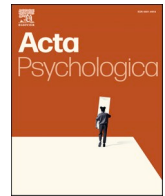




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# Early impact of the COVID-19 pandemic on promotion of infant activity, strength and communication: A qualitative exploration

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## ARTICLE INFO

**Keywords:**  
COVID-19  
Infant development  
Caregivers  
Qualitative

## ABSTRACT

**Introduction:** Fostering physical activity, muscle strengthening and communication skills in diverse environments are vital to ensuring healthy infant development; however, promotion of these skills may be impacted by the COVID-19 pandemic. Therefore, the purpose of this study was to explore healthcare workers, parents and childcare providers' perceptions of the pandemic's influence on how they engage with infants to promote physical activity, muscle strength and communication.

**Methods:** 37 subjects (12 = parents; 12 = childcare providers, 13 = healthcare workers) participated in a semi-structured interview. Data were analyzed via an inductive content analysis.

**Results:** The majority of caregivers identified concerns related to: limitations in social interactions (especially masks impacting communication), lack of access to peer modeling, fewer opportunities for physical exploration, and a need for creative activities in diverse environments (e.g., home/childcare) for infant development during and after the pandemic.

**Conclusions:** Caregivers are concerned about the role COVID-19 is having on infant development. Additional resources on how to promote infant physical activity, muscle strength and communication despite challenges associated with the COVID-19 pandemic are needed.

## 1. Introduction

The first year of human life is vitally important to overall health and development. Infants (0–12 months) require varied environments, opportunities for exploration and social interaction to support healthy growth and achievement of milestones (Winston & Chicot, 2016). Individuals who are critical to providing these opportunities and subsequent healthy development include caregivers (e.g., childcare, parents) and healthcare workers (Malina, Bouchard, & Bar-Or, 2004). The COVID-19 pandemic has had substantial influence on the ways in which caregivers and healthcare workers promote infant development (Benner & Mistry, 2020). For example, global lockdowns led to reduced length of hospital stays after childbirth and fewer home health visits. This has led to a concern among some healthcare workers about the reduced ability to identify the need for referral to special support services (i.e., physical therapy, occupational therapy) (Conti & Dow, 2020; Gutschow & Davis-Floyd, 2021). Further, millions of parents have had to adjust parenting

practices due to lockdown protocols, social distancing requirements, and shifts in work responsibilities (Cameron et al., 2020). This has guided increased rates of depression and anxiety among infant parents, a cause for concern as positive parental mental health has a direct association with healthy infant development (Cameron et al., 2020; Patrick et al., 2020; Zeanah, 2018). Childcare providers have also had to quickly adapt to meet new safety standards leading to changes in the structure and routine for infants (Crawford et al., 2021). Overall, the environment infants are developing in both at home and in childcare are different now and the specific influence of the pandemic on different components of infant development remains poorly understood.

Three key areas that have a complex reciprocal relationship in infancy are physical activity, muscle strengthening and communication (Alcock & Krawczyk, 2010; Iverson, 2010; Ulrich & Hauck, 2013). Importantly, opportunities for active movement (e.g., crawling, walking) and related opportunities to develop and utilize strength (e.g., pulling to a standing position) have been demonstrated to benefit motor

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<https://doi.org/10.1016/j.actpsy.2021.103480>

Received 3 June 2021; Received in revised form 16 December 2021; Accepted 20 December 2021

Available online 22 December 2021

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and cognitive development (Ulrich & Hauck, 2013). Skill acquisition in motor and cognitive domains is linked to improvements in language development and an infants' ability to communicate, further demonstrating the critical nature of development (Alcock & Krawczyk, 2010; Iverson, 2010; Ulrich & Hauck, 2013). Given the impact infant physical activity, muscle strengthening and communication have on a child's development it is crucial to understand how caregiver and healthcare workers perceptions have been influenced by the pandemic.

### 1.1. Infant physical activity

A growing body of evidence highlights the critical biological and behavioral implications for physical activity offerings in the first year of life (Stodden et al., 2008; Neelon, 2018). However, infants may not be achieving the recommendations of 180 min of daily physical activity and limiting time in restrictive devices (e.g., swings, strollers) (Borkhoff et al., 2015; Hesketh et al., 2017). Previous investigations found parent and childcare providers were utilizing restrictive devices like swings or strollers for excessive durations of time (Hesketh et al., 2017; Neelon, 2018). However, these investigations took place before the COVID-19 pandemic. Specific to investigations during the pandemic, a study of Spanish children aged 0–12 found low levels of activity among the sampled infants (0–2 years) and frequent daily use of digital screens, a known proponent of sedentary behavior (Cachón-Zagalaz et al., 2020; Carson et al., 2015). Another recent study of Spanish children under five found children were not meeting World Health Organization physical activity recommendations and had high usage of televisions and tablets (Arufe-Giráldez, Sanmiguel-Rodríguez, Zagalaz Sánchez, Cachón Zagalaz, & González Valero, 2021). Finally, a study of toddlers (1–2 years old) in Chile found reduced physical activity and increased recreational screen time and sleep (Aguilar-Farias et al., 2021). This is despite several pediatric agencies calling for the critical need to deliver safe outdoor activities and indoor play to increase physical activity during the pandemic (Duh-Leong et al., 2021; UNICEF, 2021; Healthy Children, 2020). To better understand the reductions seen in the already low levels of physical activity among young children more research is needed. Specifically, an understanding of how caregivers and healthcare workers are promoting and perceiving infant activity amidst the pandemic would be beneficial.

### 1.2. Infant muscle strengthening

The development of strength in infancy is critical in supporting the acquisition of developmental motor skills which are required for engagement in physical activity. This development of strength must be sufficient to mobilize the individual's body relative to the environment and experience in developmentally appropriate position has been shown to be directly related to acquisition of strength for subsequent motor activities (e.g. time spent in standing contributes to acquisition of independent walking). The strength required for each developmental skill is unique to the individual infant as it relates to their physical morphology and the environment in which they are performing the skill (Adolph, 2018). Therefore, infants who have low muscle tone at rest may struggle to achieve milestones such as holding up their head, rolling over, sitting and crawling due to the increased strength required to overcome the lower resting stiffness in the muscle and mobilize the desired body part (Hewitt, Stanley, & Okely, 2017). To promote opportunities for repeated movement against gravity to support strength acquisition for maturing motor skills, healthcare workers recommend activities such as tummy time and floor play in early infancy. Prior to the pandemic, parents and childcare providers struggled to deliver the appropriate dosing of these activities to promote strength development, and the influence of the pandemic on this provision of opportunities remains largely unknown (Hewitt et al., 2020).

### 1.3. Infant communication

Infant communications skills are largely influenced by caregiver interactions and healthcare recommendations (Sices et al., 2008; Vernon-Feagans & Bratsch-Hines, 2014). For instance, healthcare provider education on infant cognitive and language development provided to parents when their child was 1 week old was directly related to caregiving practices at 9 months of age (Leung, Hernandez, & Suskind, 2020). Further, diversity of caregiver vocabulary has been found to be predictive of child language (Rowe, 2012). Caregiver sensitivity and responsiveness are also crucial to language acquisition in infancy (DiCarlo, Onwujuba, & Baumgartner, 2014; Hoff & Naigles, 2002). Further, attending a quality early childhood education center during the pandemic was associated with growth in receptive vocabulary among children (Davies et al., 2021). However, children from low-income households that did not attend an early childhood center and had informal childcare (e.g., stayed with a neighbor) did not have improved receptive vocabulary. These findings suggest infants, especially those from families with low-incomes, that were kept out of early childhood care centers due to global lockdown protocols may be at a disadvantage related to their language development compared to those who attended early childhood care. However, these findings were limited to the United Kingdom. More research is needed to understand how all caregiver types are promoting infant communication behaviors to better facilitate development in spite of the COVID-19 pandemic.

The promotion of physical activity, muscle strengthening and communication behaviors in infancy can have a lifelong impact. It is evident the COVID-19 pandemic has caused a substantial shift in infants' environments, caregiver experiences and what resources healthcare workers recommend. Thus, the purpose of this study was to explore caregiver and healthcare provider perceptions of the pandemic's influence on engagement and promotion of infant physical activity, muscle strengthening and communication. This study took place in a Midwestern state in October 2020–February 2021. During this time there was a mask mandate set for the majority of cities and COVID-19 related hospitalizations peaked (Nebraska Department of Health & Human Services, 2021).

## 2. Methods

A total of 37 subjects participated in this cross-sectional study. A diverse cohort of infant healthcare workers ( $n = 13$ ), childcare providers ( $n = 12$ ) and parents ( $n = 12$ ) was sought. Participation included completing an audio-recorded telephonic interview based on constructs of the Health Belief Model (Strecher & Rosenstock, 1997). The Health Belief Model is founded on two basic premises: 1) there is an innate desire to be well and avoid illness and 2) engaging in healthy actions can prevent or treat illness. For the purposes of this study, analysis included questions specific to the COVID-19 pandemic. Interviews took place between October 2020 and February 2021 in a Midwestern State. The study was approved by a University affiliated Institutional Review Board (Protocol #: 0621-20-EP).

### 2.1. Participant recruitment & selection

Purposive and snowball sampling were utilized to recruit participants for this study. Recruitment took place by sharing a flyer with community partners via social media and email as well as by referral from other participants. All participation was voluntary. Participants who responded to social media posts or e-mails completed a short screening survey via Qualtrics and, if eligible, were contacted by research personnel by their preferred contact method (phone call, text, or e-mail). Those who were recruited by referral from others were directly contacted by research personnel given their provided contact information. Participants were eligible if they were the parent of a child <1 year of age, a healthcare provider that provided pediatric care or a

childcare provider who worked with children <1 year of age. In addition, all participants were at least 19 years of age, the age of adulthood in the state in which this study took place. A total of 17 healthcare workers, 29 childcare providers, and 17 parents expressed interest or were contacted to participate; however, 19 were unavailable at follow-up (5 parents, 14 childcare). A total of 37 interviews were completed (12 parents, 12 childcare providers, 13 healthcare workers).

2.2. Instruments

Study materials included a demographic questionnaire and a semi-structured interview guide. The demographic questionnaire obtained the following information: age, race/ethnicity, marital status, education level, annual household income and employment status. The purpose of the larger study was to identify the current practices and perceptions of physical activity, strength and communication for infants by caregivers (parents, childcare providers and healthcare workers in a Midwestern state). Questions related to typical infant routine and the COVID-19 pandemic were included and are the focus of this analysis. These questions can be seen in Table 1. The interview guide was piloted with a former childcare provider, using a cognitive interview approach to evaluate face validity and assess the length of the interview (Willis, 1999). After the pilot testing was done, minor word changes were made in the interview guide. First, the word activity was changed to physical activity throughout the guide. Second, several questions identified as repetitive in nature were removed.

2.3. Data collection

Three graduate student researchers were responsible for completing the interviews. All students had received interview training by trained qualitative researchers (PhD's). Each participant was asked to give a preferred date/time for the Zoom or telephonic interview to take place. Prior to the interview beginning, participants were given a brief synopsis of the study's purpose, privacy information and definitions of the terms infant and physical activity. First, infants were defined as children 0–12

Table 1  
Semi-structured interview questions.

Healthcare workers	Childcare providers	Parents
Question 1: Has the pandemic changed how you engage with infants to promote their physical activity, strength or communication, how so?	Question 1: Has the pandemic changed how you engage with infants to promote their physical activity, strength or communication, how so?	Question 1: Has the pandemic changed how you identify resources or ideas related to your infant's physical activity, strength or communication? If so, how?
Question 2: Has the pandemic altered the type of activities you are recommending to parents to promote physical activity, strength or communication? If so, how?	Question 2: Has the pandemic altered the activities infants are engaging in while in your care? If so, how?	Question 2: Has the pandemic altered the type of activities your infant is engaging in? If so, how?
Question 3: Are there any resources you wish you could provide to parents related to infant physical activity, strength, or communication during the pandemic that you do not currently have?	Question 3: Are there any resources you wish you could provide to parents related to infant physical activity, strength, or communication during the pandemic that you do not currently have?	Question 3: Are there any additional resources you think are needed related to infant physical activity, strength or communication during the pandemic that you do not currently have?
NA	Question 4. What is your typical daily routine with infants in your care?	Question 4. What is the typical daily routine for your infant?

months of age. Second, physical activity was defined as “opportunities to be active several times a day in a variety of ways such as through interactive floor-based play; with the more activity, the better.” (World Health Organization, 2019). Participants were asked if they had any questions prior to interview initiation, were told there were no wrong answers and were encouraged to freely express their views. At this point, the interview was initiated and was audio recorded. Interviews lasted approximately 45 to 60 min. After the interview, a brief demographic survey link via Qualtrics was emailed to the participants. A total of 37 individuals were interviewed (13 healthcare workers, 12 childcare providers; 12 parents). Specific to the healthcare workers, a diverse cohort was sought with the following specialties included: physician (n = 2), advanced practice provider (n = 3), chiropractor (n = 1); occupational therapist (n = 2); Speech-Language pathologist (n = 2); physical therapist (n = 3). In reference to the childcare providers, we interviewed a home-based setting (n = 5) and a daycare setting (n = 4), additional details of interviewees can be seen in Table 2.

Table 2  
Sociodemographics of participants.

Characteristics	Healthcare provider N (%)	Childcare provider N (%)	Parent N (%)
Age (years) (mean SD)	36.33 (6.94)	38.33 (12.91)	29.5 (3.43)
Race/ethnicity			
Non-Hispanic Whites	11 (91.7)	9 (100.0)	7 (77.8)
Hispanic or Latino	0	0	0
Black or African American	0	0	0
Asian/Pacific Islander	1 (8.3)	0	2 (22.2)
Native American or American Indian	0	0	0
Other	0	0	0
Undisclosed	0	3	3
Marital status			
Married	NA	NA	9 (100.0)
Undisclosed			3
Education			
High school diploma or GED	0	1 (11.1)	0
Some college or associate degree	0	5 (55.6)	0
College degree	1 (8.3)	2 (22.2)	2 (22.2)
Master's degree	4 (33.3)	1 (11.1)	6 (66.7)
Professional degree (MD, JD, DVM, PhD, etc.)	7 (58.3)	0	1 (100.0)
Undisclosed	0	3	3
Household income			
Between \$25,000 and \$34,999	NA	NA	1 (11.1)
Between \$35,000 and \$49,000			1 (11.1)
Between \$50,000 and \$74,999			3 (33.3)
Between \$75,000 and \$99,999			2 (22.2)
Over \$100,000			2 (22.2)
Undisclosed			3
Employment			
Employed for wages full-time	7 (58.3)	2 (22.2)	5 (55.6)
Employed for wages part-time	3 (25.0)	1 (11.1)	1 (11.1)
Self-employed	1 (8.3)	5 (55.6)	0
A student	0	0	1 (11.1)
A homemaker	0	0	2 (22.2)
Other	1 (8.3)	1 (11.1)	0
Undisclosed	0	3	3
Race/ethnicity primarily served			
Caucasian/White	12 (100.0)	2 (22.2)	NA
African American/Black	0	4 (44.4)	
Hispanic/Latino/Spanish	0	2 (22.2)	
American Indian/Native American	0	0	
Asian/Pacific Islander	0	0	
Mixed race	0	1 (11.1)	
Other	0	0	
Undisclosed	0	3	

## 2.4. Data analysis

Interviews were transcribed verbatim into a word document and uploaded using NVivo 12 qualitative analysis software (QSR, 2020). An inductive content analysis of open-ended questions was conducted by two researchers (KS & AP) (Lauri & Kyngäs, 2005). Both researchers began by independently coding the interview data through an open coding process. The interview data was broken up into three discrete sections (physical activity, muscle strengthening, and communication). All data were labeled with codes and separated into each group. After each researcher had completed open coding of all data, discussion occurred and developed categories were grouped under higher order headings within the three groups. Each category was developed using content-characteristic words such as physical activity, movement, muscle, strength, communication, talking, language (Elo & Kyngäs, 2008). These categories were organized into major themes. Major themes were compared across the three categories via axial coding. Themes respective to daily routine, physical activity, muscle strengthening and communication were developed. The final step was selective coding in which codes that were present across the four groups were connected via a common theme. Frequencies and percentages of responses were calculated, and final themes have also been presented. A comparative analysis was also conducted to compare responses by provider type however substantial differences were not seen. Data validity was assessed via peer debriefing.

## 3. Results

The majority of caregivers/healthcare workers felt the COVID-19 pandemic had an influence on infant physical activity, strength or communication in at least some capacity. Importantly, 40.5% (5 = healthcare provider, 5 = childcare, 5 = parent) reported no influence or change in how they engaged with infants due to the pandemic. The remaining 22 individuals were included in this analysis. The main themes identified were related to the general routine of infants, a concern for limitations in social interactions, a lack of access to peer modeling, fewer opportunities for infant physical exploration and a need for creative activities to foster infant development.

### 3.1. General routine of infants

Caregivers mentioned a wide variety of activities they included in infants' typical daily routines. A majority of caregivers (n = 18; 81.8%) described activities focused on providing infants opportunities for movement or focused on the development of fine or gross motor skills. For example, one parent stated, "*The typical routine would be just playing with toys, moving hands and feet, and we try making him walk.*" Tummy time was another frequently mentioned activity to help build strength as another childcare provider described providing time for "*...tummy time, being able to roll around on their backs and have that opportunity to roll over.*" About half of caregivers mentioned activities that involved communicating or interacting with themselves or other children, as one childcare provider explained, "*I'll set him on my lap in front of me so we can talk and verbalize back and forth.*"

### 3.2. Limitations in social interactions

A main theme identified across all interviewees was limitations in social interaction with infants (n = 17; 77.2%). Caregivers and healthcare workers reported concerns related to infants having fewer opportunities to interact with adults and/or other infants. Childcare providers were especially concerned about the influence of policies related to mask wearing. Some childcare providers reported not following health directives because of these concerns. One provider running an in-home care program noted, "*No. But I have to say because we are not following county health directives. We are not wearing a mask in my home. So I think*

*that if we were following those directives, definitely it would*".

Healthcare workers, especially speech therapists, also reported difficulties with providing services through masks. However, many discussed barrier resolutions such as masks with clear panels so children could see their lips move. Healthcare workers also reported concerns related to isolation protocols especially when working with immunocompromised children. Finally, parents echoed sentiments regarding the role masks may play in infant development.

### 3.3. Lack of access to peer modeling

A majority of respondents (n = 16; 72.2%) noted a concern related to a lack of access to peer modeling opportunities. Parents and childcare providers reported worries that their child/children in their care were limited in their ability to observe and engage with other children. Healthcare workers reported similar concerns related to a reduction in playdates and parents' ability to observe and learn from other parent/child interactions. Finally, a childcare provider also noted the limited activities available to the children in their care were hindering peer modeling opportunities.

### 3.4. Fewer opportunities for physical exploration

Many provider types (n = 19; 86.3%) reported infants were engaging in fewer opportunities for physical exploration. Caregivers/healthcare workers specifically reported concern that, given fears related to the pandemic, infants weren't receiving as many opportunities for physical exploration of their environment. Some childcare providers reported having to limit access to toys or parts of a school environment due to cleaning or social distancing procedures. Parents had similar sentiments and often noted physical activities with their children were much more isolated. Healthcare workers were concerned about a lack of physical exploration related to more time being spent in restrictive devices (i.e., bouncers, swings) or less time to engage in tummy time experiences.

### 3.5. A need for creative activities for infant development

Caregivers/healthcare workers across the three groups (n = 19; 86.3%) echoed requests for creative ideas to promote infant development given the constraints the pandemic has created. Healthcare workers noted a desire to see more ideas for physical activities that could be done at home. Parents also wanted ideas of activities to physically engage with their infant at home as well as ways to support language development when their child wasn't exposed to other children. Finally, childcare providers reported a desire for more resources to be shared that could be incorporated throughout the day. Example quotes across all themes can be seen in Table 3 below.

## 4. Discussion

The secondary influence of the COVID-19 pandemic on infants remains largely unknown and not well understood. However, the rise in childhood obesity, social isolation protocols and mask wearing have led many experts to be concerned about the potential consequences to the future generation (Green, Staff, Bromley, Jones, & Petty, 2021). This study provides additional information as to the perceptions of infant caregivers (parents, childcare providers) and healthcare workers regarding the impact of the COVID-19 pandemic on infant physical activity, muscle strengthening and communication. Our findings included caregiver descriptions of general routines for their infants and highlighted concerns related to limited social interactions, lack of access to peer modeling, and decreased opportunities for infant physical exploration and a need for creative activities to foster infant development. Importantly, given the positive influence healthcare and childcare provider education can have on parent/child interactions, these findings offer indications for where future research and practitioner efforts are

**Table 3**  
Example quotes by provider/caregiver type.

Theme	Parent example	Childcare provider example	Healthcare provider example
Limitations in social interactions	“She’s at that age that she is watching people’s faces. With masks on she doesn’t get that and so even like interacting with Grandma, she doesn’t see their smile or that facial piece that they [the infant] really thrive on now...I wonder if communication will be affected in these children who are at the prime time for developing words and haven’t seen anyone’s mouth move besides their parents?”	“I do think that COVID-19 has changed it, something that is really difficult is, babies look at your mouth to understand a lot of the words that you say, and then having that [mask] is a challenge honestly, or even just getting a new baby who is used to seeing people’s full faces and they never met you before, it can be kind of scary for them to meet you with a mask on. You know, you look like a doctor”	“Well, when you’re in a hospital, we only allow one parent at a time. So that also limits interaction. No sibling interaction which is hugely detrimental to these kids. Um because of PPE [Personal Protective Equipment] and infectious risks, you know, we try to limit how many times they go in and out of rooms and how long they’re there”
Lack of access to peer modeling	“We spend a lot less time around people and infants to see what they are doing, what milestone they are meeting, so just fewer opportunities”	“We can’t go to the park, we can’t go to zoo, we can’t show them how to interact in the activities they normally do at this age because we’re scared to take them out and expose them to anything”	“I think when kids get together for playdates and their’ [parents] are able to make comparisons with other parents from one child to another as far as how much time they’re doing this or that, I think that’s where a lot of the education takes place for many families”.
Fewer opportunities for physical exploration	“If there wasn’t the pandemic, I would have so many friends at my house, so many would be playing with and, you know, promoting physical activity with him”.	“For the longest time we thought it [COVID-19] lived on surfaces longer, you know having the opportunities to get those different textures, feel things, reach for items, it is a very sterile environment, it’s not supposed to be clean. Opportunities for the kids are not as widespread as they have been”	“I do worry that babies are even more in containers, because, let’s be honest, if you have two parents working from home and trying to take care of a couple of kids, it’s not safe for them to be left on their own”.
A need for creative activities for infant development	“what activities can they do? Just to keep their physical [activity] going on, if they can’t, you know, play with other kids. So, like even communication wise if they can’t talk to other kids how do you keep their communication level strong?”	“I would love educational materials, like a pamphlet of ideas for infants of a certain age group. So like here is for 0–4 months, here is 4–8 months, 8–12 months, and why it is important and what you should be doing”.	“I’m really interested in seeing if more resources come about specific to being, you know, kind of stuck at home”.

needed to promote physical activity, muscle strengthening and communication behaviors (Vernon-Feagans & Bratsch-Hines, 2014).

Prior to the COVID-19 pandemic there were concerns that young children were not achieving physical activity recommendations

(Hesketh et al., 2017; Neelon, 2018). This is compounded by early findings during the pandemic that suggest social distancing and lockdown protocols have exacerbated physical activity barriers leading to increased rates of sedentary behavior and screen time (Arufe-Giráldez et al., 2021; Cachón-Zagalaz et al., 2020). Our findings suggest infant physical activity behaviors may be hindered due to lack of access to peer modeling and fewer opportunities for physical exploration. Specifically, infants have had fewer opportunities to learn from their peers due to increased rates of social isolation resulting in fewer play dates and decreased opportunities within childcare settings. An infants’ ability to learn through imitation and free play exploration are well known for promoting healthy infant motor development; thus, efforts should be made to allow children to safely interact with other children when appropriate (Lorang & Sawyer, 2019; Yang, Sidman, & Bushnell, 2010). Consequently, caregivers and healthcare workers must consider educating parents on creative strategies to develop and implement safe interactions among children (Lorang & Sawyer, 2019). These interactions may include outdoor play gatherings given the relatively low transmission of COVID-19 during outdoor activities (MIT Medical, 2021) or through intentional identification of social “pods” for regular interaction with others who are also limiting potential exposures to COVID-19.

Additionally, the decreased number of opportunities for physical exploration hinders infants’ abilities to engage in muscle strengthening activities. Although caregivers did often mention inclusion of tummy time within the infant’s general routine, some acknowledged that infants were spending greater amounts of time in restrictive devices to accommodate parent work schedules. This is likely related to the increase in closures of childcare programs since March 2020 and/or closure protocols related to COVID-19 exposures, both of which often leave parents without childcare for extended periods of time (CDC COVID-19 Guidance, 2021b; Gromada, Richardson, & Rees, 2020). Concerns related to inadequate utilization of tummy time existed prior to the start of the COVID-19 pandemic and our findings suggest additional barriers may now exist which need to be addressed (Hesketh et al., 2017). Objective measures to quantify how much tummy time infants are engaging in are warranted to determine the scope of the need for additional interventions. While healthcare workers play a vital role in emphasizing the importance of tummy time during well child visits, they may be experiencing barriers such as an increased conversation focus on COVID-19, limited time to address this topic with caregivers, and/or a general lack of knowledge on specific tummy time guidelines (Koren, Reece, Kahn-D’angelo, & Medeiros, 2010). Efforts are needed to ensure healthcare workers as well as childcare providers are aware of tummy time recommendations and are encouraged to regularly share this information with parents.

In addition to concerns regarding infant physical activity, our study found there is concern about the impact of social isolation on infant communication, and many childcare providers reported uneasiness about the potential negative influence of masks. There are theoretical underpinnings to this argument that warrant further exploration. Specifically, bioecological theory posits reciprocal interactions between an infant and caregiver impact brain development, and positive emotional attachment leads to positive psychological outcomes (Green et al., 2021; Rosa & Tudge, 2013). Therefore, a mask could potentially hinder an infant’s ability to form these attachments by limiting the observation of facial expressions and impairing the development of facial processing abilities and subsequent communication engagement; however, more research utilizing objective assessments is needed to fully understand this potential impact. Given the substantial value of masks in preventing COVID-19 transmission, experts have developed recommendations for communication within a face mask (Pan, Harb, Leng, & Marr, 2021), and these recommendations encourage maximizing opportunities for interaction between parents and infants before and after daycare, suggest utilization of clear face masks as able, encourage talking to the infant through the mask, and propose playing peek a boo from a distance so the

infant can see the mouth with an emphasis on facial expressions through eye and eyebrow use (Green et al., 2021).

The ability for caregivers and healthcare workers to appropriately promote activities to foster physical activity, muscle strengthening and communication appear to be negatively influenced by the COVID-19 pandemic. The complexity of motor, language and cognitive development that occurs rapidly in the first year of life only augments the critical need for appropriate and accessible resources to support knowledge and awareness in caregivers and healthcare workers which is positively correlated with positive health outcomes in children (Gadsden, 1994). Our study confirms that parents and childcare providers want and need creative activity ideas to promote infant development that can supplement the lack of physical play opportunities that occurred and may continue to occur during the COVID 19 pandemic. Future resources for caregivers should help them become more aware of timing for key developmental milestones but also deliver easily implemented strategies to support achievement of these milestones, particularly for parents who are now more often working from home. Resources for caregivers should be no-cost, easily accessible (e.g., short online videos or mobile applications), and focus on activities or strategies that require no or limited equipment.

The influence healthcare worker education can have on parenting practices in conjunction with the evidence to support the positive correlation between parent knowledge and positive infant outcomes suggests that healthcare workers should be a key target for dissemination of information and resources (Leung et al., 2020; Vernon-Feagans & Bratsch-Hines, 2014). Healthcare workers have experienced significant challenges related to the COVID-19 pandemic, potentially shifting focuses away from infant physical activity, muscle strengthening and communication. However, given the identified need for resources development and distribution, healthcare workers have a strong potential to address these secondary implications of the pandemic and should be one of the primary targets for efforts in increasing awareness of existing and newly developed resources.

This study is strengthened by the diversity in caregiver and provider types included in this study. It is weakened by the limited geographic representation as all interviewees resided in the Midwestern United States. This reduces the ability to generalize findings without further investigation. This study is also limited by its cross-sectional nature. The policies and procedures related to the COVID-19 pandemic are constantly evolving and thus caregivers' perceptions and needs may shift in relation to these changes.

## 5. Conclusion

The way infants interact with the outside world has shifted due to the COVID-19 pandemic. This has led to increased reliance on infant caregivers (e.g., parents, childcare providers) to deliver effective stimulation to promote healthy infant development. However, caregivers need support to understand how to intentionally engage with infants in a way that will promote infant activity, muscle strengthening and communication. Low-cost, easily accessible, creative activities that promote infant development need to be developed that acknowledge the increase in work-from-home parents as well as changes to the childcare environment. Healthcare workers are a trusted source for education and should be utilized to share ideas and resources for developmentally age-appropriate activities for infant/caregiver interactions.

## Funding

The authors have no funding to disclose.

## Declaration of competing interest

The authors have no conflicts of interest to disclose.

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