

## Strollers, Baby Carriers, and Infant Stress: Horizontal Versus Upright Transport in Early Infancy

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### **Introduction**

Countries in Europe seem to host the most pediatricians who recommend that babies should lay flat on their backs in a stroller in early infancy and not be carried due to avoid pressure on their underdeveloped bodies. Yet, laying a young infant on his back alone in a stroller is actually stressful both physically and emotionally and can be developmentally inhibiting. Being carried or worn in an upright position with proper leg support is not only developmentally sound but the preferable way to bring the baby along with you throughout your day. Upright carrying optimizes the physical, emotional and intellectual growth of your baby.

### **Spine Development in an Infant**

Our spine is not perfectly straight, even though it may appear so when looking at someone from the front or the back. When you look at a person from the side four slight curves are visible forming an elongated "S" shape. These curves help keep us flexible and balanced. They also

help to absorb stresses placed on our bodies through daily activities that impact our spine like walking, running and jumping.

We weren't born with these curves. Normal curves of the spine develop gradually. "They are formed as a consequence of adaptation to the external environment (gravity)"(Morningstar, 2005). At birth, babies are in a state of flexion, still curled up, with their spine in a natural long c-shaped (convex) curve. At first, a baby does not have the strength to hold his head up, nor the balancing curves in his spine to do so. But gradually as the muscles in his neck get stronger, he begins to lift his heavy head against gravity, and a curve starts to develop in his neck (the cervical curve) to help balance his head. When your baby starts to creep and crawl the lower back (lumbar curve) and the muscles that support it develop. Only by about the first year does your baby attain these curves in his spine(Leveau,1877).

### **At Birth**



The spine of an infant is C-shaped (a convex curve). He has neither the balancing curves nor the strength to his head upright.

## First Several Months



As your infant works against gravity his muscles start to develop. Strong neck muscles help an infant hold up a heavy head forming the neck (cervical) curve of the spine.

## Six Months to One Year



As an infant learns to crawl and stand, the lower back (lumbar) curve and his muscles develop so that he can stand upright. When he walks away from you on his own, only then are all of his curves developed.

### **Laying Flat is Stressful on Spine and Hips**

As shown above an infant's c-shaped spine doesn't stretch out immediately after birth. On the contrary, the s-shape of the spine is not fully developed until he starts to walk on his own. Laying your young infant flat on his back is not gentle on his spine. In fact, it is stretching the c-curved spine into a straight line. It is actually stressing the infant's spine instead of supporting its natural shape. Research shows that keeping an infant's spine straight is not a sound

physiological position. In addition to stressing the baby's spine it can also negatively influence the development of your baby's hip joints (Kirkilionis, 2002).

### **Laying Horizontal Causes Physical Deformities**

Not only is spending most of the day flat on your back bad for your hips but infants who lie frequently on their backs in a stroller may end up with plagiocephaly (deformed skulls, flattened on the back or side) and deformed bodies with poor muscle tone (Bonnet,1998). Research backed by the American Academy of Pediatrics states that "with prolonged immobilization on a firm mattress or a flat bed (as in a stroller), the constant influence of gravity flattens the body surface against the mattress producing positional disorders and infants with decreased muscle tone (Short, 1996)".





Plagiocephaly in an infant corrected by helmet to reshape her head

### **Existence in Containers**

This does not mean that laying flat for a couple of walks around the block in a stroller is going to reek havoc on your baby's physical development. But the truth is that the average Western infant between three weeks and three months of age is carried a little more than two and a half hours a day (Heller, 118.) We end up carrying the baby to the car in a container, through the store in a container, to eat lunch in a container, back to the car in a container and home in a container\*. Sometimes from there to the swing that we can click right into without touching the baby so we can make dinner, into the bouncy seat while we eat, and soon after to sleep in a crib. The west has diverged from eons of child rearing and have gotten to the point so that objects are defining our baby's existence more so than our bodies.

"To remove the newborn baby from his mother and place it on its back or on its front on a flat surface, often uncovered is to fail to understand the newborn's great need for enfoldment, to be supported rocked and covered from all sides, and that the infant may only gradually be introduced to the world of more open spaces. From the supporting, continuous, tangible presence of his mother the infant will gradually come to move some distance toward the outside world". (Montagu, 294)



Sometimes containers may help us out for short periods of time and free our hands. Yet, no container can replace a mother's arms.

\*Please note that the author does not mean to imply that a baby carrier should replace your car seat for transport while in the car. Never drive or carry your baby in the baby carrier while in a moving vehicle.

### **The Fetal Tuck**



Newborns are virtually impossible to stretch out unless wrapped or swaddled. When you place an infant flat on his back, his thighs will usually be pulled up towards his chest (Schon, 2007), or

when sleeping straddled and bent in a frog position. "The fetal tuck, the natural position of babies is the most calming and the most adaptive.

Infants use less oxygen which conserves energy and waste less calories and they digest their food better. It is also the best position for thermoregulation because of reduced stomach exposure. We have more efficient temperature regulating cells and more fat on the back side of our bodies as well. When we hold our infants stomach to stomach we are protecting all the receptor and vital organs (Montagu, 1986).

The instinctual flexed widespread legs that an infant maintains when picked up, coupled with the palmar plantar reflex that helps an infant to cling to his mother, suggests that infants little bodies are adapted to be carried upright and oriented toward their mothers.



By holding your baby with his knees flexed flat against your chest and supporting the his bottom you are supporting your baby in the natural position that his body instinctively assumes to ensure that he is comfortable, warm and safe.

### **Carseats**

If the stroller positions the baby in a somewhat upright position (like in infant car-seats) it may be gentler on the baby's c-shaped spine in that it is not stretching it flat. However, although it may seem like gentler option for transporting your little one around, research by the International Chiropractic Pediatric Association shows that car seats are not the ideal transport for your infant due to "restricted postural options which can impact your baby's developing cranium and spine" (International Chiropractic Pediatric Association).

By keeping and maintaining the spine in a c-shaped configuration these contraptions can actually prevent and inhibit the natural curves forming. Babies can have a hard time acquiring

adequate muscle strength to hold their big heads up if they don't get much of a chance to deal with gravity.



This baby is enjoying a nap outside near the peonies. Although the car seat does support her spine and head and neck while she is napping, when she is awake the straps prevent her from working her muscles to hold up her own head. Many babies spend most of their waking hours in restrictive seats like these.

### **Carrying Upright Allows for Positive Physical Development**

When infants are held upright, however, they are allowed to practice compensatory movements enhancing muscular strength and allow them more control over their fine motor skills. When the mother walks, stops, or turns an infant's body naturally works against the pull of gravity to maintain his position. The force of gravity is a positive element in infant development allowing infants to learn from early on to hold their heads up and keep their bodies clinging to the mother and balanced in equilibrium.

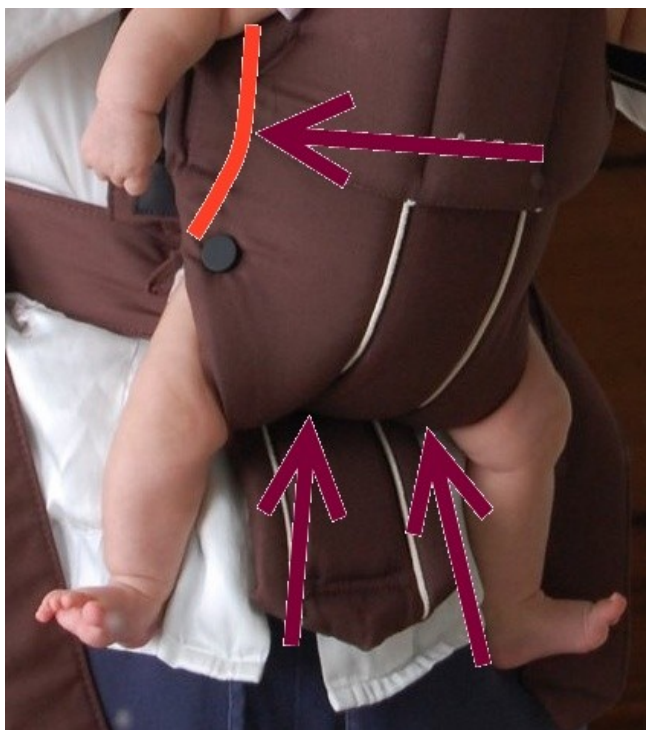
### **Discord with Upright Carrying**



So why do some still claim that the horizontal position is better for your infant? The physiological arguments as to why a baby should be transported in a horizontal position for his first months of life seem to stem from the assumption that the upright position may be stressful to his underdeveloped spine and pelvis.

Although some pediatricians are advocates of natural parenting, many don't have that much hands on experience with baby carriers. They may be acquainted with the upright carriers from the eighties and nineties with the typical lack of adequate head/neck support, tight or chaffing leg holes, leaving babies to dangle from the crotch due to complete lack of leg support. Perhaps they have seen so many babies facing out when carried upright that they assume all upright carrying is nonsupportive.

It may be that the studies of the Inuits and their high prevalence of spondylolisthesis or the Navajo Indians and their high prevalence of developmental dysplasia of the hip (DDH) is enough evidence from babywearing cultures to close the book- deem all upright baby carriers harmful- and recommend strollers as a safer option of transport.



The images above are perhaps the carriers that many doctors imagine and classify as unsafe or harmful. Both are nonphysiological carrying devices. These front-facing carriers unlike wraps, slings, mei-tais and soft structured carriers, do not provide proper leg support which can make their pelvis tilt backward and place them in the dangerous "hollow back position".

Not facing the carrying adult, and facing out their center of gravity is off. Pressure is placed on the baby's shoulders and the chest area, often retracting the shoulders and hollowing the back even more. Facing out is a nonphysiological position that places pressure on the inner thighs of the baby and the base of the spine. Upright carrying facing out is stressful on babies.



The wider base of the above carrier would provide some spinal support (maintaining the natural convex "c-shape") if the baby was turned facing the mother and his bottom was seated in it. Instead the baby's spine is straightened and often hyperextended (concave "hollow back" shaped) due to weak abdominal muscles and lack of leg support.

When an infant is carried in a baby carrier he should be oriented toward the mother and ideally the fabric should extend to the back of the knee to adequately support the legs, which in turn positions the pelvis, and then supports the spine properly. Although the baby does benefit from being carried close to his mother, facing out in this position there is no leg support, improper spine and hip support, and no head or neck support if the baby falls asleep.

### **Swaddling Infant Legs linked to Hip Dysplasia**

Although there is a myriad of psychological, emotional and physiological benefits from the swaddling style of the Navajos, there is clear evidence that swaddling the legs, so that they were bound together and not allowed to flex at the knee or at the hip, lead to hip abnormalities (Crisholm, 1983). In the case of the Navajos, stress to the hips of the infant was not caused by the upright positioning but from improper leg support, by not allowing the legs to spread or the knee to freely bend (Van Slewen, 2007). By not allowing the head of the femur to sit in the socket, due to forced straightening of the legs, the socket often did not develop properly causing Developmental Dysplasia of the Hip or DDH (Crisholm, 1983).

Although carrying your young infant laying in the horizontal position with legs together in a baby carrier (like a sling or a wrap) provides adequate spinal support, it is not the optimal nor the preferred position for hip development or prolonged carrying, especially if there is congenital dysplasia present in the infant.

The American Academy of Pediatrics released a review of swaddling under Van Slewen in 2007 that reaffirmed that infant's legs should not be tightly swaddled. In 1965, the incidence of DDH (developmental dysplasia of the hip) was high in Japan when a swathing diaper was used widely by the population. The swathing diaper kept the hips together. However eight years later in 1973, doctors advised mothers to avoid "prolonged extension of the hip and knee of infants during early postnatal life". Soon after experts reported a marked decrease in infants with DDH (Van Slewen, 2007) .



Babies love to be contained and enclosed but straightening their legs goes against their instinctual position of flexed widespread legs. This baby is swaddled so that the legs are wrapped loosely and not forcefully straightened.

### **Harmful Hollow Back Position**

The Inuit's use of papooses, which also inadequately support the legs and retract the shoulders, places the spine in a compromising "hollow back" or hyperextended position. With unsupported legs and very weak abdominal muscles the pelvis tilts back in the infant and hyperextends his back. Taking in the pressure produced with each step the mother takes on his hyperextended spine is stressful on an infant.

The development of spondylolisthesis, the slipping of the vertebrae to compensate from repeated stress (usually on a hyperextended spine) is pretty common in gymnasts and weight lifters. It is also unusually high in the Inuit and Athabaskan populations- where nearly half may be afflicted.

Yochum and Rowe suggested that the Eskimos, who carry their infants in a papoose, place undue amount of premature stress on the pars (part of the vertebrae) and explains the high prevalence of (isthmic) spondylolisthesis in their population. Since no one has ever been born with spondylolisthesis Yochum and Rowe dismiss the possible genetic element as the cause instead favoring the papoose (a nonphysiological carrying device) as a more favorable explanation to the cause of the disease (Wong, 2004).

Although different in appearance, any modern baby carrier that does not support an infant's legs (in a flexed abducted position oriented toward the wearer), any front facing carrier with leg holes is no more developmentally sound than a papoose, as these carriers retract the shoulders and create the stressful "hollow back" position. Lacking proper leg support infant biomechanics when worn in papooses, cradle boards and front-facing baby carriers with leg holes are very similar, pinning the shoulders back and placing all the child's weight on his crotch or the base of the spine.



Navajo Cradleboard Inuit Papoose on left . Baby with swaddled legs in a nonphysiological position to the right.

### **Flexed Abducted**

Upright baby carriers that support the legs carry a baby as a mother would naturally would in arms do not compromise a baby's spine or hips (Kirkilionis, 2002). When an infants legs are flexed and straddled, the instinctive position that his little body assumes when picked up, the

head of his femur (bone of the thigh) fills out the hip socket (acetabulum). The hip socket is filled most evenly when the legs are pulled up to roughly 100 degrees and spread roughly 40 degrees at the same time (Kirkilionis, 2002). DDH does not occur when an infant's legs are supported. Actually this is the position that doctors advocate as treatment for babies with hip dysplasia.

Interestingly enough the Netsilik Eskimos who are big babywearers don't use papooses but carry their infants in their amautis or their parkas. They assume a seated straddling position on their mother's back inside their coats (Montagu, 1986). There have been no studies indicating prevalence of either DDH or spondylolisthesis in this northern Eskimo baby carrying group. Their hips and spines develop normally.



This baby's spine, hips, and legs are supported. A mother using either her arms or a simple piece of cloth, supports her baby's legs in a flexed (with the knees bent) abducted (away from midline) position supporting the hip and the spine. Instead of fabric at the crotch which contributes no leg support, or swaddling the legs which is too restrictive, ergonomic carriers put the baby in the position that supports the legs just as a mother's arms would. The flexed abducted position is what infants are hard-wired to assume when picked up. (Schon, 2007). It is what nature intended- legs spread around the mother's hip, back or torso with knees bent in a seated position.



A mother's arms supports the baby's bottom and legs. Subsequently, pressure is taken off the spine and the weight of the baby is evenly distributed in an ergonomic position.



The fabric is pulled to the back of the baby's knees offering proper leg support. The legs should be pulled to at least hip level for optimal positioning and proper hip development.





The photo above shows proper spine position, oriented toward mother, proper leg support, proper head/neck support.

### **Improved Respiratory Patterns**

Proponents of horizontal positioning in early infancy may be concerned with whether the infant actually receives adequate levels of oxygen while being carried as compared to in a stroller. According to Dr. Maria Blois, premature infants placed in an upright position on their mother's chests had improved respiratory patterns and are more regular than in an incubator.

They also showed "reduced episodes of sleep apnea (temporary cessation of breathing) and bradycardia (slowing of the heart rate). Transcutaneous oxygen levels do not decrease indicating that oxygen saturation is not compromised". These studies were done on premature infants some weighing as little as three pounds, placed upright on their mother's chest. The preferred position for these tiny three pound babies is upright- usually secured by a piece of cloth. They thrive upright on their mother's chest and are almost allowed to leave the hospital earlier than little preemies left in incubators.(Blois,72). If the upright position is the preferred position for a three pound preemie, it doesn't make sense that it could be harmful to a newborn.

### **Prevents Ear Infections**

Laying horizontally is not only a poor option for your baby's spine, hips, and cranium, it can also be a major contributing factor inner ear infections in infants. Gastric reflux of contents into the middle ear causes ear infections. Gastroesophageal reflux disease or GERD can be pretty prevalent in infants as sphincters tend to take a while to fully close.

Infants diagnosed with GERD are advised to be carried upright to ease the symptoms. Yet as infants are frequently placed lying in the horizontal position, not only are the symptoms exacerbated, but gastric juices can enter the immature Eustachian tubes easier making reflux from the throat into the middle ear more probable. The same may occur when bottle fed infants are fed positioned flat on their backs and not slightly upright as milk may enter into the middle ear.

The build up in the Eustachian tube can cause inflammation and a build up of bacteria and subsequently an infection. Wearing your baby upright can actually be a preventative measure against ear infections and can help ease the symptoms of GERD(Schon, 2007).

### **Upright Position Tunes Vestibular System**

An other benefit of carrying your baby is that carried babies receive a lot of vestibular stimulation whereas lying babies do not. Our vestibular systems helps us out with our sense of balance and our security in space. When a mother holds her baby, the baby moves back and forth with mom's walking and side to side from her swaying or rocking. Mom may stop and turn and reach to grab something or she may moves gently smoothly. All of these varied movements force her baby to respond appropriately to keep himself balanced. All of these movements tune her baby's vestibular system.

When pushed in a stroller the movement is either forward or backward planar movement and not very varied. When changed from the upright position and the containment of his mother's arms to the horizontal position laying down uncontained a baby may produce random movements and suddenly flail his arms and legs as if to save himself from falling. This is called a baby's Moro Reflex. It acts as a baby's primitive fight/flight reaction and is replaced later in life by an adult 'startle' reflex.

Carrying, rocking and swaying stimulates an infants' vestibular apparatus and helps them to feel secure in space. Most babies today spend most of their day apart from their mothers in a container or in a stroller leaving them prone to vertigo, and a feeling of physical insecurity in space in general. Native Americans are typically very secure in space are actually known for their comfort with heights and apparently tend to have little problem washing skyscraper windows. Most Native Americans were swaddled or spend most of their infancy either in cradleboards or on their mothers hips owing to enhanced vestibular development. Interestingly enough, the fear of flying and the fear of heights which plagues many of today's adults can often be traced back to not being carried as an infant. Carried babies feel secure and are less apt to develop space related phobias. (Montagu, 1986)



### **Upright on Mother's Chest- Learning all the Time**

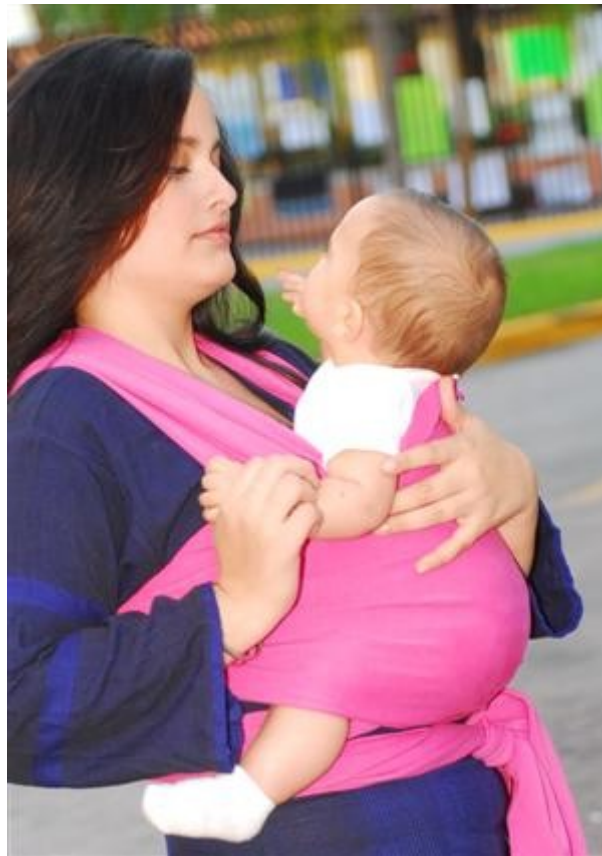
Babies have reason to feel secure. They physically need to be in close contact with their mothers. They giggle and coo and drink in all of our expressions. Upright on mother they are able to view the world unobstructed from a safe place and can learn about all around them at their own pace. Not only are babies better off physically, in the upright position they are happier and calmer when held upright. Dr Sharon Heller states,

"The more time that babies spend vertical, the more time that they are alert and calm. Even newborns who spend most of their time sleeping, stop crying and perk up when picked up and placed on our shoulder. Interestingly, how alert a newborn is relates to *where* he is. Upright in

an infant seat, he is less alert than when upright in arms... Vertical positioning as optimal in infants makes perfect sense. Think of how much time our infants spend horizontal- flat on their back in a crib or a buggy. Might this affect their alertness? There's a good chance... Researchers found that infants too young to sit independently learn more when placed in a vertical position."(Heller, 94)

### **Upright on Mom's Chest Stimulates all the Senses**

And what an incredibly stimulating environment. Not only can the infant learn about the world around her from all the different sights she sees, she is in the state of mind to do so. When an infant is calm but alert, that's when all the information is allowed to permeate into his being. He finds out about the world and his place in it.



"Our body is a sensual cornucopia where smiles, aromas and laughter mingle amid undulating caresses that put the entire sensory world at our baby's fingertips. Our baby gets tactile or cutaneous stimulation from our skin touching hers and proprioception from the pressure of her limbs flexed into our body. She gets tactile, olfactory, and gustatory stimulation if we nurse, of our milk, and vestibular stimulation from the gentle stimulation of our movements and, when held upright, from her efforts to right her head and maintain her balance. She gets visual stimulation when she looks all around her, auditory impulses as we whisper endearments, and kinesthetic stimulation as we change her to the other side... when we put our babies in a container, and especially if out of sight all of this sensory nourishment is lost." (Heller,112)

### **Autonomic System Regulation Easier**

The mother/infant relationship actually provides physiological regulation of the infant's autonomic system. Studies have shown that when an infant is taken away from his mother he experiences a "decreased heart rate, temperature decreases, sleep disturbances and EEG changes"- representing an impairment in the regulating processes of his own little body (Archer, 1992). On separating mother and baby, his immune system weakens. His body literally stops producing as many leukocytes. But when mother rejoins him, he strengthens again (Montagu, 1986). An infant's body physically needs his mother present to help regulate his own body.

### **Mechanistic Child Rearing and Dissuasion of Infant Carrying**

With all the studies and the clear physical benefits of carrying a baby upright on mother's chest hard to understand a pediatrician's ambivalence on the matter or outright scorn when his patients choose to do so. Perhaps the reason for not supporting upright carrying may be that they want to discourage mothers from spoiling their babies or to prevent the mother and baby from getting too close or attached to each other.

Straying from wearing our babies may be linked to the old school of thought in which dates back to 1928 when the famous behaviorist Doctor Watson set out to change the course of humanity and make infants independent, strong and tough. His theory was that we were all born basically a blank slate- ignoring any evolutionary hard wiring or any inborn biological tendencies- and that in order to "form" an independent child it was necessary to prevent the newborn baby from creating dependent habits. In other words, if you hold on to your baby he will cling to you and never let go. He will be needy. Not only should you withhold from carrying your baby but cuddling, kissing and rocking him too; if you show affection, your baby will expect it.

So many of our grandparents and parents were influenced by this mechanistic train of thought, pressured by the experts to believe that if we picked up their babies when they cried that we would create a tyrant of a child and become enslaved. Unfortunately this psychology had a profound effect upon pediatric thinking and practice and even pervades into conversations between mothers and doctors today. (Montagu, 1986)



### **Evolutionary Need For Touch**

Most mothers are still pressure to carry out the harsh parenting methods that were inculcated into our grandparents and our parents. Yet, these mechanistic methods only go back so far. Anthropologist James McKenna claims that with our babies more often in a type of container than in our arms, they are at "odds with evolution". "Virtually all of our biochemistry and physiology are fine-tuned for the conditions of life that existed when we were hunters and gatherers, in which babies were held by their mothers. Our culture may be changing, but our evolutionary need for touch remains the same.

Babies' brains have evolved to expect closeness and proximity-to be held- for their safety, their psychological growth, physical growth, mental growth, to aid and stabilize their physiological processes and keep their immune systems strong" (Field, 69-74). "Touch is not an emotional fringe benefit. It's as necessary as the air we breathe" (Heller, 5).



**Making Carrying the Rule of Thumb**



Even though most Western parents cannot conceive of life without a stroller, they are not as gentle on an infant as we assume them to be. Placing an infant alone on his back for long periods of time is not what we as humans are hard-wired to expect. Laying horizontally in early infancy is not easier or less stressful on an infant's spine, skull, or neck. Upright on mother's body, mom adjusts to all her baby's movements, and he to hers, moving like perfect dance partners. The two create a rhythm together, physically, and psychologically and move together in sync. Even the most state-of-the-art strollers can't provide the warmth that a mother's body does, her comforting smell, the varied movement, and the sensitive motherly responses that are so essential to her baby's healthy growth and development, especially during such a critical period when his brain is growing more than any period in his life. No toys can match the joy that an infant gets from his mother's face. Alone, gazing up at a fabric liner with which the manufacturer chose to line the stroller, is no comparison to the rich environment he witnesses and observes himself when he moves together through the day with his mother.

Strollers are not "bad" per se. To go further, babywearing and strollers need not be mutually exclusive as long as an infant is content and his cues are responded to when he signals that he needs to be held (seated and facing his mother is preferable to encourage interactions and communication) (Zeedyk, 2008).

### **Conclusion**

Laying babies flat on their backs in a stroller is actually not easier on their necks, spines, hips, or their minds. Nature intended for babies to be carried. Upright positioning with proper leg support is the preferable position for your infant and is gentle enough not to physically stress even tiny three-pound babies. A mother should trust what her heart tells her, by holding baby close to her heart she will not only be choosing the most beneficial and physically supportive method of bringing baby along with her, she will be providing the optimal environment for his psychological and emotional growth as well.

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