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The impact of the COVID-19 pandemic on infant and toddler development

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ABSTRACT

Background: The COVID-19 pandemic has created new cultural norms with pervasive societal implications. Families have experienced a heightened amount of physical, psychological, emotional, and financial stress. Infants and children living with stress have the potential for delayed developmental milestones, difficulty with emotional regulation, and social or behavioral issues.

Purpose: This study aims to determine if the pandemic has affected developmental outcomes in infants and toddlers.

Methodology: Prepandemic and postpandemic developmental (ASQ-3) scores were obtained from charts of 1,024 patients (6, 12, 18, 24, and 36 months) from two pediatric practices.

Results: There were no significant differences in prepandemic and postpandemic ASQ-3 scores for the overall sample. Age-group analysis showed statistically significant differences in domain scores. Postpandemic problem-solving scores decreased among 6-month-olds while increasing among 24-month-olds. Categorization by score interpretation categories showed a slight decrease in postpandemic scores in the communication domain among 6- and 12-month-olds.

Conclusions: The pandemic has the potential to affect childhood development. However, the results of this study are reassuring, showing only slight differences in developmental scores prepandemic versus postpandemic. More studies are needed to establish causation and possible trends in future developmental trajectories.

Implications: An increased focus on communication screening and promotion of language and communication skills in young children postpandemic is needed. Education about the importance of parent–child engagement, nurturing relationships, opportunities for free-play and exploration, and caregiver support and stress reduction will continue to be of paramount importance.

Keywords: ASQ-3; child development; infant development; pandemic; toddler development.

Journal of the American Association of Nurse Practitioners 34 (2022) 509–519, © 2021 American Association of Nurse Practitioners

DOI# 10.1097/JXX.0000000000000653

The ongoing COVID-19 pandemic has led to profound implications across the lifespan. In just over a year, nearly 35 million people have had a known infection with COVID-19, over two million have been hospitalized, and over 611,000 have died because of the virus in the United States alone (CDC, 2020b; CDC 2021). Furthermore, the long-term health sequelae of COVID-19 infection are not fully understood and numerous indirect health effects are difficult to quantify. Overwhelmed hospitals, closure of medical offices, and fear of contracting infection have led many people to forego preventative health care. In a survey of over 5,000 parents of children aged 5 years and below, 34% report having missed a well-child visit and 12% have missed immunizations during the pandemic (Center for Translational Neuroscience [CTN], n.d.). Mental health disorders and substance use disorders have risen substantially during this time (Gadermann et al., 2021). Moreover, pandemic-related psychological stress has undoubtedly contributed to psychophysiological conditions that are exceedingly complex to identify. To compound the situation, drastic measures to curb the spread of COVID-19 in the United States have affected every facet of society.

The pandemic has created new cultural norms with pervasive societal implications. During the pandemic, families have experienced a heightened amount of physical, psychological, emotional, and financial stress. Such family strain is unavoidably shared with children.

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Received: *22 June 2021; revised: 4 August 2021; accepted 13 August 2021*

Infants and children living with stress have the potential for delayed developmental milestones, difficulty with emotional regulation, and social or behavioral issues (Committee on Psychosocial Aspects of Child and Family Health [CPACFH] et al., 2016). Assessment of children's development and functional health patterns is part of routine pediatric care and is even more important during times of great turmoil such as during a pandemic. Anticipatory guidance and early intervention for developmental or behavioral issues are key to lessening their long-term effects.

Literature review

Child development

Early experiences influence childhood development. The parent–child relationship contributes to a child's socioemotional and psychological well-being, especially in the period of birth to 3 years (DePasquale & Gunnar, 2020). A parent's nurturing behavior can positively impact cognitive functioning, mental health, and social competence (DePasquale & Gunnar, 2020). Another important factor influencing a child's development includes reciprocal interaction with the environment (Maaks et al., 2020). The infant learns from exploring the environment and forming trust with caregivers.

Eight key principles have been identified that provide a contextual understanding of childhood development. Growth and development: 1) are orderly and sequential; 2) involve pacing that varies among children; 3) occurs in cephalocaudal and proximodistal direction; 4) increasingly integrates; 5) create behaviors and responses that are capable of organizing and differentiating; 6) are influenced by a child's internal and external environments; 7) are influenced by critical periods; and 8) are a continual process, often with smooth transitions (Maaks et al., 2020).

Developmental surveillance

Pediatric primary care providers have the responsibility and the opportunity to assess a child's health and development over time due to the number of health visits recommended in the first few years of life. An important role of the provider is to conduct developmental surveillance. The American Academy of Pediatrics (AAP, 2017) recommends the use of standardized developmental screening tools to help identify concerns. Validated screening tools are quick and inexpensive and can be completed by the primary care pediatric provider or the parent. These should be conducted at every wellness visit, any time a concern is presented, and at follow-up when appropriate. A commonly used screening tool is the Ages and Stages Questionnaires (ASQ-3). When there is a concern on the screening, proper monitoring or referral can be initiated to ensure the child receives the appropriate intervention. This may require a developmental specialist or an early intervention program.

Pandemic effects on development

Little is known about pandemic-related social, emotional, and developmental impacts on very young children. The AAP categorizes infancy and early childhood as sensitive periods for development. Rapid growth and brain development during the first years of life make children especially vulnerable to stressors such as changes in routine, adverse childhood experiences, or failure to have their needs met by caregivers (Bhutta et al., 2017). Prolonged exposure to stressors can cause physiological and neurobiological changes and subsequent negative long-term behavioral, cognitive, and health outcomes. Unless a child has the protection of nurturing relationships, excessive stress exposure can disrupt the ability to adapt to situations and leads to unhealthy future coping skills and functional health patterns (CPACFH et al., 2016). Although COVID-19 is typically more severe and prevalent in adults, children have not been entirely spared (CDC, 2021). Children are at risk for serious disruption of normal developmental outcomes due to changes in their daily lives and stressors in their families. An estimated 40,000 children have lost a parent to COVID-19 and many more have lost grandparents, relatives, or loved ones (Kidman et al., 2021). The psychosocial impact of these losses cannot be ignored. So far, only minimal data are available about pandemic effects on young children; however, preliminary research shows increased incidence of externalizing behavioral and emotional issues such as clinging, inattention, irritability, fear, depression, anxiety, and post-traumatic symptoms in all age groups (Jiao et al., 2020; Marques de Miranda et al., 2020). Children have dealt with many changes to fundamental daily routines; lost opportunities for play and recreation, socialization, and education; missed events and celebrations; and heightened family stress.

School closures. COVID-19 profoundly changed the face of childhood education in the United States. Most daycares and schools were closed to in-person learning or had considerably reduced time with students in the classroom; some have still not fully reopened. Worldwide, more than 1.5 billion children were affected by school closures, affecting learning outcomes and the development of human capital (United Nations, 2020). Likewise, drastic changes in the normalcy of daily routines and decreased face-to-face interaction with peers and teachers have the potential for a detrimental impact on mental health and behavioral outcomes in children. Children with special learning needs are exceptionally vulnerable to school closures due to the need for dedicated support and difficulty learning remotely (Ghosh et al., 2020; Marques de Miranda et al., 2020; United Nations, 2020).

Home environment. Widespread closure of schools and early childhood facilities has led to more infants and young children staying home with parents throughout the day. The impact that the home environment has on developmental outcomes is multifactorial. An abrupt change in daily routines can be unsettling for any child, particularly when a sense of security has not been fostered in the home. Children living in safe nurturing homes are likely to develop resiliency, allowing them to cope with stressors better than children facing additional hardships such as neglect, hunger, and abuse (Yoshikawa et al., 2020). Fortunately, most parents report that family cohesion and affection have remained stable (CTN, n.d.). However, for some children, the school system provides the only source of structure, education, nutrition, exercise, and positive role modeling. Economic challenges facing households will exacerbate the detrimental effects of loss of school-based resources (United Nations, 2020). Nearly one third of families have reported food insecurity during the pandemic with corresponding emotional and behavioral issues in their children (CTN, n.d.). If basic needs such as love, safety, food security, cleanliness, and hygiene are not being met, it is difficult for children to thrive and there will be potential for long-term effects on physical and emotional well-being.

Caregiving. Caregiver factors play a prominent role in child development. The amount and type of nurturing that a child receives have direct effects on development. Closure of schools and childcare facilities has put a strain on parents, often forcing them to risk losing a job to stay home to care for their children. The ability to enlist family members such as grandparents to babysit is limited due to the risk of them contracting COVID-19. Childcare issues are especially pertinent for frontline workers who may be required to work while at the same time being at an increased risk for bringing infection home (United Nations, 2020). Fortunately, in certain industries, employees have been allowed to work from home. Although working remotely has many positive attributes, it may be difficult to maintain focus and productivity from home with distractions and conflicting responsibilities such as caring for children or assisting with remote learning. Parents who are already stressed over work–life balance may have difficulty finding time and energy to be present and active with young children, particularly if there are multiple children in the home or single-parent households. A majority (68%) of caregivers have reported increased stress levels, and 33% have reported an increase in fussy or disruptive behaviors in their young children above prepandemic levels (CTN, n.d.). Busy caregivers may resort to using infant swings, bouncers, playpens, or play saucers to contain infants, consequently limiting their ability to explore and learn about the environment (Yogman et al., 2018). Caregivers reported using screen time entertainment more than reading or exercise to successfully occupy or distract children (Jiao et al., 2020). However, although screens may be a viable coping and learning tool for older children, technology such as television, smartphones, tablets, or other screen time used to occupy young children may not promote optimal learning or developmental outcomes (Marques de Miranda et al., 2020; Vanderloo et al., 2020; Yogman et al., 2018).

Financial strain. Pandemic mitigation measures have resulted in a global recession (United Nations, 2020). Financial strain due to the economic effects of the pandemic has affected parents from all socioeconomic backgrounds, an effect that is heightened by social and racial inequities. The longer the pandemic ensues, the more likely the economic downturn will be long-term, placing some children into poverty for much of their early childhood years (Yoshikawa et al., 2020). Business profits have decreased because of mitigation efforts, resulting in a drastic economic decline (United Nations, 2020). Regulations imposed by governments have limited the number of people allowed in public places and even required nonessential businesses to close. Health officials recommend people stay at home to avoid contracting illness and in some cases "stay at home" orders or curfews were put in place, restricting entertainment, fitness, recreation, dining, and shopping. Employees feel the burden of lost income due to decreased sales, tips, cut hours, and varied levels of business closure. Single-earner households are particularly vulnerable to such financial strain. Income reduction and associated worries about affording food, transportation, rent, utilities, and medical care put pressure on caregivers. Financial hardships cause a chain reaction leading to parental distress and child emotional difficulties (CTN, n.d.).

Coping. Pandemic containment measures have led to decreased opportunities for stress reduction through leisure activities such as socialization, recreation, churchgoing, and exercise. Social relationships and emotional support are important for caregivers and children alike (Hostinar & Gunnar, 2015). Unfortunately, pressures imposed by social distancing measures have decreased the ability to lean on friends and coworkers for support, with 63% of caregivers reporting that they have lost sources of emotional support through the pandemic (CTN, n.d.). Maladaptive coping behaviors such as substance abuse have increased, and mental health issues, family conflict, and abuse have been on the rise (Gadermann et al., 2021; Ghosh et al., 2020; Marques de Miranda et al., 2020). Lockdowns increase the risk of violence due to isolation and increased tension in the home while also decreasing the opportunity for children to seek outside help from teachers or counselors (Marques de Miranda et al., 2020; United Nations, 2020). Children as young as 2 years old have demonstrated awareness of family

changes around them and even infants show neural responses when exposed to family discord (Dalton et al., 2019). Abuse or exposure to abuse in the home at a young age may lead to impaired brain development and higher rates of psychological disorders (Ghosh et al., 2020). Overwhelmed parents struggling with these issues will have difficulty effectively engaging with their children.

Communication and socialization. Pandemic mitigation efforts have limited fundamental aspects of socialization inside and outside of the classroom. The CDC recommends limitations on group gatherings, maintaining a distance of at least 6 feet from persons not residing in one's household, and wearing a mask to cover the mouth and nose to prevent inhaling infectious respiratory droplets (CDC, 2020a). Therefore, even when in the same room with peers, limited physical touch, hidden facial expressions, and alteration of verbal communication affect personal interaction.

When masks are worn properly, they cover the lower half of the face, limiting visibility of facial expressions and potentially muffling speech. Numerous studies have supported the premise that infants start recognizing and differentiating faces and demonstrate the ability to interpret and imitate facial expressions during the newborn period (Palama et al., 2018). Infants born during the pandemic frequently interact with masked individuals, even the child's own parents when in public. Masked interactions have the potential for neurobehavioral and social implications in infants (Green et al., 2021). Face masks hinder social referencing, the process whereupon an infant in an unfamiliar situation looks to their parents for facial cues indicating approval or reassurance. The inability to use techniques such as social referencing can affect feelings of security in young children (Green et al., 2021). Furthermore, milestones dependent on facial cues such as social smiling, facial imitation, and stranger anxiety may be affected.

Social distancing measures coupled with school closures have drastically reduced the amount of time young children are spending with their peers engaged in play. According to the AAP, childhood play has been shown to serve an important role in development, executive functioning, emotional regulation, and stress reduction in addition to providing physical exercise, active engagement, and fun (Yogman et al., 2018). Unstructured playtime encourages creativity, focus, memory, and learning. Social and emotional benefits include teaching children problem-solving, cooperation, conflict resolution, and ultimately self-regulation and independence. Play helps to buffer against the harmful effects of stress and has been shown to affect levels of stress hormones and neurotransmitters (Yogman et al., 2018). The importance of play should be considered when balancing the risks and benefits of pandemic mitigation efforts.

Developmental theories. Numerous developmental theories have described how children grow, change, and acquire skills and traits throughout the lifespan and can be useful to understand how the pandemic may affect child development. Erikson's Psychosocial Theory describes how development proceeds in a series of predefined stages in which the child must overcome a task or crisis through interactions and understanding of society and culture around them (Erikson, 1969). The numerous psychosocial impacts of the pandemic have the potential to disrupt the successful mastering of developmental stages. However, contrary to Psychosocial Theory, behavioral perspectives reject the idea that each person's development proceeds through the same series of stages and instead focuses on the results of the unique environmental stimuli a person is exposed to. Behavioral theories would suggest that the atypical circumstances resulting from the pandemic would have the potential to alter development through conditioning, which could be positive or negative depending on the environment (Feldman, 2018).

Contextual theories consider development to be the result of the environmental, social, and cultural context surrounding an individual. Bronfenbrenner's Bioecological Approach considers the interconnectedness between the everyday environment of the child, relationships, institutions such as schools, culture, and historical events, each of which has been altered during the pandemic (Bronfenbrenner, 1992). Another contextual theory, Vygotsky's Sociocultural Theory, describes the reciprocal relationship between a child and his or her environment, each influencing the other (Vygotskij & Cole, 1981). Sociocultural Theory highlights the importance of play, culture, and interaction with family and society to shape development (Feldman, 2018).

Elder initially developed Life Course Theory to describe the effects of the Great Depression on child development. Life Course Theory continues to be a useful tool for understanding the combined historical, social, and psychological impacts of life events (Elder, 1998). Historical, especially nonnormative, events result in alterations in society that in turn affect employment, education, and families and ultimately influence the lives of individuals in a manner dependent on their current developmental stage (Benner & Mistry, 2020; Elder, 1998). Evidence exists of how historical events, such as the Great Depression, the 9/11 terrorist attacks, and prior pandemics, have affected youth; however, there are far fewer studies that include infants and toddlers (Benner & Mistry, 2020).

Prime, Browne, and Wade (2020) developed a conceptual model to illustrate a cascading effect of how the social disruption of COVID-19 ultimately affects child well-being through heightened levels of psychological distress in caregivers and disruption of family processes.

They further support their model using Bowen's Family Systems Theory because it describes the interconnectedness of family well-being, with each family member's emotional wellness affecting the system as a whole (Kerr & Bowen, 1988; Prime et al., 2020). If one family member is adversely affected by illness, job loss, stress, emotional issues, or other hardship, the remaining family members will be affected (Prime et al., 2020).

Methods

Design

A nonexperimental correlational design was used for this study.

Setting

The setting included two private pediatric practices, one rural and one urban.

1. Rural: This practice is in a rural region of southern Illinois and provides health care for approximately 11,000 pediatric patients at five office locations. Primary care providers include six physicians, four nurse practitioners, and three physician assistants.
2. Urban: This practice is in the Metro East area of southern Illinois near the city of St. Louis, Missouri, and provides health care for approximately 5,000 pediatric patients at a single office location. Primary care providers at this location include one physician and four nurse practitioners.

Participants

The sample population included patients from both pediatric offices. Inclusion criteria were patients aged 5 months through 38 months who attended a well-child visit during the study period and whose caregiver completed an ASQ-3 in the age categories of 6, 12, 18, 24, or 36 months (see age specifications as follows per ASQ-3 form).

- 6-Month Questionnaire: Children aged 5 months, 0 days through 6 months, 30 days.
- 12-Month Questionnaire: Children aged 12 months, 0 days through 13 months, 30 days
- 18-Month Questionnaire: Children aged 17 months, 0 days through 18 months, 30 days.
- 24-Month Questionnaire: Children aged 23 months, 0 days through 25 months, 15 days.
- 36-Month Questionnaire: Children aged 34 months, 16 days through 38 months, 30 days.

Sampling procedures. Prepandemic data from October 2018 through January 2019 and pandemic (hereinafter referred to as postpandemic) data from October 2020 through January 2021 data were collected from the electronic medical records. A report consisting of all patients meeting the age criteria and having a billing (CPT) code for a well-check or an ASQ-3 screening during the prepandemic and postpandemic study period was generated. Patient charts meeting these criteria were chosen at random by the investigators (each is a pediatric primary care nurse practitioner who is employed by the respective clinics). Patients were excluded if they did not have an ASQ-3 in the specified age categories during the study period or if they had a documented medical diagnosis known to be disruptive to normal development (hearing or vision impairment, autism spectrum disorder, syndromes such as trisomy 21, or prematurity).

Measures

The AAP reports the ASQ-3 sensitivity range to be 0.70 to 0.90 and specificity to be 0.76 to 0.91 (Lipkin & Macias, 2020). The five scored domains include communication, gross motor, fine motor, problem-solving, and personal–social. Scores of 10, 5, and 0 are applied, respectively, to caregiver responses of "yes," "sometimes," and "not yet" to 30 items. The scores are tabulated for each domain and are further categorized into a color-coded chart based on score interpretation. "Above cutoff" is considered typical development and is defined as any score in the white area (higher than 1 SD below the mean); scores within the gray area indicate the "monitoring zone" in which the child should be observed and another screening may be desirable in a few months (1–2 SD below the mean); and scores within the black area are "below cutoff" and indicate the child may be at risk for developmental delays and should be referred for further assessment (2 SD below mean) (Agarwal et al., 2020).

Existing ASQ-3 scores were obtained from the medical record and documented in a de-identified manner on a Microsoft Excel spreadsheet. Total overall scores, specific domain scores, and interpretation categories per ASQ-3 guidelines were included on the spreadsheet. Numeric total overall scores of 0–300 total points and domain scores of 0–60 points were possible. ASQ-3 was already routinely being performed both prepandemic and postpandemic at both sites at well-checks and stored in the chart. Therefore, no changes in office practices were necessary, making the study seamless in this regard and resulting in a large amount of available data with potential for future study as well.

Analysis

At the end of the data collection period, the prepandemic and postpandemic ASQ-3 scores were analyzed to determine whether a difference existed. Statistical analysis was performed using SPSS Version 27. A nonparametric, independent samples Mann–Whitney *U* test was used to compare the prepandemic and postpandemic numeric scores (total overall and each domain) for each specified age group and the total group. An independent samples Kruskal–Wallis test was performed to compare the

prepandemic and postpandemic score interpretation for each domain (ordinal scale variables categorized as 1 = below cutoff, 2 = monitoring zone, and 3 = above cutoff). Statistical significance was determined based on a *p*-value of less than .05.

Study size

A priori power analysis was performed using the statistical program G*Power to determine that a sample size of 90 for each comparison group was needed (Cohen *d* = 0.05 and power of 0.9).

Ethical considerations

Approval was obtained from the Southern Illinois University Edwardsville (SIUE) institutional review board (IRB), at which the investigators are employed. Approval to implement the project was also obtained from the owners of both pediatric practices. Confidentiality was maintained. All data were de-identified before conducting the analysis to decrease risk of bias or loss of confidentiality. No funding was sought or obtained.

Results

Sample

A total of 1024 ASQ-3 questionnaires (*n* = 747 rural, 277 metro) were included in the study, 518 prepandemic (*n* = 381 rural, 137 metro) and 506 postpandemic (*n* = 366 rural, 140 metro). There was nearly equal distribution of ages (*n* = 94–112 in each age group) in both prepandemic and postpandemic samples (**Table 1**). Males comprised 51.4%

Table 1. Demographics

	Overall		Prepandemic		Postpandemic	
	n	Percent	*n*	Percent	*n*	Percent
Gender						
Male	526	51.4	273	52.7	253	50
Female	498	48.6	245	47.3	253	50
Insurance						
Medicaid	661	64.6	348	67.2	313	61.9
Private	294	28.8	157	30.3	137	27.1
Unknown	57	5.4	4	0.8	53	10.5
Self-pay	12	1.2	9	1.7	3	0.6
Parents						
Both	681	66.5	345	66.6	336	66.4
Single	310	30.3	154	29.7	156	30.8
Foster	25	2.4	14	2.7	11	2.2
Other/unknown	8	0.8	5	1	3	0.6
Race						
Caucasian	597	58.3	318	61.4	279	55.1
Black	49	4.8	22	4.2	27	5.3
Asian	2	0.2	1	0.2	1	0.2
Middle Eastern	1	0.1	1	0.2	0	0
Unknown	375	36.6	176	34	199	39.3
Age (months)						
6	214	20.9	102	19.7	112	22.1
12	213	20.8	112	21.6	101	20
18	205	20.0	104	20.1	101	20
24	197	19.2	99	19.1	98	19.4
36	195	19.0	101	19.5	94	18.6

(n = 526) of the sample and females comprised 48.6% (n = 498) of the sample. Medicaid was the most represented insurance type at 64.6% (n = 661), followed by private insurance at 28.8% (n = 294), unknown at 5.4% (n = 55), and self-pay/no insurance at 1.2% (n = 12). Two-parent household represented 66.5% (n = 681) of the sample, followed by single-parent households at 30.3% (n = 310), foster care at 2.4% (n = 25), and other at 0.8% (n = 8). Race was unknown (36.6%, n = 375) for a substantial portion of the sample. Race demographics were not routinely collected at the urban site and were occasionally undisclosed by patients/family at the rural site. Caucasian patients composed 58.3% (n = 597) of the sample followed by Black patients at 4.8% (n = 49), Asian 0.2% (n = 2), and Middle Eastern 0.1% (n = 1). Ages ranged from 5 through 38 months with nearly equal representation of 6-month (n = 214, 20.9%), 12-month (n = 213, 20.8%), 18-month (n = 205, 20%), 24-month (n = 197, 19.2%), and 36-month (n = 195, 19%) age groups due to stratified sampling. Sampling was further stratified within age groups to select nearly equal numbers of prepandemic and postpandemic observations (**Table 1**).

Table 2. Median ASQ-3 scores

	Total Scores						Domain Scores					
			Communication		Gross Motor		Fine Motor		Problem-Solving		Personal–Social	
Age (months)	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
6												
	272.5	270	55	55	50	50	60	60	60	55	55	55
	U = 5,439		U = 6,259		U = 5,647		U = 5,426		U = 4,881.5		U = 5,227.5	
	p = .55		p = .2		p = .88		p = .49		**p = .04**[a]		p = .32	
12												
	272.5	275	55	55	60	60	60	60	55	55	55	55
	U = 5,787		U = 5,487.5		U = 5,927		U = 5,580		U = 5,733.5		U = 5,615	
	p = .77		p = .69		p = .47		p = .85		p = .86		p = .92	
18												
	265	270	45	50	60	60	55	60	50	50	55	60
	U = 5,862.5		U = 5,988.5		U = 5,308.5		U = 5,731		U = 5,506		U = 5,375	
	p = .15		p = .79		p = .86		p = .23		p = .54		p = .76	
24												
	277.5	280	60	60	60	60	55	55	55	60	55	60
	U = 5,183.5		U = 4,723		U = 4,707.5		U = 5,192.5		U = 5,678		U = 5,571	
	p = .27		p = .73		p = .64		p = .37		**p = .03**[a]		p = .06	
36												
	275	270	55	55	60	60	50	50	60	60	55	55
	U = 4,757		U = 4,800		U = 4,944		U = 5,074.5		U = 4,635		U = 4,490.5	
	p = .99		p = .89		p = .53		p = .4		p = .76		p = .5	
6–36												
	270	270	55	55	60	60	55	55	55	55	55	55
	U = 134,838		U = .135,606.5		U = .131,438		U = 1,234,946.5		U = 132,992		U = 131,266	
	p = .361		p = .314		p = .925		p = .382		p = .665		p = .918	

Note: *Median ASQ-3 scores by age group and total sample are included. Mann–Whitney test results are included for each group.*
[a]$p < .05$.

Overall sample ASQ-3 comparison scores

A Mann–Whitney nonparametric statistical test revealed no significant differences in prepandemic (median = 270) and postpandemic (median = 270) total ASQ-3 scores for 6-month-old through 36-month-old patients in our sample (U = 134,838, p = .361). Patient scores on the

Table 3. ASQ-3 score interpretation categories

		Communication			Gross Motor			Fine Motor			Problem-Solving			Personal–Social		
Age (months)		**< n**	**± n**	**> n**	**< n**	**± n**	**> n**	**< n**	**± n**	**> n**	**< n**	**± n**	**> n**	**< n**	**± n**	**> n**
6																
	Pre	0	0	102	0	10	92	2	6	94	2	3	97	1	7	93
	Post	3	2	107	1	8	103	3	8	101	3	2	107	4	7	101
		H (2) = 4.64			H (2) = 0.185			H (2) = 0.261			H (2) = 0.018			H (2) = 0.283		
		***p* = .03**[a]			*p* = .67			*p* = .61			*p* = .89			*p* = .6		
12																
	Pre	0	1	111	2	6	104	0	8	104	2	5	105	0	5	107
	Post	0	6	95	0	7	94	1	5	95	0	9	92	2	3	96
		H (2) = 4.24			H (2) = 0.006			H (2) = 0.11			H (2) = 0.476			H (2) = 0.039		
		***p* = .04**[a]			*p* = .94			*p* = .74			*p* = .5			*p* = .84		
18																
	Pre	4	20	80	1	5	98	2	5	97	2	5	97	1	4	99
	Post	2	17	82	1	3	97	1	7	97	1	2	98	1	2	98
		H (2) = 0.627			H (2) = 0.352			H (2) = 0.092			H (2) = 1.545			H (2) = 0.449		
		p = .43			*p* = .55			*p* = .76			*p* = .21			*p* = .5		
24																
	Pre	10	6	83	1	7	91	5	3	91	3	7	89	5	12	82
	Post	9	7	82	2	2	94	3	2	93	4	2	92	4	9	85
		H (2) = 0.000			H (2) = 1.286			H (2) = 0.709			H (2) = 0.923			H (2) = 0.567		
		p = 1.0			*p* = .26			*p* = .4			*p* = .34			*p* = .45		
36																
	Pre	9	8	84	1	2	98	4	13	84	6	11	84	9	4	88
	Post	6	12	76	0	4	90	4	14	76	6	7	81	9	7	78
		H(2) = 0.093			H (2) = 0.216			H (2) = 0.199			H (2) = 0.279			H (2) = 0.568		
		p = .76			*p* = .64			*p* = .66			*p* = .6			*p* = .45		
6–36																
	Pre	23	35	460	5	30	483	13	35	470	15	31	472	16	32	470
	Post	20	44	442	4	24	478	12	36	458	14	22	470	20	28	458
		H(2) = 0.43			H(2) = 0.65			H(2) = 0.15			H(2) = 1.03			H(2) = 0.23		
		df = 1			df = 1			df = 1			df = 1			df = 1		
		p = .51			*p* = .42			*p* = .9			*p* = .31			*p* = .88		

Note: *Columns include the number of children whose scores fall into each of the predefined ASQ-3 score interpretation categories. "<" indicates below cutoff, "±" indicates monitoring zone, ">" indicates above cutoff. Kruskal–Wallis test results are included.*

[a]p < *.05*

developmental domains of the ASQ-3: communication, gross motor, fine motor, problem-solving, and personal-social were entered into SPSS by raw score in each category with a range of scores 0–60 and by score interpretation categories. Mann–Whitney statistical tests revealed no significant differences in prepandemic and postpandemic ASQ-3 domain scores for 6-month-old through 36-month-old patients (**Table 2**). No significant differences were found in prepandemic and postpandemic ASQ-3 domain scores for the overall group, even when the domains were entered as ordinal data. Kruskal–Wallis statistical test results comparing each domain for the total sample of 6-month through 36-month-olds prepandemic and postpandemic can be found in **Table 3**.

Age group Ages and Stages Questionnaires comparison scores

No significant differences in prepandemic and postpandemic total ASQ-3 scores were found by age group (**Table 2**). Only two significant differences were found in prepandemicpandemic and postpandemic ASQ-3 domain raw scores when grouped by age. A significant difference (U = 4881.5, p = .04) in prepandemic (median = 60) and postpandemic (median = 55) problem-solving ASQ-3 raw scores was found among 6-month-olds, with this age group having slightly higher prepandemic problem-solving scores. A significant difference (U = 5,678, p = .03) in prepandemic (median = 55) and postpandemic (median = 60) problem-solving ASQ-3 raw scores was also found among 24-month-olds. However, for 24-month-olds, postpandemic problem solving was slightly better than prepandemic problem-solving.

When ASQ-3 domain scores were labeled by score interpretation categories, significant differences were found in prepandemic and postpandemic scores in the communication domain among 6-month-old patients (H (2) = 4.64, p = .03) and 12-month-old patients (H (2) = 4.24, p = .04). No other age groups demonstrated significant differences between prepandemic and postpandemic domain scores (**Table 3**). Three of the 6-month-old patients in the postpandemic group scored below cutoff and two scored in the monitoring zone for communication, whereas the entire prepandemic 6-month-old group was above cutoff. Six of the 12-month-old patients in the postpandemic group scored in the monitoring zone for communication, whereas only one of the 12-month-old patients in the prepandemic group had a communication score in the monitoring zone. However, for the entire sample of 6-month-old through 36-month-old patients, prepandemic and postpandemic ASQ-3 domain scores labeled by score interpretation failed to show any significant differences with the Kruskal–Wallis statistical test.

Discussion

The COVID-19 pandemic has the potential to affect childhood development. Although pediatric health care providers, child development experts, and parents are understandably concerned about negative pandemic-related effects, the results of this study are reassuring. Although there were slight differences found in prepandemic and postpandemic problem-solving ASQ-3 domain scores of 6- and 24-month-old patients, the results are conflicting with 24-month-olds fairing slightly better in the problem-solving domain postpandemic and 6-month-olds fairing slightly better prepandemic. The differences were very slight and could be the result of a "fishing" error or may be due to extraneous variables such as home life that were not measured.

There was a slight decrease in postpandemic communication ASQ-3 scores among some infants in the 6-month and 12-month age groups. Interestingly, these were the age groups that had lived all or most of their life entirely during the pandemic. Furthermore, it would be intuitive that communication would be one of the domains most profoundly affected by the pandemic mitigation measures such as mask-wearing. However, although these results were significant, more studies are needed with larger sample sizes of infants in these age groups to determine causation and possible future developmental trajectories.

Limitations

Considering a substantial portion of the sample included Caucasian or race unknown, the generalizability of the findings to minority populations is unknown. Further studies of developmental surveillance postpandemic in minority populations are needed. Also, while factors such as type of insurance and number of the parents in the home were included in the descriptive statistics, there was no exploration of extraneous variables such as home life, caregiver socioeconomic and educational status, parenting practices, and specific pandemic-related stressors occurring in the family.

Conclusion

The COVID-19 pandemic has pervasive implications that will undoubtedly affect the population into the future. However, there is a paucity of data surrounding pandemic effects on the development of young children. The results of this study indicate that there was no significant difference in developmental assessments related to the pandemic in the overall sample. Although there were small, but significant, differences in communication and problem-solving domains in certain age groups, larger sample sizes looking solely at these domains should be explored to make further conclusions. One implication of these findings is the need for "safer" unmasked face-to-

face communication with infants. Nurse practitioners are in an ideal position to counsel parents about ways to promote optimal development in their children, despite pandemic-related barriers. Simple recommendations for nurturing development include engaging in back-and-forth vocalizations and facial expressions, responding to social referencing and emotional cues, and offering ample playtime. Additionally, promoting and offering vaccinations to caregivers and older siblings will allow increased opportunities for safe mask-free time. Nurse practitioners can leverage their trusted patient–provider relationship to encourage vaccination through discussion at appointments, social media, and role modeling. Further, an increased focus on developmental screening and tools to develop language and communication skills in infants and toddlers postpandemic is indicated. Future research exploring the effects of numerous confounding variables specific to a child's home will yield richer data. Pediatric primary care providers have the unique opportunity to support and reassure parents and caregivers, thereby reducing the risk of negative pandemic effects on child development. Education about the importance of parent–child engagement and provision of caregiver support and stress reduction will continue to be of paramount importance.

Acknowledgments: *A. Imboden led the research, conceptualized the project, performed data collection, and wrote the literature review and various sections of the paper. B. Sobczak participated in research design, statistical analysis, and writing of methods, results, and conclusions. V. Griffin performed data collection, wrote portions of the literature review, and revised the manuscript for final submission.*

Competing interest: *The authors report no conflicts of interest.*

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DOI: 10.1097/JXX.0000000000000651