PART 3

The First Two Years of Life

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As parents and other proud relatives keep discovering, infants grow and change more rapidly than the rest of us. Every few weeks, or sometimes even in a matter of days, infants seem to do something new. In just months, they are able to smile, sit, and babble. In just a few more months, they begin acquiring language, show signs of make-believe play, and take their first tentative steps. They go from smiling at any human face, to preferring their parents' familiar faces, to crying and showing distress at the sight of strangers.

These changes are pivotal in many ways as they lay important foundations for all future development. The next three chapters describe these crucial changes.

Physical Development during the First Two Years

CHAPTER 5

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Chapter Outline

Focusing Questions

- What do infants look like when they are first born? How do we know if they are healthy?
- How much do children grow during infancy?
- What changes occur in the brains of infants?
- How do infants' sleep and wakefulness patterns change as infants get older?
- What motor skills evolve during infancy?
- What do infants need nutritionally?
- What factors can impair growth during infancy?

Anne was looking at the journal she had kept about her daughter since Kamala was seven months old.

- April 9: For two weeks, she has been sleeping through the night! Maybe it helped to start nursing her just before bedtime—but it's so hard to tell. She is starting to enjoy bedtime stories, too; babbles at the book and points at the pictures.
- June 10: Kamala has been crawling all over—mostly after the dog. Gets mad, cries when Huggins, their dog, walks away; struggles to crawl after him; but then forgets all about him.

- August 10: Here's Kamala's latest words: "dada" (daddy), "tigg'n" (Tigger, the cat), "buh" (book). Maybe not polished English, but she's getting there. At this rate, I'm going to lose track of her full vocabulary soon.

As Anne can attest, during the first months of life a baby's behaviors evolve rapidly. In this chapter, we trace some of these changes through the first two years of life. We begin by discussing young infants' physical growth: what they look like, how they sleep, hear, and see, and what behaviors they can already perform at birth. We also look at variations in growth and nutritional needs in the first months of life. In Chapter 6, we take a second look at infants' development, this time from a cognitive perspective. We explore infants' perceptions and representations of their surroundings and how they learn from their world even before they learn to speak. Finally, we consider one of the most universal yet remarkable of all human accomplishments: the acquisition of language.

As we will see, when compared to other parts of childhood and adolescence, development during infancy shows more obvious growth and more discontinuity, but less diversity. Growth occurs now as at no other time of life! Babies change daily, putting on pounds and inches and acquiring new skills. "You can almost *see* them grow," said one mother. Growth—both physical and psychological—continues throughout life, but never in quite such an obvious way as in infancy. The very speed of infant growth creates important *dis*continuities: a child who cannot talk at six months, for example, is well on their way to talking at eighteen months.

Babies also show diversity. For example, not every infant acquires language in quite the same sequence or with the same timing. However, compared to the important developments of adolescence, infant developments are among the most predictable of the lifespan, both in timing and in nature. It is possible to predict within a few months either way, for example, when most infants will take their first step or speak their first word. Such accurate predictions are rarely possible for adolescents and adults.

The Newborn

As we saw in the last chapter, birth continues rather than initiates physical development. Most organs have already been working for weeks, or even months, prior to this event. The baby's heart has been beating regularly, muscles have been contracting sporadically, and the liver has been making its major product, bile, which is necessary for normal digestion after birth. Even some behaviors, such as sucking and arm stretching, have already developed. Two physical functions, however, do begin at birth: breathing and ingestion (the taking in of foods). These fundamental physical functions constitute the basic physical continuities that must last a lifetime. The baby's heart is the same one that will be beating eighty years and more than two billion heartbeats later; their lungs and stomach will grow larger, but they will be the same lungs and stomach taking in oxygen and food decades later during late life.

The First Few Hours

neonate A newborn infant.

When first emerging from the birth canal, the newborn infant (also called a **neonate**) definitely does not resemble most people's stereotypes of a beautiful baby. Regardless of race, neonate skin often looks rather red. If born a bit early, the baby may also have a white, waxy substance called *vernix* on the skin, and the body may be covered with fine, downy hair called *lanugo.* If the baby was born vaginally rather then delivered surgically, its head may be somewhat elongated or have a noticeable point on it; the shape comes from the pressure of the birth canal, which squeezes the skull for several hours during labor. Within a few days or weeks, the head fills out again to a more rounded shape, leaving gaps in the bones. The gaps are called *fontanelles,* or "soft

spots," although they are actually covered by a tough membrane that can withstand normal contact and pressure. The gaps eventually grow over, but not until the infant is about eighteen months old.

Immediately after birth, many hospitals and midwives recommend Kangaroo Care, which includes skin-to-skin contact between the newborn and mother for a period of time, as well as breastfeeding (Boundy et al., 2016). Kangaroo Care has been linked to lower rates of infant hypothermia, hypoglycemia, and mortality, as well as higher levels of oxygen in the blood (Boundy et al., 2016). Infants receiving Kangaroo Care demonstrated less pain during painful procedures such as heel sticks (Wang et al., 2022). Research also suggests that Kangaroo Care is beneficial to birth parents as well, resulting in less anxiety about parenting, more bonding, and higher rates of breastfeeding (Sweeney et al., 2017; Zehra & Tukiye, 2020).

Is the Baby All Right? The Apgar Scale

The **Apgar Scale** (named after its originator, Dr. Virginia Apgar) helps doctors, midwives, and nurses to decide quickly whether a newborn needs immediate medical attention. The scale consists of ratings that are simple enough for non-specialists to make, even during the distractions surrounding the moment of delivery (Apgar, 1953). To use it, someone present at the delivery calculates the baby's heart rate, breathing effort, muscle tone, skin color, and reflex irritability and assigns a score of zero to two on each of these five characteristics. Babies are rated one minute after birth and again at five minutes. For each rating, they can earn a maximum score of two, for a total possible score of ten, as Table 5.1 shows. Most babies earn eight, nine, or ten points, at least by five minutes after delivery. A baby who scores between five and seven points at one minute is given immediate special medical attention, which usually includes an examination by a pediatrician while oxygen is held under the baby's nose, and is then carefully observed to make sure that the Apgar scores increase to between eight and ten points at the five-minute retest. Monitoring continues during the next few hours and days for any problems that may develop (American Academy of Pediatrics, 2015a; Brazelton & Nugent, 1997).

Apgar Scale A system of rating newborns' health immediately following birth based on heart rate, strength of breathing, muscle tone, color, and reflex irritability.

Size and Bodily Proportions

A typical full-term newborn baby weighs about 7.5 pounds and measures about twenty inches lying down. The length of a neonate matches their adult size more closely than their weight does: a length of twenty inches represents more than one-quarter of an individual's final height, whereas her 7.5 pounds amounts to only a small percentage of one's adult weight.

TABLE 5.1 The Apgar Scale Score

	Score		
Characteristic	*0*	*1*	*2*
Heart rate	Absent	Less than 100 beats per minute	More than 100 beats per minute
Efforts to breathe	Absent	Slow, irregular	Good; baby is crying
Muscle tone	Flaccid, limp	Weak, inactive	Strong, active motion
Skin color	Body pale or blue	Body pink, extremities blue	Body and extremities pink
Reflex irritability	No response	Frown, grimace	Vigorous crying, coughing, sneezing

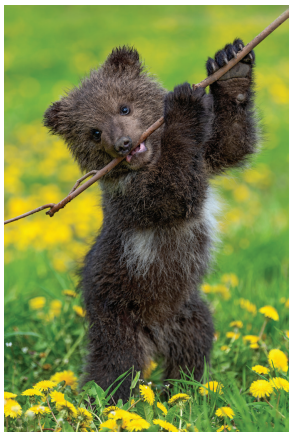
Source: Apgar (1953).

This neonate was delivered moments before the photo was taken. Notice the vernix coating much of the newborn.

Source: RMC42/Shutterstock.com.

Two adorable brown bear cubs.

Sources: (left) interstid/Shutterstock.com; *(right)* Volodymyr Burdiak/Shutterstock.com.



Babies' proportions and general physical appearance may have psychological consequences by fostering *attachments*, or bonds, with the people who care for them (see Chapter 7, "Psychosocial Development during the First Two Years"). Such bonds promote feelings of security. The cuteness of infants' faces in particular seems to help. No matter what their racial or ethnic background, most babies have relatively large foreheads, features that are concentrated in the lower part of the face, eyes that are large and round, and cheeks that are high and prominent. A pattern of babyish features occurs so widely among animals, in fact, that biologists who study animal behavior suspect it has a universal and genetically based power to elicit parental or nurturing responses among adult animals (Archer, 1992; Lorenz, 1970). Mothers in some species of ducks, for example, take care of ducklings even when the babies are not their own. Among human parents and children, attachments may start with this sort of inherent attraction of parents to infants, though, of course, it deepens as additional personal experiences accumulate across the lifespan.

Growth during Infancy

Infants experience a remarkably high rate of growth—they gain height and weight more rapidly during their first two years than at any other point during their post-birth lifetimes. And while increases in height and weight will be clearly evident and frequently measured by pediatricians (because gains in height and weight are indicative of the infant's overall health), less visible growth in the brain will also produce dramatic changes in the infant.

Physical Growth

While actual gains in height and weight can vary from infant to infant, on average, infants double their weight from 7.5 pounds at birth to about 15 pounds by the age of five months, and triple their weight to about 22 pounds by their first birthday (see Figure 5.1). Weight is gained less rapidly during the second year of life, with the average twenty-four-month-old

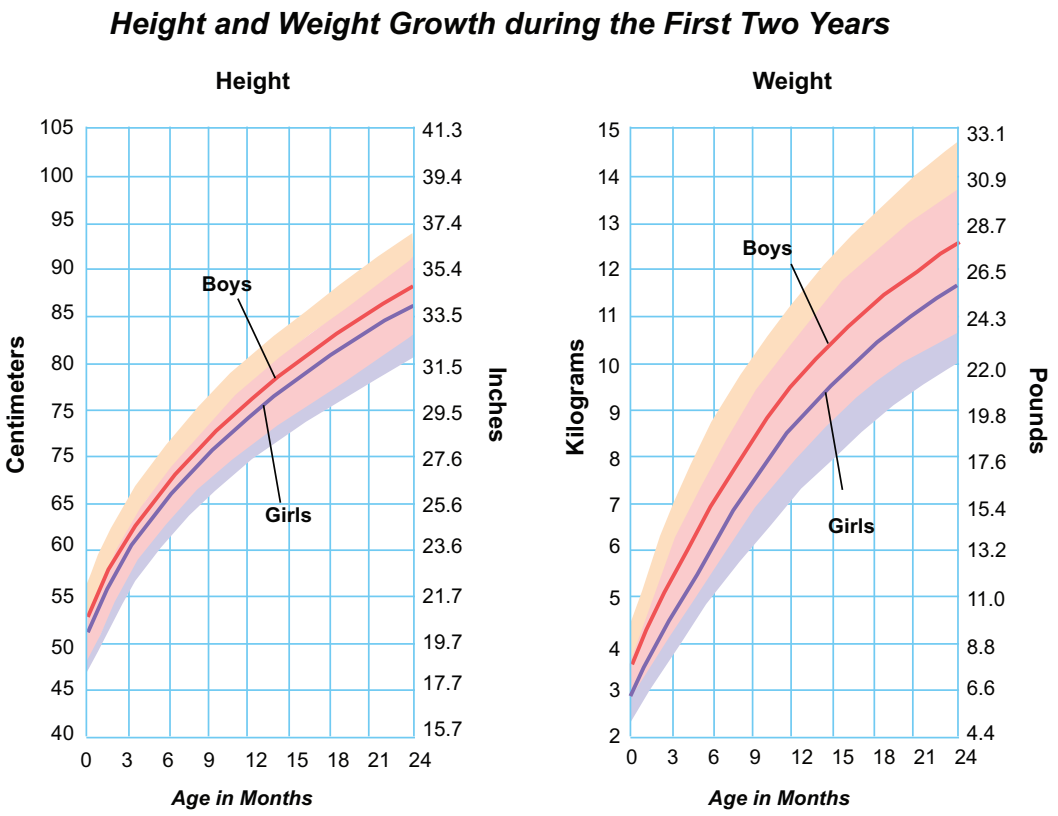


FIGURE 5.1
Growth Curves for the First Two Years

During infancy, rapid gains in height (left chart) and weight (right chart) are evident. On average, boys are slightly taller and heavier than girls are, but differences are minimal and are often overshadowed by increasing variability in height and weight within groups of boys and girls.

weighing about 28 pounds, approximately four times the weight of a newborn. Young infants tend to have a plump, soft look that results from the accumulation of fat. Body fat helps the infant maintain a constant body temperature. By their first birthday, infants will have lost much of their "baby fat," a trend that continues until puberty (Fomon & Nelson, 2002).

Infants also gain height, adding approximately ten inches (twenty-five centimeters) to their newborn length of twenty inches (fifty centimeters) by their first birthday, and they will continue to get taller during their second year, achieving an average height of about thirty-four inches (eighty-six centimeters) by their second birthday, which is roughly half of their adult height (see Figure 5.1). Body proportions are also changing during the first two years, revealing differences in growth for various parts of the body. At birth, the baby's head accounts for one-quarter of the newborn's total height. In other words, the head is more developed than the torso and limbs. By age two, the head accounts for one-fifth of the total height, as growth of the torso and limbs proceeds at a greater rate than the growth of the head. By adulthood, the head will account for approximately one-eighth of the total height of the average adult. As we will see in Chapter 14, adolescents also experience asymmetrical growth that makes them look gangly rather than like adorable bear cubs.

Brain Growth

While the head may not be growing as rapidly as the rest of the body, significant development is occurring in the brain and central nervous system during the first two years of life. The **central nervous system** consists of the brain and nerve cells of the spinal cord, which together coordinate and control the perception of stimuli, as well as motor responses of all kinds. The more complex aspects of this work are accomplished by the brain, which develops rapidly from just before birth until well beyond a child's second birthday. In fact, it will be at least two decades until the brain is fully mature (Stiles & Jernigan, 2010). At seven months past conception, the baby's brain weighs about 10 percent of its final adult weight, but by birth, it has more than doubled to about 25 percent of final adult brain weight. By the child's second birthday, the brain has tripled to about 75 percent of its final adult weight (Freund et al., 1997).

central nervous system
The brain and nerve cells of the spinal cord.

FIGURE 5.2
Anatomy of a Typical Human Neuron

This illustration shows the typical structures of a human nerve cell, including dendrites through which information typically enters the cell, the cell body, the axon covered by a myelin sheath, and the axon terminals through which nerve impulses are passed to adjacent neurons.

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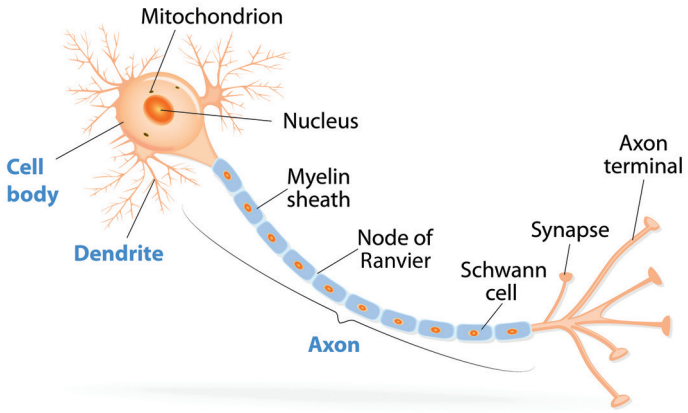

neurons Nerve cell bodies and their extensions or fibers.

synaptogenesis The forming of connections, or *synapses,* between neurons.

transient exuberance The rapid but temporary increase in the rate of synaptogenesis and, hence, the number of synapses formed between neurons during infancy.

synaptic pruning The process through which unused synapses and neurons are eliminated.

plasticity The degree to which a developing structure or organ (like the brain) can be influenced by the environment.

Most of this increase results not from increasing numbers of nerve cells, or **neurons**, but from the development of a denser, or more fully packed, brain. This happens in two ways. First, the neurons generate many new dendritic fibers that connect them with one another in a process called **synaptogenesis** (see Figure 5.2). Prenatally, neuron production is very rapid during the first half of gestation, and glial cell production is more rapid during the second half of gestation (de Graaf-Peters & Hadders-Algra, 2006; Oldham & Fornito, 2019). During the last trimester, neurons increase the development of dendrites and synapses, and this continues at a rapid pace throughout the first year of life (de Graaf-Peters & Hadders-Algra, 2006). However, at birth, relatively few neuronal connections or *synapses* exist, but by age two, each neuron may be connected to hundreds or even thousands of other neurons. Growth of the dendrites is the primary reason why brain weight triples from birth to age two (Johnson, 2010). New synapses are formed in response to every experience the child has; in fact, during infancy, more synapses are formed than are necessary, a phenomenon described rather colorfully as **transient exuberance**, due to the temporarily rapid and overproductive nature of synaptogenesis at this time. Because more synapses form in response to every experience during infancy and childhood than are needed, many of these synapses are never used again. Consistent with the adage "use it or lose it," unused synapses are eliminated in a process called **synaptic pruning**. When redundant and unused synapses and neurons are eliminated, the nervous system functions more efficiently.

An important consequence of the transient exuberance that occurs during infancy is that it heightens the **plasticity** of the brain, which is the degree to which the brain reacts to experiences with the environment. Plasticity plays a central and often protective role in infant development. If an infant is raised in an enriched environment that provides lots of stimulation and nurturance, the production of synapses is amplified. However, if the infant is raised in an environment with little stimulation, the brain responds by forming and retaining fewer synapses. We can illustrate this with an explanation that is often offered for the superior verbal abilities of firstborn children when compared to their later-born siblings. Firstborn children, at least until the second child is born, are the recipients of all of their caregivers' attention. This verbally enriched and supportive environment leads to the proliferation of synapses in the regions of the brain responsible for language—areas of the cerebral cortex in the left hemisphere of the brain. Parental attention must be divided among siblings when later-borns arrive, creating an environment for later-borns that is not as verbally enriched as that experienced by the firstborn child (Frank et al., 2010; Glass et al., 1974; Lehmann et al., 2018), leading to lower scores on measures of verbal ability for later-born children.

Environmental deficiencies can have long-term effects if they are severe and exposure is prolonged during infancy and early childhood. One longitudinal study in Great Britain found that "early adversity"—measured by ratings of the childhood home environment, including cleanliness, age, state of repair, and crowdedness, along with ratings of hygiene

What Do You Think?

Do you think that everyone grows at the rates described? Did you grow at the described rates? What factors might lead to more or less growth during infancy? If possible, find out how tall you were on your second birthday and multiply that figure by two. How close is that number to your current height? Why might the numbers be different?

and cleanliness of the children themselves (prior to age four)—was associated with lower scores on a variety of cognitive measures through childhood and adolescence that persisted into adulthood (Richards & Wadsworth, 2004). However, plasticity serves in a protective capacity as well, as indicated in infants who suffered left-hemisphere strokes. The areas of the brain responsible for understanding and producing language are localized in the left hemisphere of the brain. However, after an intervention that included intense verbal stimulation, the right hemisphere assumed control of verbal comprehension and production, and language was able to develop normally (Rowe et al., 2009). The plasticity of the brain is greatest during infancy and early childhood, when the rates of synaptogenesis and synaptic pruning are highest.

An additional, important change in the brain during infancy that has a great impact on development is **myelination**, a process in which certain brain cells called *glia* produce fatty sheathing, or *myelin,* that gradually encases the neurons and their fibers. The myelin serves to protect and insulate the axons of neurons, allowing them to conduct neural impulses much more quickly. Myelination occurs rapidly during infancy and childhood, and then continues at a slower rate until about age thirty (Taylor, 2006). More recent research suggests that to some extent, myelination and myelin plasticity continue throughout life (Chapman & Hill, 2020; de Faria et al., 2021). It is important to note that like most biological processes, myelination is also affected by environment. Children who begin their lives in poorer neighborhoods and with lower socioeconomic status demonstrate slower myelination (Ziegler et al., 2020). However, this slower myelination was found to be mitigated by higher parental education and parenting styles (Ziegler et al., 2020).

myelination The process through which myelin, a fatty sheathing, covers the axon of some neurons.

One important function of the brain is to control infants' states of sleep and wakefulness. The brain regulates the amount of stimulation infants experience, both externally and internally. Thus, periodic sleep helps infants to shut out external stimulation and thereby allows them to obtain general physical rest while strengthening and consolidating memories of what they have learned while awake. And somewhat paradoxically, sleep may provide the opportunity for the brain to stimulate itself.

Infant States: Sleep and Arousal

Perhaps one of the biggest surprises for first-time parents is how little time they actually have to interact with their newborn babies while the babies are alert and responsive. Also, the sometimes irregular sleep patterns of newborns can prove to be both physically and emotionally challenging for parents. These challenges are compounded when new parents receive conflicting information about how to help their babies sleep better or longer when they seek advice on the subject.

Sleep

In the days immediately after birth, newborns sleep an average of sixteen hours per day, and it is expected that they will sleep between fourteen and seventeen hours each day, although some sleep as little as eleven hours a day and others as much as twenty-one (Hirshkowitz et al., 2015; Michelsson et al., 1990). By age six months, babies average just thirteen or fourteen hours of sleep per day, and by twenty-four months, only eleven or twelve. But these hours still represent considerably more sleeping time than the six to eight hours typical for adults. So if infants sleep so much, why are their parents so tired?

Focusing On . . .

Sudden Infant Death Syndrome

Each year, about one out of every two thousand young infants dies during sleep for no apparent reason. Doctors call this phenomenon *sudden unexpected infant death* (SUID), which is more commonly known as sudden infant death syndrome (SIDS), or "crib death." The problem is most frequent among infants between ages two months and four months, although SIDS can affect babies as young as one month and as old as one year. Even though the rate of SIDS has been reduced by 50 percent since 1994, it is the leading cause of death among infants who survive the first few weeks after delivery (AAP Task Force on SIDS, 2016).

SIDS is disturbing because it is so mysterious. Typically, parents put a seemingly healthy baby down to sleep as usual, but when they come in to get them up again, they discover their baby is dead. Sadly, because the baby had exhibited no health problems, the parents often blame themselves for the death, suspecting that somehow they neglected their child or hurt him in some way (Garstang et al., 2016). Even more unfortunately, friends and relatives often concur in blaming the parents, simply because they can think of no other way to explain SIDS. What causes SIDS? Epidemiological research suggests that sleeping position plays a significant role—specifically, placing infants to sleep in a prone, or "facedown," position is linked to a higher risk of SIDS (Horne, 2019; Mitchell, 2009). Having blankets or soft materials in bed with an infant is also linked to SIDS risk because it increases the risk of suffocation and possibly also the risk of overheating because babies cannot regulate their body temperatures very well (Horne, 2019; Mitchell, 2009). Another theory suggests that SIDS occurs primarily at a special transition in development, just when inborn reflexive control of breathing begins to fade in importance but before infants have firmly established voluntary control of breathing. For most infants, this transition occurs at about two to four months of age, just when SIDS strikes most often. An additional theory suggests that SIDS infants suffer from heart problems: their nervous systems may fail to prompt regular, strong heartbeats and in essence cause them to suffer a heart attack. Unfortunately, no clear evidence points to any of these alternative explanations. Recent neuroscience research suggests that prenatal exposure to nicotine appears to alter receptors in the brain stem that play a role in the governance of certain autonomic functions (like heart rate and respiration). In preterm infants, prenatal exposure to nicotine impairs their recovery from *hypoxia*—low levels of oxygen in the blood—that might result from an obstruction, like a soft blanket, pillow, or stuffed animal, interfering with their supply of oxygen (AAP Task Force on SIDS, 2016; Mitchell, 2009).

Medical research has identified several factors that make a particular family or infant more likely to experience SIDS (American Academy of Pediatrics, 2013b; Byard & Cohle, 1994; Horne, 2019; Mitchell, 2009). Very young mothers and fathers (younger than twenty years) stand a greater chance of having a SIDS infant, as do mothers who smoke cigarettes or have serious illnesses during pregnancy. Mothers who are poorly nourished during pregnancy also carry more risk than mothers who keep reasonably well nourished. Infants who begin day care before four months of age also appear to be at higher risk for SIDS. Preliminary data indicate that 20 percent of SIDS deaths occur when the infants are being cared for someone other than a parent, and one-third of those deaths occurred during the first week of day care. But certain

sudden infant death syndrome (SIDS) Sudden infant death syndrome (or "crib death"), an unaccountable death of an infant in its sleep.

REM sleep A stage of sleep in which one's body is paralyzed, but one's eyes and brain are very active. REM sleep is believed to be important for memory consolidation.

non-REM sleep The stages of sleep that vary from light sleep to very deep, restorative sleep. The deeper stages of non-REM sleep play a pivotal role in helping us feel rested, growing, repairing cells, and bolstering immune function.

As Figure 5.3 shows, newborns divide their sleeping time about equally between relatively active and quiet periods of sleep. The more active kind is named **REM sleep**, after the "*r*apid *e*ye *m*ovements," or twitchings, that usually accompany it. In the quieter kind of sleep, **non-REM sleep**, infants breathe regularly and more slowly, and their muscles become much limper. It takes approximately sixty minutes for an infant to cycle through REM and non-REM sleep, as compared to a ninety-minute cycle for adults. This discrepancy in the duration of infant cycling and adult cycling is thought to be one reason for new parents' exhaustion: Their sleep cycles are being continually interrupted by their infant's waking, fragmenting their sleep much like someone with a sleep disorder (Montgomery-Downs et al., 2010).

Unfortunately for parents, a baby's extra sleep time does not usually include long, uninterrupted rest periods, even at night. In the first few months, it is more common for the baby to waken frequently—often every two or three hours—but somewhat unpredictably. Sleep can be improved, and awakening reduced, by swaddling infants, or wrapping them up snugly in a swaddling cloth or specialized swaddling device, although care should be taken to provide time for movement because infants who are swaddled tightly for most of the day (particularly if on a swaddling board) run the increased risk of hip dysplasia (Short et al., 1996; Van Sleuwen et al., 2007). Studies of brain development suggest that much of

Focusing On . . .

Sudden Infant Death Syndrome *continued*

babies also are at greater risk for SIDS independent of their parents' qualities or behaviors. Boys die of SIDS more often than girls do, for example, and infants born small (less than seven pounds) die more often than larger infants do. These relationships do not mean, however, that being a boy or being small actually *causes* SIDS; they imply only that for reasons still not understood, SIDS seems to strike boys and small infants more frequently.

Even taken together, these factors do not predict SIDS very accurately. The vast majority of high-risk infants do not die, whereas some infants with few risk factors die from SIDS. This circumstance creates problems in translating the studies of risk factors into concrete recommendations for medical personnel and parents because taking the risk indications too literally can arouse fears in parents unnecessarily. The most useful recommendations tend to be valid for all families, whether or not they are at risk for SIDS (Horne, 2019). For example, the American Academy of Pediatrics (2013b; AAP Task Force on SIDS, 2016) offers the following recommendations as part of their safe sleep policy for all children:

- Infants should sleep on their backs until age one for every sleep; sleep positioners like foam wedges or rolled blankets designed to encourage side-sleeping should NOT be used.
- Infants should sleep in the same room as caregivers in their own separate sleep area for the first six months of life. Infants should never sleep on couches or chairs.
- Consider the use of pacifiers for naptime and nighttime sleep.
- Infants should sleep on a firm surface that is covered by a fitted sheet.
- Soft objects, loose bedding, bumper pads, top sheets or blankets, and stuffed animals should *not* be in the baby's sleep area.
- Specifically designed sleep clothing (e.g., sleepers, snug-fitting pajamas) should be used instead of blankets.
- The temperature in the room should be comfortable for a lightly clothed adult.
- Children should not be exposed to smoke, and parents should avoid the use of alcohol and illicit drugs during pregnancy and infancy.
- When possible, infants should be breastfed.
- Children should be immunized according to guidelines provided by the American Academy of Pediatrics and the Centers for Disease Control and Prevention.

These are good pieces of advice for everyone, but unfortunately, they do not guarantee complete protection from SIDS. For parents whose babies do die, many hospitals and communities have created support groups in which couples can share their grief and come to terms with it.

What Do You Think?

If you were counseling a parent who lost a baby to SIDS, what would be your most important concern? What might you say to the parent? What might you also say to a relative of the parent who suspects that neglect may have caused the death?

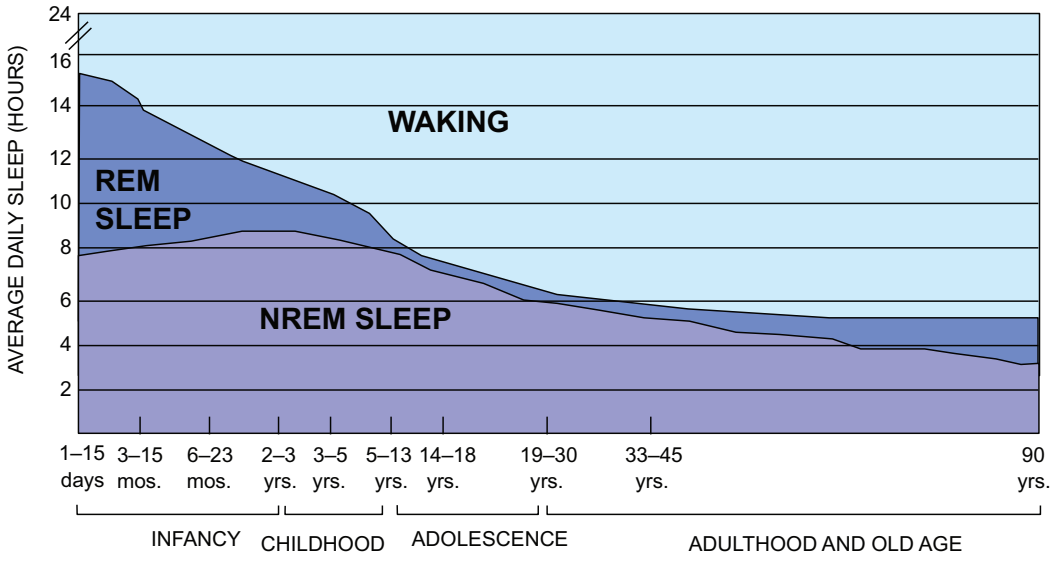

FIGURE 5.3
Developmental Changes in Sleep Requirements

Sleep changes in nature as children grow from infancy to adulthood. Overall, they sleep less, and the proportion of REM (rapid-eye-movement) sleep decreases sharply during infancy and childhood.

the unpredictability of sleep may result from the physical immaturity of the baby's nervous system: their brain may have frequent, accidental "storms" of impulses because it is not yet fully formed (Fransson et al., 2009; Sheldon et al., 1992). In most cases, the irregularities pose no problem to an infant, although as the previous "Focusing On" feature describes, in some children, irregularities of neural activity may be related to "crib death," or sudden infant death syndrome, in a very small percentage of infants. Once a baby's sleep begins to consolidate into longer periods of wake and sleep, these periods have a tendency to "drift" so that a baby who is mostly sleeping through the night one week may be awake most of the night a few weeks later, another reason new parents are so sleepy (Kaltman & Engelmann, 1953; Parmelee et al., 1964).

Parents' Response to Infant Sleep and Arousal

The unpredictability of infants' sleep can create chronic sleep deprivation in many parents; as a group, in fact, parents of infants and toddlers—along with older teenagers—are among the most sleep-deprived people in society (Coren, 1996). Research has demonstrated that new mothers obtain about seven hours of sleep each day, which is not significantly less than the average adult gets (Mongtomery-Downs et al., 2010). So why are new parents so much more tired than the rest of us? As noted previously, when babies wake up to be fed or changed, parents' sleep cycles are interrupted, causing sleep fragmentation similar to various sleep disorders (Insana & Montgomery-Downs, 2013; Montgomery-Downs et al., 2010). In fact, there is evidence that new fathers may be sleepier than new mothers are; most men do not get paternity leave and, therefore, cannot "make up" for disrupted sleep with daytime napping (Insana & Montgomery-Downs, 2013). Parents' fatigue is aggravated by living arrangements common in modern Western society. Unlike in many non-Western societies, where babies often sleep in the same bed the mother does (something that the American Academy of Pediatrics warns against), infants in our society are often "stationed" in an adjoining room, or at least in a separate bed across the room—an arrangement that makes assisting the baby more disruptive. Bedside sleepers, which provide infants with their own separate sleep area but are adjacent to the caregiver's bed, can make nighttime awakenings and feedings easier; however, it is pivotal for infants to be returned to their own sleep area after feedings (AAP Taskforce on SIDS, 2016). Furthermore, many non-Western households may have a number of adults or older relatives regarded as capable of calming a baby at night. In our society, in contrast, a household commonly has only two adults, or even just one. The scarcity of "qualified" helpers places a disproportionate burden of nighttime child care on parents, and eventually contributes to fatigue.

Infants spend more time sleeping than doing anything else. Unfortunately, their sleep may not occur at night, so chronic sleep deprivation and sleep fragmentation is a real problem for most parents, particularly primary caregivers. If possible, it is helpful for the caregiver to nap at the same time as the baby. However, because of discrepancies in the time it takes infants (sixty minutes) and parents (ninety minutes) to complete a sleep cycle, even this is not optimal.

Source: Alliance/Shutterstock.com.

The "cure" for nighttime fussiness eventually depends on physical maturation, but parents can also influence their infant's sleep patterns by developing regular (though not rigid) times for and methods of waking, feeding, and sleeping that involve the infant. One study found that infants change toward more adult-like levels of wakefulness and sleep within six weeks after arriving home, provided routines are (relatively) regular (Bamford et al., 1990; Rivkees, 2003). Another found that regularity offers dividends later in childhood: comparisons of Dutch and American families found fewer sleep problems among the young children of Dutch families, whose culture encourages regularity of daily routines more strongly than North American society does (Harkness & Keefer, 1995).

The advice to strive for (relatively) regular routines is widely supported among parent advice experts, but note that it makes assumptions about families that are not always true. In some families, routines cannot be made regular because of competing pressures from other children, because of exhaustion from work or from earlier ill-timed wakings or feedings, or because the family has only one parent. Under these conditions, parents need additional support from friends, extended family, or social service workers. They cannot do it all themselves.

What Do You Think?

How do parents deal with differences in children's sleep patterns? Ask a classmate or friend who is a parent of more than one child, or ask your own parent(s) how he or she responded to sleep differences in the children as infants. Combine your information with that of several other classmates. Do you see any trends?

TABLE 5.2 States of Arousal in Infants

State	Behavior of Infants
Non-REM sleep	Complete rest; muscles relaxed; eyes closed and still; breathing regular and relatively slow
REM sleep	Occasional twitches, jerks, facial grimaces; irregular and intermittent eye movements; breathing irregular and relatively rapid
Drowsiness	Occasional movements, but fewer than in REM sleep; eyes open and close; glazed look; breathing regular, but faster than in non-REM sleep
Alert inactivity	Eyes open and scanning; body relatively still; rate of breathing similar to drowsiness, but more irregular
Alert activity	Eyes open, but not attending or scanning; frequent, diffuse bodily movements; vocalizations; irregular breathing; skin flushed
Distress	Whimpering or crying; vigorous or agitated movements; facial grimaces pronounced; skin very flushed

Source: Ferber and Kryger (1995).

States of Arousal

As Table 5.2 shows, infants exhibit various states of arousal, from sleep to full wakefulness. As they get older, their patterns of arousal begin to resemble those of older children (Ferber & Kryger, 1995). The largest share of time, even among older infants, goes to the most completely relaxed and deepest form of sleep.

Obviously, a fully alert state is a time when babies can learn from their surroundings, but it may not be the only time. During REM sleep, infants' heart rates speed up in reaction to sounds, suggesting that infants may process stimulation even while asleep. But the meaning of a faster heart rate is ambiguous: changes in it may also show neural *dis*organization or an inability to shut out the world. However, getting a sufficient amount of high-quality sleep has been linked to better memory, language development, and physical growth among infants and toddlers (Tham et al., 2017).

Sensory Acuity

If you have not spent much time around infants, you may share William James's (1890) conclusion that "the baby, assailed by eyes, ears, nose, skin, and entrails at once, feels it all as one great blooming, buzzing confusion" (p. 462). William James was trained as a physician and was a professor of philosophy at Harvard University during the late nineteenth and early twentieth centuries. His writings on the intersection of physiology and philosophy helped to establish and shape the new discipline of psychology. James was pondering what parents have questioned for ages: how can infants, new to this world and with no knowledge or point of reference with which to interpret their experiences, interpret the information flooding their senses? What do they sense, and what is their understanding of it? Are they truly confused amidst the blooming buzz of sensory signals? Since James's 1890

description of infants, more than a century of research that utilized new methodologies and technologies revealed some surprising capabilities regarding the sensory acuity of infants.

Visual Acuity

Infants can see at birth, but they lack the clarity of focus or *acuity* (keenness) characteristic of adults with good vision. When looking at stationary contours and objects, newborns see more clearly at short distances, especially at about eight to ten inches—about the distance, incidentally, between a mother's breast and her face. Their vision is better when tracking moving objects, but even so their overall vision is rather poor until about one month of age (Seidel et al., 1997).

Visual acuity improves a lot during infancy, but it does not reach adult levels until the end of the preschool years. An older infant (age one to two) often has 20/30 or 20/40 vision, meaning he can see fine details at twenty feet that adults can see at thirty or forty feet. This quality of vision is quite satisfactory for everyday, familiar activities; in fact, many adults can see no better than this, without even realizing it. But this level of visual acuity does interfere with seeing distant objects.

Color vision also improves dramatically during the few months after birth. Specialized neurons called cones that are located in the retina at the back of the eye enable humans to see color, but these cones are immature at birth (Kellman & Arterberry, 2006). One-month-old infants can distinguish between black, red, and white, and their attention is drawn to bold, high-contrast color patterns. By approximately four months of age, their ability to see colors, including soft pastels and subtle differences between hues, is similar to that of adults (Franklin et al., 2005).

Auditory Acuity

Auditory acuity refers to sensitivity to sounds. Infants can hear at birth, but not as well as adults. Newborns receive an auditory screening at birth to detect for functioning of the middle and inner ear because early intervention is critical for children who have difficulty hearing (Wroblewska-Seniuk et al., 2017). Moreover, any sudden loud noise near an infant, such as that caused by dropping a large book on the floor, demonstrates that the infant can hear. Such a sound produces a dramatic startle reaction, called a *Moro reflex:* The neonate extends their limbs suddenly, sometimes shakes all over, and may also cry. Not all noises produce this reaction; pure tones, such as the sound of a flute, cause relatively little response. Complex noises containing many different sounds usually produce a stronger reaction; a bag of nails spilling on the floor, for example, tends to startle infants reliably.

Regardless of the type of sound, infants tend to exhibit a preference for higher-pitched sounds than lower tones. This fact has sometimes led some experts to suggest that infants have a "natural" preference for female—that is, high-pitched—human voices. Studies of voice preferences, however, have not confirmed this possibility consistently, probably because newborns' range of special sensitivity lies well above the pitch of even female voices and because male and female voices usually are more similar in overall quality than gender stereotypes suggest. Instead, it is more accurate to say that infants prefer sounds in the middle range of pitches, which is the range most similar to human voices, male or female. Research on infant auditory preferences has indicated that infants exhibit a distinct preference for human speech sounds over other human and nonhuman vocalizations (Shultz & Vouloumanos, 2010), especially those that are expressed in higher pitches (Fernald & Kuhl, 1987) such as the babbling of other infants (Masapollo et al., 2016).

Tactile, Taste, and Olfactory Acuity

Newborns and infants are sensitive to touch (i.e., *tactile acuity*), as all caregivers who have comforted a crying baby by swaddling the child in a blanket or by cradling the child in their arms can attest. Also, as will be addressed in the next section, infants respond reflexively to physical contact—turning toward a touch on the cheek or closing their hands around objects that touch their palms—abilities that are present at birth (Futagi et al., 2009).

What Do You Think?

Do parenting books agree with our comments that young infants have the use of vision and hearing? That babies can feel pain and have very well-developed senses of taste and smell? Check the comments made in two or three books about the capabilities of newborn babies. Do they seem consistent, or at least not *in*consistent?

Infants feel pain, although the degree to which infants experience pain is still being researched and is complicated by the subjective nature of the perception of pain (Warnock & Sandrin, 2004; Williams et al., 2009). For example, in one study involving a control group of newborns whose heels were pricked, the newborns cried loudly in response to the pain-inducing prick. However, an experimental group of newborns who were first given a drop of sucrose before receiving the heel prick exhibited little outward response to the prick (Harrison et al., 2010). Even though the neurological response between the control and experimental groups was similar, it suggested that unlike adults, the neurological experience of pain and the display of pain may be separate in infants (Fitzgerald, 2015). Current guidelines for painful procedures, such as circumcision, include nerve blocks and/or a topical anesthetic (Brady-Fryer et al., 2004).

As for taste and smell (technically called "olfaction"), infants reveal well-developed acuity, even prior to birth. Preferences for sweet tastes have been demonstrated by fetuses who swallow more frequently after an artificial sweetener has been added to their amniotic fluid (Booth et al., 2010). Infants smile and lick their lips when presented with sweet substances (Steiner et al., 2001), and they pucker and grimace when presented with sour or bitter substances (Kaijura et al., 1992). Researchers have argued that infant preferences for sweet tastes may have evolutionary survival advantages, as breast milk tends to be sweet (Liem & Mennella, 2002). Infants also respond with facial expressions that suggest pleasure or disgust when presented with pleasant and unpleasant smells, and by four days after birth, they can discriminate between their own mother's breast smell and that of another lactating mother, keeping their heads turned toward pads with their own mother's scent (Porter & Reiser, 2005), as well as the odor of relatives, which may affect attachment and future relationships (Schaal et al., 2020).

Given the remarkable sensory acuity of infants, parents may be partly right when they claim their newborn child recognizes them even from birth. What parents may be noticing is their newborn's immediate responsiveness to sights, sounds, smells, taste, and touch. They are right to exclaim over it: by taking an interest in the environment, infants create conditions where they can begin organizing (or *perceiving*) stimuli and attaching meanings to them. As we will see in the next section of this chapter, certain kinds of lines, shapes, and contours are especially interesting to a young infant. So are certain kinds of sounds. Fortunately for the development of family ties, parents are able to provide many of the most interesting sights and sounds with their own faces and voices; and partly in this way, attachments between parents and children are born.

Can infants feel pain? Any parent who has taken a baby to the doctor for a vaccination can attest that their baby feels pain.

Source: In The Light Photography/Shutterstock.com.

Motor Development

reflex An involuntary, automatic response to a stimulus. The very first movements or motions of an infant are reflexes.

Infants begin life with more than two dozen inborn **reflexes**, or automatic responses to specific stimuli. Table 5.3 summarizes the most important ones. A few reflexes, such as sucking, clearly help the baby to adapt to the new life outside the womb. Others look more like evolutionary vestiges of behaviors that may have helped earlier versions of *Homo sapiens* to cope, for example, by clinging to their mothers at the sound of danger. A few reflexes, such as blinking, breathing, and swallowing, persist throughout a person's life, but most reflexes disappear from the infant's repertoire during the first few months. Their disappearance, in fact, helps doctors to judge whether a baby is developing normally. Newborn reflexes that persist over many months may suggest damage to the nervous system or generally impaired development (El-Dib et al., 2012; Menkes, 1994).

TABLE 5.3 Major Reflexes in Newborn Infants

Reflex	Description	Development	Significance
Survival Reflexes			
Breathing reflex	Repetitive inhalation and expiration	Permanent, although becomes partly voluntary	Provides oxygen and expels carbon dioxide
Rooting reflex	Turning of cheek in direction of touch	Weakens and disappears by six months	Orients child to breast or bottle
Sucking reflex	Strong sucking motions with throat, mouth, and tongue	Gradually comes under voluntary control	Allows child to drink
Swallowing reflex	Swallowing motions in throat	Permanent, although becomes partly voluntary	Allows child to take in nourishment and to avoid choking
Eyeblink reflex	Closing eyes for an instant ("blinking")	Permanent, although gradually becomes voluntary	Protects eyes from objects and bright light
Pupillary reflex	Changing size of pupils smaller in bright light and bigger in dim light	Permanent	Protects eyes from bright light and allows better vision in dim light
Primitive Reflexes			
Moro reflex	In response to a loud noise, child throws arms outward, arches back, then brings arms together as if to hold something	Arm movements and arching disappear by six months, but startle reaction persists for life	Indicates normal development of nervous system
Grasping reflex	Curling fingers around any small object put in the child's palm	Disappears by three months; voluntary grasping appears by about six months	Indicates normal development of nervous system
Tonic neck reflex	When laid on back, head turns to side, arm and leg extend to same side, limbs on opposite side flex	Disappears by two or three months	Indicates normal development of nervous system
Babinski reflex	When bottom of foot stroked, toes fan and then curl	Disappears by eight to twelve months	Indicates normal development of nervous system
Stepping reflex	If held upright, infant lifts leg as if to step	Disappears by eight weeks, but later if practiced or in water	Indicates normal development of nervous system
Swimming	If put in water, infant moves arms and legs and holds breath	Disappears by four to six months	Indicates normal development of nervous system

The First Motor Skills

Motor skills are voluntary movements of the body or parts of the body. They can be grouped conveniently according to the size of the muscles and body parts involved. *Gross motor skills* involve the large muscles of the arms, legs, and torso. *Fine motor skills* involve the small muscles located throughout the body. Walking and jumping are examples of gross motor skills, and reaching and grasping are examples of fine motor skills.

motor skills Physical skills using the body or limbs, such as walking and drawing.

Viewed broadly, the sequence in which skills develop follows two general trends. The **cephalocaudal principle** ("head to tail") refers to the fact that upper parts of the body become usable and skillful before lower parts do. Babies learn to turn their heads before learning to move their feet intentionally, and they learn to move their arms before they learn to move their legs. The **proximodistal principle** ("near to far") refers to the fact that central parts of the body become skillful before peripheral, or outlying, parts do. Babies learn to wave their entire arms before learning to wiggle their wrists and fingers. The former movement occurs at the shoulder joint, near the center of the body, and the latter occurs at the periphery.

cephalocaudal principle The tendency for organs, reflexes, and skills to develop sooner at the top (or head) of the body and later in areas farther down the body.

proximodistal principle Growth that exhibits a near-to-far pattern of development, from the center of the body outward.

Gross Motor Development during the First Year

Almost from birth, and before reflex behaviors disappear, babies begin doing some things on purpose. By age four weeks or so, most babies can lift their heads up when lying on their stomachs. At six or seven months, many babies have become quite adept at using their limbs; they can stick their feet up in the air and "bicycle" with them while a parent struggles valiantly to fit a diaper on the moving target. At ten months, the average baby can stand erect, but only if an adult helps. By their first birthday, one-half of all babies can dispense with this assistance and stand by themselves without toppling over immediately (Savelsbergh, 1993). By age seven months, on the average, babies become able to locomote, or move around, on their own, although some children forego this step. At first, their methods are crude and slow; a baby might simply pivot on her stomach, for example, to get a better view of something interesting. Consistent movement in one direction develops soon after this time, although the movement does not always occur in the direction the baby intends!

Reaching and Grasping

Even newborn infants will reach for and grasp objects they can see immediately in front of them. They often fail to grasp objects successfully; they may make contact with an object but fail to enclose it in their fingers. This early, crude reaching disappears fairly soon after birth, only to reappear at about four or five months of age as two separate skills, reaching and grasping (Pownall & Kingerlee, 1993). During their second year, infants gain increased control over the movements of their fingers, producing a *pincer grasp* in which the thumb

The toddler on the left is watching his older, preschool-aged sister use a pincer grasp to perform a more precise operation using the toy tools on the workbench.
Source: Glenda/Shutterstock.com.

What Do You Think?

If motor skills develop primarily through learning, why not just deliberately teach infants to walk? What do you think would be the result of doing so? Do similar considerations apply for certain other important developments during infancy?

and forefinger are brought together to pick up small objects. These skills soon serve infants in many ways. For example, by their second birthday most babies can turn the pages in large picture books one at a time, at least if the paper is relatively indestructible. But they can also point at the pages without grasping for them. The pincer grasp also allows for improved self-feeding with their hands, fingers, and ultimately, utensils (Ho, 2010). For children who may be delayed in some of these tasks, early intervention resources may be available in the community, as you can see in the "Working With" featuring Rachael Staley later in this chapter.

Walking

A reasonably predictable series of events leads to true walking in most children; Figure 5.4 describes some of these milestones. While the development of walking, overall, tends to follow a progression of "stages," on any given day, infants will exhibit creativity and resourcefulness when it comes to their mobility, so caregivers should not be alarmed if their own infant moves around a room in a manner that is unconventional (Adolph, 2008). By about twelve to thirteen months, most children take their first independent steps. Well before two years, they often can walk not only forward but backward or even sideways. Some two-year-olds can even walk upstairs on two feet instead of on all fours. Usually, they use the wall or a railing to do so. Usually, too, coming downstairs proves more difficult than going up; one solution is to creep down backward, using all four limbs.

Cultural and Sex Differences in Motor Development

Differences in motor development exist among cultures and between the sexes, though they are not always large or dramatic. Certain African, Caribbean, and Indian cultures, for example, give their infants frequent chances to sit upright, exercise, be massaged,

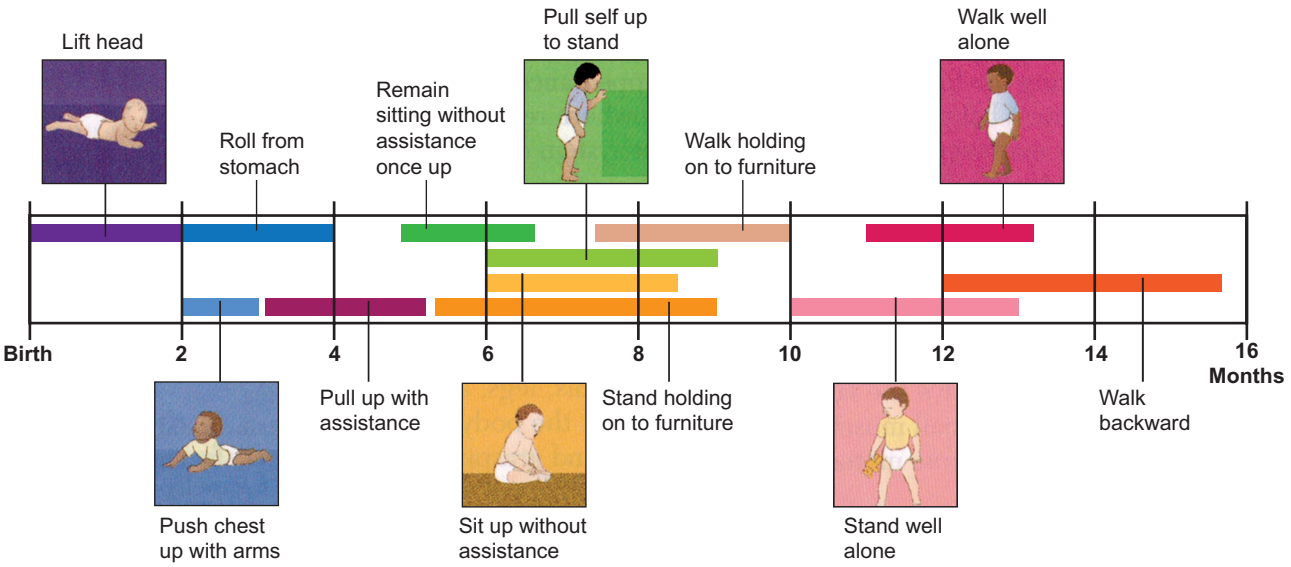

FIGURE 5.4 Milestones of Motor Development

Walking alone is one of the major physical achievements of the first year of life. Quite a few other physical skills usually develop prior to walking, as the figure shows. Note, though, that skills appear at different times for different individuals. Some skills may even appear "out of sequence" in some children.

and practice their "walking" reflex when held at a standing position by adults and older children (Karasik et al., 2010; LeVine, 1994; Munroe et al., 1981). These opportunities seem to stimulate toddlers in these societies to learn to walk earlier and better than North American toddlers do. Early walking, in turn, may prove especially valuable in societies that do not rely heavily on cars, bicycles, or other vehicles that make walking less important. Additional evidence that these early differences are due to environment is that in cultures for which walking is a primary means of transport, walking gait is adjusted to conserve energy, and in cultures that rely on running and hunting for food, the motor skills of adults outpace those of the typical North American adult (Karasik et al., 2010).

Yet differences in motor skills do not always appear where we might expect. Take the Navajo and Hopi tribes, whose infants spend nearly all of their first year bound and swaddled tightly to a flat board, with their arms and legs extending straight down along their bodies (van Sleuwen et al., 2007; Whiting, 1981). Apparently as a result, Navajo and Hopi toddlers do tend to acquire walking a little later than Anglo-American children do. But they do not show delays in other skills inhibited by swaddling—notably, reaching and grasping—and the deficit in walking disappears by the end of the preschool years in most cases (Connelly & Forssberg, 1997).

Culture aside, do boys and girls differ, on average, in motor development? The answer depends on distinguishing what infants *can* do from what they typically *actually* do. What they can do—their competence—has relatively little relationship to their sex. Girl and boy babies sit upright at about the same age, for example, and stand and walk at about the same time. Similar equality exists for all of the motor milestones of infancy.

How infants use their time is another matter. Almost as soon as they can move, boys show more activity than do girls. The trend begins even before birth, when male fetuses move about in their mothers' wombs more than do female fetuses (Moore & Persaud, 1998). After birth, the trend continues: girls spend more time using their emerging fine motor skills. Of course, the differences in use of time may stem partly from parents' encouragement (praise) for "gender-appropriate" behaviors. Given the young age of the children, though, and the fact that activity actually precedes birth, part of the difference must come from genetic endowment: an inborn tendency to be more (or less) active.

It is important to note that whatever their source, sex differences in infants' motor development are only averages and, in any case, rather slight. As groups, boys and girls are more alike than different, and numerous individual boys are less active than numerous individual girls, despite "average" behavior. As a practical matter, it is therefore more important for parents and teachers to respond to the qualities of the individual children for whom they are responsible than to stereotypical "gender" averages.

Swaddling of infants, as has been done with this baby, is practiced in many cultures. Swaddling improves the sleep of newborns (Van Sleuwen et al., 2007). However, if a newborn is tightly swaddled for most of the day, there is an increased risk of hip dysplasia, which could affect motor development (Short et al., 1996).

Source: atyana Vyc/Shutterstock.com.

WORKING WITH Rachael Staley, BSW, Director of Early Intervention

Rachael is the supervisor of the Early Intervention Department at the Allen County, Ohio, Board of Developmental Disabilities. She has worked with her agency for twenty years in several roles, including as a service coordinator, developmental specialist, and director.

Megan: *What made you want to work with infants and toddlers and their families?*

Rachael: I have always been drawn to children. When I was in college, I completed an internship with the Children's Developmental Center, a nonprofit organization that serves children aged eighteen months to five years old with special needs. This was where I realized my calling in life was to impact the lives of children with special needs.

Megan: *What are some common developmental issues for which you provide services?*

Rachael: Speech delay is the largest identified need of the children we serve in Early Intervention. We work with children who are identified [as needing services] or who have a delay in any of the following areas: speech, adaptive, fine and gross motor skills, cognitive, and behavioral.

Megan: *Once a child has been identified as possibly needing services, you do an in-home visit and assessments to provide individualized plans to families. What are some physical goals that are regularly included in those plans?*

Rachael: Due to the young age of the children we serve, all of our goals are parent-friendly and are linked to family routine. We go through a Family-Directed Assessment that maps out what the routines of the family are and see if there are specific areas that the family would like to address. We know from years of working with families that unless the family has identified it as a concern, and when it is linked to a routine, the family is more likely to address and work on those concerns. For example, "Kamilla will wave to Mom when she is leaving for work." This is addressing a physical and social goal of wanting the child to wave to Mom. We would be working on foundational physical skills in conjunction with social skills because Mom really wants Kamilla to wave when she is leaving. This is an excellent goal that is family-friendly and one that they will do daily.

Megan: *So it seems like there is a fair amount of domain overlap—that one goal might be focused on a physical act but includes aspects of social relationships and cognitive skills. How do you manage to do all of that skill building with such young children?*

Rachael: We are actively pushing our families to engage in meaningful play with their child. Making it fun! Having parents on the floor, actively involved with their child, following their child's lead,

Nutrition during the First Two Years

As obvious as it sounds, the physical developments in infancy depend on good nutrition throughout the first two years. Like adults, babies need diets with appropriate amounts of protein, calories, and specific vitamins and minerals. For various reasons, however, infants do not always get all the nutrients they need. Often poverty accounts for malnutrition: parents with good intentions may be unable to afford the right foods. In other cases, conventional eating practices interfere: despite relatively expensive eating habits, such as going to fast-food restaurants, some families may fail to provide their children with a balanced diet.

Compared with older children, infants eat less in overall or absolute amounts. A well-nourished young baby in North America might drink somewhat less than one liter (about .95 quarts) of liquid nourishment per day. This amount definitely would not keep an older child or a young adult well nourished, although it might prevent starving. In proportion to their body weight, however, infants need to consume much more than older children or adults do. For example, every day a three-month-old baby should take in more than two ounces of liquid per pound of body weight, whereas an eighteen-year-old needs only about one-third of this amount (Queen & Lang, 1993). If adolescents or young adults drank in the same proportion to their body) weights, they would have to consume six quarts of liquid per day. That is equivalent to twenty-five cups per day, or about one cup every forty-five minutes during waking hours!

WORKING WITH Rachael Staley, BSW, Director of Early Intervention (*continued*)

and doing what interests the child. Socially right now, there is so much on TV, tablets, and phones that we really want to encourage families to do play that is evidence based. It doesn't involve a tablet or device, and it utilizes the items that they have right in their home. It can be with pots and pans or noodles—it doesn't have to be fancy, store-bought toys. We do not take items into the homes. Rather, we utilize what the families have in their environment and let them know that what they have in their home is what the child needs and can play with.

Megan: *Can you tell me a little about the challenges and rewards of your work?*

Rachael: Our challenges can also be the rewards! Each day is challenging and rewarding. We get to go into families' homes and provide services and supports to them. The most difficult part, at first, is obtaining parents' buy-in. Our job is to empower parents because they are the ones who will make a difference in their child's life; it isn't the time that we come in and are doing "therapy." It is what *they* do after our visits implementing the strategies that we are giving them to impact their child. So that can be a challenge, but it is also the reward. We have the opportunity to walk with a family very early on and be a special part of their child's journey. The child may not remember us working with them; however, the parents never forget. That is the part I encourage my staff to remember: we are blessed to be a small part of a family's journey, and oftentimes, we are walking a path with them that they didn't think they would be on. A quote I found a couple of years ago really sums it up: "Our job is not to create the path, but to shine a light on it." That is truly what I feel Early Intervention does. We shine a light on a path that is sometimes very dim for a parent, allowing them to see the light at the end of the tunnel.

What Do You Think?

1. Rachael noted that she uses items in clients' homes to provide to children to lead the play. Think of items you typically have at home or in your dorm room that could be used to initiate fine or gross motor skills while playing with a small child. In a small group of classmates, compare your ideas.
2. One thing Rachael encourages families to avoid is relying too heavily on technology and screens, particularly for children two and under. Pair up with a classmate and talk about the costs and benefits of screens. If time permits, find an app or program targeting small children and evaluate what kinds of physical or verbal skills the program might nurture.

Breast Milk versus Formula

Someone (usually parents) must provide for an infant's comparatively large appetite. Whenever breastfeeding is possible, health experts generally recommend human milk, usually in conjunction with a vitamin D supplement, as the sole source of nutrition for at least the first six months or so of most infants' lives and as a major source for at least the next six months. After one year, neither breast milk nor formula is necessary, although some women choose to breastfeed longer. In some cases, of course, this recommendation proves difficult or impractical to follow. Babies who need intensive medical care immediately after birth cannot be breastfed without special arrangements. Some women have difficulty producing milk. Also, some women choose not to breastfeed. For example, if a woman is taking medications that might be passed on to the baby, if job situations make breastfeeding difficult, or if she finds breastfeeding inconvenient or uncomfortable, she may choose not to breastfeed. For these infants, formulas can be either safer or more convenient. Interestingly, several studies have shown that lockdowns and working from home, particularly during the early COVID-19 pandemic, were associated with higher rates of breastfeeding, especially for those with formal or informal support, and this was likely due to the flexibility permitted in day-to-day life during this time (Brown & Shenker, 2021; Dağlı et al., 2022; Lapillonne et al., 2023).

Why do pediatricians recommend breastfeeding? First, human milk seems to give young infants more protection from diseases, rashes, gastrointestinal ailments, and possibly ear infections (Oster, 2019). Second, human milk matches the nutritional needs of

human infants more closely than formula preparations do, and the makeup of human milk changes over time to meet infant nutritional needs, although current infant formulas are of high quality. Third, breastfeeding may encourage a healthy emotional relationship between mother and infant, simply because it involves a lot of close physical snuggling (La Leche League International, 1991). Breastfeeding also provides benefits to mothers: it is less expensive than formula, it is better for the environment, it helps reduce the risk of postpartum hemorrhaging, and it has been linked to a reduced risk of breast cancer later in life (Dermer, 2001; Oster 2019).

After about six months, infants can be introduced gradually to solid foods such as strained cereals mixed with breast milk and strained fruits. As babies become tolerant of these new foods, parents can introduce others that sometimes require a more mature digestive system, such as strained meats and cooked eggs. Overall, the shift to solid foods often takes many months to complete (see Table 5.4 for guidelines about how to do this). As it occurs, parents must begin paying more attention to their baby's overall nutritional needs because many solid foods lack the broad range of nutrients that breast milk and

TABLE 5.4 Changing Nutritional Needs during Infancy

Age	Parents May Begin
Birth–4 months	Complete diet of breast milk or baby formula, vitamin D supplement as directed
6 months	Puréed single-grain cereal, preferably iron-fortified; begin with one to two teaspoons and work up to one-half cup, twice per day
6–8 months	Puréed vegetables or fruit, one at a time; begin with one to two teaspoons and work up to one-fourth to one-half cup per serving, twice per day
	"Finger" foods (e.g., chopped banana, bits of dry cereal)
	Begin introducing potential allergens, such as mixing peanut powder thinned with breast milk.
10–12 months	Puréed meats or poultry, beginning with one to two teaspoons and working up to one-fourth to one-half cup per serving, three to four times per day.
	Soft but chopped foods (e.g., lumpy potatoes)
	Whole milk, one-half cup per serving, four to five times per day.
24 months	Milk, one-half cup per serving, four to five times per day.

Source: Adapted from International Food Information Council (1993), USNLM (2011), and Schroer et al. (2021).

In recent decades, increasing numbers of mothers have chosen to breastfeed their babies, as recommended by most pediatricians. For a significant number of parents and infants, however, partial or complete bottle-feeding remains a valuable option—for example, if fathers wish to be involved in feeding or if the mother's work schedule makes breastfeeding difficult.
Source: Krakenimages.com/Shutterstock.com.

formula provide. Foods that are common allergens, such as eggs and peanuts, should be introduced during the first year to reduce the likelihood that children will develop these allergies (Schroer et al., 2021).

Poor Nutrition

Often, North American diets fail to provide enough of three specific nutrients: vitamin A, vitamin C, and iron. Prolonged deficiencies of vitamins A and C seem to create deficits in motor ability, and deficiency of iron appears to lead to deficits in cognitive performance (Black et al., 2011; Pollitt, 1995). For about 4 to 5 percent of infants, these nutritional deficiencies are serious and require immediate remedy. For another group of about the same size, the nutritional deficiencies are less severe but are still a cause for concern. Worldwide, about half of all deaths among children under the age of five are due to undernutrition (UNICEF, 2020). If undernourishment is prolonged, it may produce a condition called **stunting**, which, as the term implies, results in stunted growth—specifically, falling below the fifth percentile in height for one's age when compared to typical growth norms (Abukabar et al., 2010). Although rates of stunting are improving, one in five children had stunted growth, with rates of 30 percent or more of children with stunted growth clustered in South Asia, eastern Africa, southern Africa, and western and central Africa (UNICEF, 2020).

stunting Being excessively short in stature—falling under the fifth percentile for height for one's age—caused by chronic undernourishment.

Even when undernourished infants appear healthy and "bright," they may be at risk for later developmental problems because poorly nourished families often experience other serious deprivations, such as poor sanitation, inadequate health care, and lack of educational opportunities. Under these conditions, it may not take much to turn mild undernourishment into severe malnutrition and thus reduce cognitive and motor performance to below satisfactory levels.

Overnutrition

In affluent, calorie-loving societies such as our own, the problem often is not lack of food but getting too much of calorie-rich, nutrient-poor foods. Social circumstances make it difficult for parents to keep convenience food and "junk" food from their children (or to avoid it themselves!). Food manufacturers and fast-food restaurants have discovered that foods sell better if they contain high amounts of fat, sugar, and salt and low amounts of fiber—all of which are violations of well-established nutritional guidelines (Wootan & Liebman, 1998). The short-term result during infancy can be **overnutrition**: too many calories, too much of the wrong nutrients, and not enough of other nutrients. The longer-term result can be to establish food preferences that may create health risks when the infant becomes a child and later an adult. A toddler who eats too much ice cream and chips may be "cute"; an adult who does so experiences greater risk for heart problems, diabetes, and certain forms of cancer (Bronner, 1997).

overnutrition Diet that contains too many calories and is therefore unbalanced.

Note that although overnutrition can increase an infant's weight, weight itself is not a cause for *medical* concern in infancy as long as the baby is only moderately above (or below) the average. Infants born bigger or heavier than usual tend to have diets relatively higher in calories. They also tend to drink more milk (via either breast or bottle) and other liquids than usual, and to shift earlier to solid foods. Some parents fear that heavier infants are prone to becoming overweight or obese as children or adolescents, but the evidence for this is inconclusive; some researchers have found that weight in infancy correlated little with weight in childhood and even less with weight in adulthood (Williams & Kimm, 1993). However, other researchers have found significant correlations between weight statuses during infancy (e.g., "overweight" or "obese") with weight statuses during childhood or adolescence (Gunnarsdottir & Thorsdottir, 2003; Harrington et al., 2010; Zhang et al., 2013). Parents sometimes feel concerned about a heavy infant for essentially social and psychological reasons: the paradox of a society that makes overnutrition too easy is that it also values thinness in physical appearance too much. As an infant grows into a child and then an adolescent, he or she will inevitably be affected by the social value placed on thinness. We discuss the results of this development in Chapter 11, in conjunction with discussing extremely overweight (or *obese*) children. In the meantime, though, it will be the child's parents who worry about weight on the child's behalf.

What Do You Think?

If you (or a partner) were expecting a child, would you prefer that the baby be breastfed or bottle-fed? Discuss this question with a classmate of the *same* gender; then compare your responses with those of a classmate of the *other* gender. Do your responses differ?

Impairments in Infant Growth

Within broad limits, healthy infants grow at various rates and become various sizes, and most of the time the differences are no cause for concern. But a small percentage do not grow as large as they should, beginning either at birth or a bit later during infancy. When a baby's size or growth is well below normal, it *is* a major cause for concern, both for the infant and for the infant's parents. At the extreme, it can contribute to infant mortality.

Low-Birth-Weight Infants

low-birth-weight A birth weight of less than 2,500 grams (about 5.5 pounds).

A small percentage of newborns are considered **low-birth-weight** infants if they are born weighing less than 2,500 grams, or about 5.5 pounds. The condition can result from several factors. One of the most common causes is malnourishment of the mother during pregnancy. But other harmful practices, such as smoking cigarettes, drinking alcohol, or taking drugs, also can depress birth weight. Mothers from certain segments of the population, such as teenagers and those from very low-SES backgrounds, are especially likely to give birth to low-birth-weight babies, most likely because of their own poor nourishment or their lack of access to good prenatal care. But even mothers who are well nourished and well cared for sometimes have infants who are smaller than is medically desirable. Multiple births (e.g., twins, triplets) usually result in small babies; so do some illnesses or mishaps, such as a serious traffic accident that causes damage to the placenta.

Consequences for the Infant

When birth weight is very low (less than 2,500 grams), infants' reflexes tend to be a bit sluggish, weak, and poorly organized (Brooten, 1992). Such infants do not startle as reliably or grasp as automatically and strongly at objects. Their muscles often seem flabby or overly relaxed. After delivery, the infants must cope with many tasks for which they are inadequately prepared physically, including breathing and digesting food. They also have trouble regulating their own sleep to keep it peaceful, sustained, and smooth.

Neurological limitations often can persist for the first two or three years of life, causing the baby to develop specific motor skills a bit later than other infants. A four-month-old baby who is small due to being born two months preterm, for example, in many ways resembles a two-month-old born at full term; both infants have lived eleven months from conception. Some of the delay may reflect stresses associated with early birth (such as parents' overprotectiveness) rather than the physical effects of early birth as such. Unless they are extremely small, though, most low-birth-weight infants eventually develop into relatively normal preschoolers (Goldson, 1992). This conclusion was supported by a sophisticated study of monozygotic and dizygotic twins in addition to single births that allowed the researchers to control for maternal, environmental, and genetic factors (Datar & Jacknowitz, 2009). The results revealed very small consequences of low birth weight on cognitive and motor development at age two for most of the children in the study, but negative effects on growth were still evident at age two. For children born very preterm (32 weeks or less) and very low birth weight (1,250 grams or less), cognitive issues with executive functioning, attention issues, and poorer academic outcomes are not uncommon, particularly among poorer families, up to the age of five or later (Linsell et al., 2016).

Consequences for the Parents

Although low birth weight can worry parents, the condition does not impair relationships with a child in the long term unless the parents are also under additional stresses elsewhere in their lives (Gross et al., 1997). In the short-term, though, low-birth-weight infants lack responsiveness, and initially need intensive care. These circumstances can create distance between parents and child at a time when parents want very much to reach out (literally and figuratively) and connect with their newborn. As the more mature members of the relationship, most parents are capable of understanding the reasons for the distance and of delaying their expectations for response from their child. The reflexive "social smile" normally shown at around two months, for example, may not come until age three or four months. If other stresses of life get in the way, though, waiting for the infant to finally "act normally" may be difficult or even impossible. Poverty, preexisting family conflicts, medical problems of parents, and the like put parents of low-birth-weight infants somewhat more at risk and in need of additional support from professionals, family members, and friends.

Failure to Thrive

An infant or a preschool child who fails to grow at normal rates for no apparent medical reason suffers from a condition called **failure to thrive**. About 6 percent of North American children exhibit this condition at one time or another, although not necessarily continuously (Cole & Lanham, 2011; Woolston, 1993). In some ways, the condition resembles malnutrition, especially when it occurs in developing nations. Failure-to-thrive and malnourished children both develop motor and cognitive skills more slowly than usual; both experience higher rates of school failure and learning disabilities; and both are more likely to live in disadvantaged circumstances and to have parents who are enduring physical or emotional stress.

failure to thrive A condition in which an infant seems seriously delayed in physical growth and is noticeably apathetic in behavior.

At one time, professionals tended to attribute failure to thrive to lack of nurturing and love between parent and child. A more complex picture may be closer to the truth: failure to thrive may have many sources, both physical and psychological, and depend on both the child and the environment. Consider this pattern: An infant has a genetically quiet, slow-to-respond temperament, making it more difficult for her mother to establish emotional contact. If the mother also is experiencing a number of other stresses (low income, illness, or disapproval of the new baby from others), the relationship between mother and infant is put at risk. A vicious cycle may develop of poorly timed feedings and ineffective efforts to nurture the infant, who persistently resists the mother's love and even her food. Parents in this situation often can benefit from professional help and support in learning new patterns of interacting with their babies.

Infant Mortality

In the past several decades, health care systems in North America and around the world have substantially improved their ability to keep infants alive. The **infant mortality rate**, the proportion of babies who die during the first year of life, has declined steadily during this century. In 1950 in the United States, about twenty-nine out of every one thousand infants died; in 2020, this number was 5.4 deaths out of every one thousand infants (CDC, 2022c). The averages conceal wide differences within society, some of which are listed in Table 5.5. In fact, there is also variability within the United States: infant mortality rates are higher in poorer states, like Mississippi, with a rate of 8.1 out of every one thousand births, than in California, with a rate of 3.9 out of every one thousand (CDC, 2022c). Families with very low incomes are about twice as likely to lose an infant as families with middle-level incomes. Likewise, African-American families are twice as likely as white families to lose an infant, perhaps because of the historical correlation of race with income level, access to health care, and institutional bias in the health care system and government. Generally, infants born to families with lower incomes are much more likely to die than infants born to families with higher incomes. Though this trend may be easy to believe when comparing poor with middle-income families, it actually holds for the full range of income in society (Finch, 2003; Pritchett, 1993). That is, infants born to middle-income families are *also*

infant mortality rate The frequency with which infants die compared to the frequency with which they live.

TABLE 5.5 Infant Mortality in Selected Nations

Nation	Infant Mortality (per 1,000 live births)	Nation	Infant Mortality (per 1,000 live births)
Japan	1.9	United Kingdom	4.1
Singapore	2.3	Canada	4.3
Finland	2.5	Poland	4.3
Norway	2.5	Hungary	4.7
Sweden	2.6	**United States, white**	**4.9**
Hong Kong	2.7	**United States, average**	**5.6**
Australia	3.1	Chile	6.2
Denmark	3.2	Russia	6.2
France	3.2	Mexico	10.7
Italy	3.2	Guam	10.8
Spain	3.2	Saudi Arabia	11.3
Austria	3.3	China	11.4
Belgium	3.3	**United States, Black**	**11.4**
Germany	3.3	Morocco	18.2
Israel	3.3	South Africa	27.8
Netherlands	3.5	India	35.4
New Zealand	3.5	Senegal	45.7
Greece	3.7	Afghanistan	104.3

Sources: CDC (2019b) and Central Intelligence Agency (2020).

more likely to die than infants born to extremely wealthy families. However, this does not provide us with a complete picture. In states with higher rates of structural racism, such as blunted educational attainment, lower incomes, poorer access to jobs, and higher rates of incarceration among African Americans, there is a 5 percent higher risk of infant mortality among Black infants (Wallace et al., 2017). This increase in infant mortality was not found among white infants, underlining the importance of reducing and eliminating structural and systemic racial bias in these systems.

On average, infant mortality rates in the United States and Canada are two or three times lower than those in many developing countries. Even so, infant mortality in the United States actually is *higher* than in numerous other developed nations, including Canada, Japan, Sweden, France, and Great Britain (Central Intelligence Agency, 2020). Cross-cultural investigations of infant mortality rates in European countries have given further clues about the reasons for the relatively high U.S. rate and have suggested ways to improve it. The research overwhelmingly indicates that parents need social supports as much as they need access to basic medical services and knowledge. Most European countries provide pregnant mothers with free prenatal care, for example, and also protect women's right to work during and after pregnancy. Pregnant women get generous sick leave, get at least four months of maternity leave *with pay*, and are protected from doing dangerous or exhausting work (such as night shifts). Moreover, many countries have generous postnatal leave policies for partners as well. Policies such as these communicate support for pregnant mothers and their spouses in ways not currently available in the United States.

Chapter Summary

- **What do infants look like when they are first born? How do we know if they are healthy?** The average newborn has rather red-looking skin, is often covered with a waxy substance, and has a skull somewhat compressed on the top. The health of newborns born in hospitals is assessed quickly after delivery with the Apgar Scale. The average newborn at full term weighs about 7.5 pounds. Regardless of cultural background, the newborn's bodily proportions make the infant look appealing to adults and may foster the formation of attachments with adults.
- **How much do children grow during infancy?** Infants grow very rapidly during the first two years of life, tripling their weight by their first birthday and adding approximately 50 percent to their length by this same time. The torso and limbs of infants grow more rapidly than their heads, enabling their bodies to slowly "catch up" to the advanced development of their heads.
- **What changes occur in the brains of infants?** The brains of infants gain mass rapidly during infancy due to important changes in the neurons and to infants' experiences with their environments. Neurons become myelinated, which improves their efficiency, and they form many new synapses as infants have new experiences and acquire new skills. The efficiency of the nervous system is enhanced by the synaptic pruning process that eliminates redundant or unused synapses.
- **How do infants' sleep and wakefulness patterns change as infants get older?** Infants sleep almost twice as much as adults do, but the amount of sleep gradually decreases as they get older. The interruptions in their sleep contribute to fatigue in their parents.
- **What motor skills evolve during infancy?** Infants are born with a number of innate reflexes, but quickly develop certain motor skills during the first year, including reaching, grasping, and walking. Motor skills develop differently depending on cultural background, biological sex, and social gender roles.
- **What do infants need nutritionally?** Infants need more protein and calories per pound of body weight than older children do. After weaning from breast or bottle, infants need a diet rich in protein and calories. Most North American families can provide these requirements, but many cannot. A common problem in North American diets is overnutrition, which can create health risks in the long term.
- **What factors can impair growth during infancy?** One of the most important impairments to early growth is low birth weight, because the condition leads to difficulties with breathing, digestion, and sleep, and impairs normal reflexes. The problems low-birth-weight infants experience can sometimes put stress on their relationships with parents, but not necessarily. For a variety of reasons, infants sometimes fail to thrive normally. Infant mortality has decreased in the recent past, but in the United States, it is still higher than it should be.

Apply It

Terry recently graduated from college with a degree in public health, and he has started a new job at his local health department doing program development and evaluation. During his tenure at his new job, he has noticed that there are many programs and resources for school-aged children but that programming for infants and toddlers is limited to breastfeeding support groups. Terry has decided to write a grant to obtain funding for a Toddler Time play group that will be hosted at the library. In the grant, he needs to outline how much money he will need for toys and supplies for the weekly Toddler Time group.

- Based on what you know about the physical and sensory abilities of toddlers, develop a list of ten toys that would be developmentally appropriate for the Toddler Time play group.
- Terry would also like to provide a nutritious snack for the children in the play group. With a classmate, develop a snack calendar of five different snacks that the Toddler Time group can rotate through.

Quiz Yourself

1. Compared with other periods of life, growth in infancy can be described as being more
   a. hidden.
   b. unusual.
   c. universal.
   d. slow.
2. The Apgar scale is
   a. the ratio of body length to body weight at birth.
   b. a measure of level of prematurity in the newborn.
   c. an early indication of intelligence in the newborn.
   d. a rating system used to determine the physical health of the newborn.

3. Babyish physical features tend to attract parenting and nurturing responses in
   a. humans only.
   b. lower animals only.
   c. many animal species, including humans.
   d. humans and some species of primates only.

4. What percentage of a newborn's sleep is REM sleep?
   a. 100 percent
   b. 75 percent
   c. 50 percent
   d. 25 percent

5. Which of the following is associated with a *lower* risk for SIDS?
   a. Avoiding use of humidifiers
   b. Having infant sleep on their back
   c. Having infant sleep in a separate room
   d. Using infant formula rather than breastfeeding

6. A newborn can see objects best at a distance of
   a. eight to ten inches.
   b. two to three inches.
   c. twenty-four to thirty-six inches.
   d. thirty-eight to forty-eight inches.

7. For what do infants show a taste preference?
   a. Sweet tastes
   b. Sour tastes
   c. Salty tastes
   d. Bitter tastes

8. Which of the following describes the rooting reflex?
   a. When the sole is stroked, the toes fan and curl.
   b. When there is a loud noise, the infant has a startle response.
   c. When the cheek is stroked, the infant turns in that direction.
   d. When held upright, the infant lifts their leg in a stepping motion.

9. Vinita, who is a new mother, asks her pediatrician when she should start her infant on solid foods. Her pediatrician's recommendation would most likely be to start around
   a. six months.
   b. nine months.
   c. three months.
   d. twelve months.

10. According to the current infant mortality rate in the United States, about how many deaths per one thousand infants occur?
   a. Three
   b. Six
   c. Nine
   d. Twelve

Answers can be found in the end-of-book Answers section.

Key Terms

Apgar Scale (p. 115)
central nervous system (p. 117)
cephalocaudal principle (p. 127)
failure to thrive (p. 135)
infant mortality rate (p. 135)
low-birth-weight (p. 134)
motor skills (p. 127)
myelination (p. 119)
neonate (p. 114)
neurons (p. 118)
non-REM sleep (p. 120)
overnutrition (p. 133)
proximodistal principle (p. 127)
plasticity (p. 118)
reflex (p. 126)
REM sleep (p. 120)
stunting (p. 133)
sudden infant death syndrome (SIDS) (p. 120)
synaptic pruning (p. 118)
synaptogenesis (p. 118)
transient exuberance (p. 118)