

# Issue BRIEF

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## Developing Math Skills in Early Childhood

Infants begin to learn math before they can sit up. They notice differences in quantity, they compare the shape and size of objects, and they use early math concepts when they play and in other aspects of their daily lives.<sup>1</sup> Math helps children to develop the ability to think critically and solve problems.<sup>2,3</sup> Both are integral to success in school and in life, but not all children learn the math skills they need to succeed.<sup>4</sup>



### WHY IS EARLY MATH IMPORTANT?

A large body of evidence shows a connection between being competent in early math and success in school, even after controlling for family characteristics, early IQ, reading achievement, and other factors.<sup>5-10</sup> In fact, early math skills may be the strongest predictor of later success in both reading and math.<sup>6,9,11-12</sup>

Weaknesses in math skills, however, begin early and are evident by the time children enter

kindergarten.<sup>13</sup> Unfortunately, children who enter kindergarten with weak math skills are likely to remain behind their peers in the later grades.<sup>10,12,14</sup> In addition, the children who are the least prepared in math when they enter kindergarten tend to be from minority and low-income families, or they are just learning to speak English.<sup>10,15</sup> These factors suggest that improving the long-term outcomes for all children may depend on exposing them to more early math concepts before they enter school.

### KINDERGARTEN READINESS<sup>16</sup>

- Many children across the nation are not ready for kindergarten math.
- Children from disadvantaged households are much less likely to be ready for kindergarten math.

This brief presents a promising approach to supporting young children's early math skills development. The approach synthesizes the influence of parents, the home environment, and children's health care providers, and is being implemented by Reach Out and Read. Reach Out and Read is a program in which health care providers give young children new books and encourage parents to read with their children at home. When families participate in Reach Out and Read, parents read aloud more often and children improve their language and literacy skills.<sup>17</sup>

Because math and reading can be easily integrated through Reach Out and Read, parents can learn to simultaneously support the development of their children's early language, literacy, and math skills in an enjoyable and developmentally-appropriate way. Thus, the program has the potential to improve kindergarten readiness in math and literacy. Because children see their health care providers often during the first few years of life, Reach Out and Read's initiative could support a large percentage of children across the nation through the network of Reach Out and Read programs.

## WHAT IS EARLY MATH?

The term “early math” refers to a broad range of basic concepts such as counting (1, 2, 3); quantity (more, fewer); shapes (circles, squares, triangles); spatial relations (over, under); measurement (tall, short; bigger, smaller); and patterns (red, blue, red, blue).<sup>18-19</sup>

Because children are naturally curious, they explore these concepts as they interact with their environment.<sup>19-20</sup> For example, young children explore math when they play and build towers with blocks. In building, they sort the blocks by size and color, notice spatial relationships, and develop reasoning skills as they learn which shapes can be placed on top of one another, which ones will topple the tower they have built, and how to combine shapes to create familiar objects.<sup>1</sup> Preschoolers count or compare objects as they play, and explore patterns and shapes.<sup>21</sup>

Children must interact with adults to learn the words that represent the basic math concepts that they experience.



“Parents are babies’ first and most important teachers. When parents engage their babies in responsive, loving, and joyful relationships from the earliest days, parents support their child’s social-emotional, language, literacy, and math skill development.”  
--Marny Dunlap, MD;  
Oklahoma City,  
Oklahoma

Children must interact with adults, however, to learn the words that represent the basic math concepts that they experience. Parents and other adults can incorporate this developmental support into their daily routine. For example, while building towers or reading books with young children, parents can point out—and use words to denote—different sizes and shapes. For toddlers and older children, parents and adults can use regular activities, such as doing laundry, as a teaching tool by encouraging children to count or sort items in a laundry basket. Setting the table for a meal is another way to encourage children to think in mathematical terms. Parents or adults could ask a child how many spoons are needed on the dinner table. Figure 1 shows the progression of some of the typical math concepts that children learn from birth through age 5.

### Development of early math skills over time

Infants	Distinguish between small groups of objects (1 versus 2)
Toddlers	Use number words to label small quantities (such as 1 dog or 2 cats)
2-3 years old	Count objects by touching or pointing to them
3-4 years old	Quickly recognize small groups of objects without counting (such as 1, 2, or 3 balls)
4-5 years old	Begin to add or subtract small quantities (such as adding or subtracting 1 or 2 toys)

Figure 1

## HOW IS THE DEVELOPMENT OF EARLY MATH RELATED TO EARLY LITERACY?

A common concern is that supporting early math might mean taking time away from something else, such as early literacy. Yet, this does not have to be the case. The development of early math and early literacy skills are intertwined,<sup>3</sup> and efforts to support both can take place simultaneously. In fact, when math is taught hand-in-hand with other subjects, such as reading, children learn more math than they would if they were taught only math.<sup>18</sup>

Children learn math and language in a similar progression. Starting in infancy, language and literacy skills develop over time as children build their vocabulary, sentence length, and sentence complexity. Children learn how to express their ideas in words by building their vocabulary, their understanding of grammar, and their ability to use longer, more complex sentences.<sup>22</sup> Learning early math involves a similar progression as children initially learn basic math vocabulary, then how to recognize math in the world around them, and then over time learn how to express more complex math concepts involving measurement, geometry, and reasoning.<sup>3,23</sup>

**Math talk** means talking about numbers, shapes, space, and dimensions in order to encourage mathematical thinking. It also involves asking children questions to stimulate a discussion about math concepts.



Recommended well-child “checkups” are frequent in early childhood: 7 before the first birthday; 6 from age 1 through age 3.

Reading books, telling stories, and using “math talk” are easy, effective ways to integrate and promote the development of early math and early literacy skills. Children’s books provide many ways to highlight math. For example, *Moo Baa La, La, La* by Sandra Boynton enables counting of animals on each page and comparisons of relative size (big and small animals). *Goodnight Moon* by Margaret Wise Brown provides opportunities to count items on each page and learn about spatial relations such as over and under. *The Doorbell Rang* by Pat Hutchins shows how sharing a plate of cookies can be used to introduce fundamentals of fractions and division. These are just three examples of children’s books that simultaneously support the development of early math and literacy skills.

### **HOW CAN PARENTS AND THE HOME ENVIRONMENT SUPPORT CHILDREN’S EARLY MATH DEVELOPMENT AND SUBSEQUENT LEARNING?**

A nurturing parent-child relationship helps children build self-esteem, confidence, and a sense of security – all of which support early learning. Nurturing relationships and a supportive home environment are critical when children are very young because the majority of brain growth and major developmental milestones occur during this time. The first few years of life are when parents and the home environment have the strongest effect on brain development, with long-lasting consequences for school and beyond.<sup>3,24-25</sup>

Language-rich interactions between parents and children not only strengthen the parent-child relationship but also stimulate children’s cognitive and linguistic development.<sup>24</sup> Having books at home and reading and talking to children—even very young infants—influences children’s development of language and literacy skills.<sup>3,26</sup> Children whose parents talked to them frequently and used a variety of words when speaking to them when they were very young, for example, have larger vocabularies when they are older, compared with their peers whose parents spoke to them less.<sup>27-28</sup>

Similarly, parent-child interactions influence a child’s early understanding of math. Children exposed to more math-related words as toddlers have a stronger understanding of math by the

time they are preschool age.<sup>29-31</sup> Likewise, when caregivers engage young children in math-related activities, children learn more readily and are more likely to succeed in school.<sup>29-30,32</sup>

For many parents, however, supporting their child’s early math development is a task laden with anxiety that stems from their own negative experiences with math, or from an uncertainty about how to help their children learn math. Anxiety about math can be passed onto young children, and these initial impressions can have lasting effects.<sup>33</sup> In addition, parents may do less math talk with their daughters than their sons in the first years of life, which could unintentionally contribute to gender differences in math in school.<sup>34</sup>

Efforts to help parents build their children’s early math skills should therefore focus on three things: (1) broadening parents’ understanding of early math and its importance, (2) helping them to overcome their own anxiety about math, and (3) giving them concrete tools to help their children learn through daily activities.<sup>33,35</sup> Parents are willing and able to help their children learn early math skills if they know how to do so.<sup>36</sup> Teaching parents how to do this is effective; young children whose parents were trained had better early math skills than children whose parents were not trained.<sup>36</sup>

### **HOW CAN HEALTH CARE PROVIDERS INFLUENCE PARENTING AND THEREFORE THE DEVELOPMENT OF CHILDREN’S EARLY MATH SKILLS?**

Health care providers have access to nearly all children and families prior to kindergarten. Parents see their children’s health care provider for regularly scheduled well-child visits that are most frequent in the first months and years of life. These visits foster trusting relationships between parents and health care providers, enabling health care providers to give families guidance and support.

Nearly all children have access to well-child care. Nationally, more than 95 percent of children are insured.<sup>37-38</sup> Coverage is particularly strong for children from low-income families, many of whom receive health care through public programs such as Medicaid and the State Children’s Health Insurance Program, or S-CHIP.<sup>37-38</sup>

Children’s health care providers are trusted by parents. Because parents trust their children’s health care providers, they are likely to follow the providers’ recommendations. When families with young children in Washington State were asked whom they trust when they want information on how to support their child’s learning, development, and health, 71 percent of parents replied that they trust and want this information “a lot” from a health care provider, far more than any other potential source of information.<sup>40</sup>



Parents want their child to be ready for kindergarten. When asked what types of early learning information they wanted, information about early reading and school readiness were some of the top answers.<sup>40</sup> At the same time, 93 percent said that they read or showed books to their child at least three times a week.<sup>40</sup> This suggests that if health care providers encourage parents to read with their children daily, many parents would do so, particularly since it builds on behaviors they may be doing already.

## WHY IS REACH OUT AND READ A PROMISING APPROACH FOR PROMOTING CHILDREN’S EARLY MATH SKILLS?

Studies of Reach Out and Read show that when health care providers urge parents to read to their children, the parents’ feelings about doing so are more positive.<sup>41-42</sup> Parents who participate in the program read aloud more often with their children and studies show improvements in young children’s language skills.<sup>17,41-42</sup> In response to the growing research base on the importance of reading aloud to young children and the effectiveness of the Reach Out and Read model, the American Academy of Pediatrics issued a policy statement recommending that literacy promotion be a standard part of pediatric primary care.<sup>17</sup>

Reach Out and Read is growing rapidly and includes participating health care providers in a variety of settings. There are currently 6,200 Reach Out and Read clinics across the country (see Figure 2 for more details). In addition, more clinics join Reach Out and Read each month.

“Parents love Reach Out and Read. They appreciate the gift of a book and they are excited to learn that they can help their child learn early skills related to both reading and math from the time they are babies. Reading books together quickly becomes a favorite family activity, and they return for the next checkup eager for more.” -- Mary Ann Woodruff, MD, Tacoma, Washington

### Number of providers and children who currently participate in Reach Out and Read

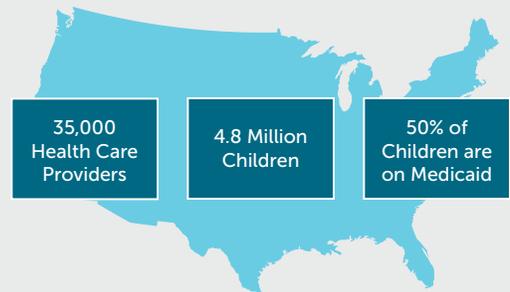


Figure 2

Reach Out and Read supports the natural integration of early math and literacy development by encouraging parents to read books with their children in a way that supports the development of both early math and literacy concepts. Integrating a focus on early math is a natural extension of the Reach Out and Read program, which encourages and supports parents and their children to read books aloud together. Most parents like to read or show picture books to their children, so this is an easy and fun way to support their child’s math and literacy development.

Initial testing of this integrated approach has been well-received by health care providers and families. Reach Out and Read is piloting approaches to integrate math and reading in select clinics in 9 states—Arizona, California, Minnesota, New Jersey, North Carolina, Oklahoma, South Carolina, Texas, and Washington. These approaches show promise for changing how parents support the development of their children’s math skills.<sup>35</sup>

## Next steps for Reach Out and Read

Leveraging the trust between parents and their children's health care providers has been shown to improve early language and literacy skills,<sup>41-42</sup> and thus is a promising approach to help parents enhance their children's early math skills. Reach Out and Read is developing and implementing an integrated approach to early math that systematically helps parents support children's understanding of basic literacy and math concepts in an enjoyable and developmentally-appropriate way. In addition, given that Reach Out and Read's network of health care providers is large and growing, it provides a unique pathway to supporting large numbers of children long before they enter kindergarten, including a large percentage of children from disadvantaged backgrounds. By supporting children prior to kindergarten, Reach Out and Read has the potential to improve critical aspects of school readiness, and put our youngest and most disadvantaged children on a path toward success in school, work, and life.



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