precisely, the fact that children interacted with a more reduced group of adults and peers in less diverse settings likely had an impact on the quality of input, by reducing lexical diversity and even exposure to some less frequent syntactic structures (some related to subsets of lexical items). We suggest that we are observing in monolingual development the effects of reduced diversity of input sources, a factor previously identified as contributing to explain individual variation in bilingual development (Place & Hoff, 2011, 2016). Therefore, public policies and governmental intervention measures are urgent, in order to improve children's low linguistic levels, considering that early linguistic skills are one significant predictor of later academic achievement (Bleses et al., 2016; Dale et al., 2022).

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Our third research question focused on identifying factors associated with the children's current linguistic development. Despite observing a general negative impact of the pandemic on children's linguistic development, with more children scoring at the 10th percentile than expected, we also found variation in linguistics scores, as anticipated. We were, therefore, interested in understanding what can explain this variation. The results of our study indicated that in terms of demographic variables, age and sex were predictors of children's linguistic development, as expected based on previous research (Eriksson et al., 2011; Silva et al., 2017). Regarding maternal education, there was an interesting finding: the effect was not direct, rather mediated by shared book reading. This result is in line with previous research that suggests a higher frequency of shared book reading, and richer interactions during pandemic, in families with more educated mothers (Leech et al., 2022; McNally et al., 2023; Muhinyi & Rowe, 2019). Regarding language-promoting practices, although these were positively related to children's linguistic development, they were not associated with maternal education. In general, it seems that richer interactions at home, especially those during reading activities, may have increased opportunities for relevant and effective social interaction. More importantly, these reading activities were likely linguistically richer and may have improved the quality of the input provided to children, potentially compensating for the generally reduced linguistic experiences during the pandemic. The linguistic richness of book reading interactions, both in terms of lexical diversity and syntactic complexity, is supported by previous research (Cameron-Faulkner & Noble, 2013; Demir-Lira et al., 2019).

Additionally, sleeping problems during the pandemic were negatively associated with children's current linguistic development. This finding is in agreement with research that has associated children's sleep quality to better linguistic outcomes (Knowland et al., 2022; Turnbull et al., 2022). This finding also suggests that sleeping problems may have more durable and long-term negative effects on language development. Another interesting finding was that children's sleeping problems predicted a higher frequency of book reading. However, this effect was limited to the periods of lockdown, quarantine, or isolation, when children's sleeping problems were also more prevalent compared to periods when children were not home confined. Thus, book reading may have been used by families as a coping strategy to try to deal with sleeping problems, as research shows that families often view book reading as crucial in bedtime routine and, consequentially, essential for children's sleep (Hall et al., 2018; Mindell & Williamson, 2018; Staples et al., 2015).

Interestingly, parental stress was related to children's sleeping problems, a trend consistent with the results of a study by Barata and Acar (2024) conducted in Turkey during the pandemic. This finding is in line with previous research that has associated the presence of parental psychopathology (depression and/or anxiety symptoms) with sleeping problems in children under three years old (Lux et al., 2023; Petzoldt et al., 2016). This association has been explained mainly by the difficulties of depressed and anxious parents to establish a consistent and calming bedtime routine (Covington et al., 2019; Petzoldt et al., 2016). Additionally, the irritability and reduced emotional availability of parents due to pandemic-related concerns may have negatively affected children's sleep (Barata & Acar, 2024). Therefore, given the negative relationship between sleeping problems and children's linguistic development, it was not surprising that, in our study, parental stress levels during the pandemic were negatively and indirectly associated with children's current expressive language via these problems.

However, we did not find an indirect effect of parental stress on children's linguistic development via language-promoting practices or shared book reading. In fact, contrary to other studies (Oppermann et al., 2021; Zhang et al., 2021), we did not find a negative association between parental stress and those practices. This finding suggests that parents

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were able to maintain a certain frequency of language-promoting practices and book reading regardless of their stress level.

Interestingly, SES was the main predictor of shared book reading. Research has consistently shown that mothers with higher educational levels have more positive beliefs about the benefits of shared book reading and their ability to do it (Curenton & Justice, 2008; Gonzalez et al., 2017), and engage more frequently in this activity than mothers with lower educational levels (Leech et al., 2022; McNally et al., 2023; Muhinyi & Rowe, 2019). Mothers with lower educational levels may, thus, engage less in shared book reading with their children, due to their perceived reading difficulties and lower reading self-efficacy (Berkule et al., 2007; Lin et al., 2015).

It is noteworthy that we found a relationship between maternal education and shared book reading, but not between maternal education and the remaining language practices, which mainly included activities related to play. Some research has linked a higher maternal education to increased children's play through maternal responsiveness, in the sense that more educated mothers are likely to be more responsive (Mermelshtine & Barnes, 2016). However, in the context of the pandemic, responsiveness from more educated mothers may have been affected by the need of dealing with challenges such as working from home. In contrast, given the high importance of shared book reading and its frequent association with bedtime routines, it is possible that mothers with higher educational levels were able to maintain (or even increase) the frequency of this practice during the pandemic.

In terms of pandemic-related factors, our study found no significant association between mask use and children's linguistic development. This finding is in line with previous research that suggest that compensatory strategies are frequently used by speakers when using a mask (Crimon et al., 2022; Pycha et al., 2022), which could have mitigated any negative impact of mask use by adults on children's language development. We should also not forget that, during the pandemic, children also interacted daily with people who did not wear masks in their presence, such as household members and other children under the age of 10 years, for whom mask use was not mandatory.

A puzzling finding emerged regarding COVID-19 infection as a significant predictor of children's linguistic development, with children who were infected having better linguistic skills. Given that COVID-19 transmission depends largely on the contact with an infected person (Lotfi et al., 2020), people who had more contacts with others also had higher odds of infection, as the transmission rate of this type of viruses is proportional to the contact rate between individuals (Wallinga et al., 2006). Therefore, children's COVID-19 infection may, in some way, reflect a higher number of interactions with other people. Research has established that children's linguistic development is strongly associated with the quantity and quality of input provided by adults (Anderson et al., 2021), and therefore, more interactions with others inside and outside of the household may have fostered children's vocabulary and sentence complexity. To this extent, this finding reinforces our general interpretation of the results, in light of language acquisition mechanisms: reduced input (at least in qualitative terms) due to isolation during the pandemic, especially when this was not compensated by language-promoting practices at home, should be at the core of the explanation for lower linguistic scores achieved by the population under study when compared to a sample collected immediately before the pandemic.

Limitations

Some limitations of this study should be acknowledged. First, there are some limitations related to the study design and data collection. The data were collected in 2023, but

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respondents were asked to recall some events, such as family practices, that occurred way before, during the first two years of the pandemic. Therefore, in this kind of retrospective studies, when data collection relies on recall, respondents may provide less accurate responses than when data are collected shortly after the events happen (Smith & Noble, 2014). Nonetheless, some retrospective studies have been conducted to assess the effects of the pandemic on various variables, as evidenced by three out of the five studies involving preschool children identified in the review by Sharma et al. (2021).

As self-report questionnaires were used, social desirability can also be present in the data to some extent. Another limitation was that shared book reading, parental stress and sleeping problems were measured by only one item each, and not by a comprehensive standardized measure. Similarly, children's linguistic development was also assessed using only one measure based on parental reports. Although the CDI has been adapted for dozens of languages and has demonstrated to be valid and reliable (Jar et al., 2023; Law & Roy, 2008), future studies should also include complementary measures, such as direct observations or standardized language assessment tests. Another limitation is that some children might have been infected with COVID-19 but not officially tested, which could influence the findings to some extent.

The fact that data collection was made online could have limited the participation among families with restricted access to or less proficiency in the use of digital means. The sample in this study had a high percentage of families with mothers with high education levels, although this proportion is comparable to that of the study validating the CDI-III for the Portuguese population (Cadime et al., 2021). Regarding the sample selection criteria, only children without developmental disorders and whose parents (at least one) spoke Portuguese to them at home were included. These criteria align with those used to construct the norms of the European Portuguese CDI-III, against which we compared the results of the children affected by the pandemic. However, future studies should explore whether similar findings to those observed in our study are replicated in children with atypical development.

Conclusion

In conclusion, and despite the limitations mentioned in the previous section, this study suggests an overall negative effect of the pandemic on the linguistic development of children who were in their first years of life. We interpret this result in light of the reduction of social interaction imposed by the mitigation measures during the pandemic. Interestingly, the relationship between children's prior COVID-19 infection and expressive language abilities reinforces the suggestion of a detrimental effect of decreased interpersonal interactions. Moreover, parental stress and children's sleeping problems during the pandemic years were also negatively associated to linguistic development.

Conversely, home language-developing practices and shared book reading during and after the pandemic had a positive effect on children's linguistic development, suggesting that such activities may compensate for the reduction of linguistic experience imposed by the pandemic. Importantly, maternal education was found to have only an indirect effect on language development, mediated by shared book reading.

Given these findings, the development of public policies and programs aimed at fostering language-developing practices, particularly those that target shared book reading, is advised.

Supplementary material. The supplementary material for this article can be found at http://doi.org/10.1017/S0305000924000412.

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