

## Perinatal Stress Reduction, Music and Medical Cost Savings

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**Abstract:** None available.

**Full Text:** Headnote ABSTRACT: The author uses his experience as an anesthesiologist involved in music medicine to discuss the psychophysiology of perinatal stress. The use of music as an adjunct to medical care for mother and child in the prenatal and postnatal period, as well as the implications for improved outcome and medical cost savings are addressed. The importance of the fetal auditory environment as a conduit for communication and learning is also examined. From the viewpoint of the anesthesiologist, consciousness is manipulated both chemically and psychotherapeutically to result in decreased pain, altered recall, and a decreased stress response. One of the common elements in my work has been the use of stress reduction techniques during various states of consciousness. I have found that both anesthesia sedation and general anesthesia can open up pathways in the mind to healing therapies. Music and guided imagery can also have powerful healing qualities. When used together during anesthesia, these audio therapies can be used to complement the stress reducing properties of anesthesia and promote faster healing. Some of the benefits of music in the labor and delivery suite that complement anesthesia are that it speeds up labor and decreases the amount of pain. It also decreases the stress response to labor which is beneficial to both mother and newborn. Couples coming to a delivery suite frequently perceive it as a foreign and unfamiliar environment. The act of choosing a musical program for childbirth allows a couple to exert some control over their environment. Music is very personal in that a particular piece may have a connection with certain past experiences and emotions. This acoustical painting of the hospital environment has been shown to make it less hostile and less anxiety provoking for patients. Since pain and enjoyment emerge as two distinct, though related dimensions of the birth process, music can express both the struggle and the joy of the occasion. The beauty here is that the benefits of the music can be utilized during natural childbirth, with childbirth under epidural anesthesia, and if need be during Cesarean section. Music can help the newborn know that a special event is happening and when the newborn comes into this world the music along with the familiar sound of voices is indeed special. Music is particularly useful during Cesarean sections. Most anesthetics for C-sections are performed under epidural or spinal anesthesia. The pregnant mother is anesthetized from the chest down. Usually no intravenous sedatives or narcotics are given to the mother until the baby is born, because these can cause sedation or respiratory depression in the newborn. There is often some degree of discomfort for mother before the baby is born, when the uterus is manipulated. Music is an effective way to decrease the discomfort here. I try to get a feel for what the couple and their unborn child find soothing. If they do not have an idea of what they want to hear, I usually suggest classical music or new age music. To me, this type of music fits beautifully with C-sections. To give you an idea of the contrast of requests I have had I will relate to you a Friday evening when there were 3 Csections in a row to do. The first 2 were done to Beethoven Piano Sonatas. Our last couple was asked what they and their baby wanted to hear, and the mother replied, "My baby only likes rock and roll, but you have to play it real loud." She picked Bruce Springstein's Born in the USA and this did seem fitting for the occasion.\* An exaggerated stress response has negative effects during pregnancy and childbirth, just as it is detrimental in most disease processes. Most of the physiologic effects of stress are mediated through stress hormones called catecholamines. In the pregnant patient, elevated levels of these stress hormones cause decreased effectiveness of uterine contractions (Simkin, 1986). Some of these patients end up needing C-sections because of this. Intense anxiety has been associated with fetal death in the third trimester (Myers & Myers, 1979). More commonly, the extremely anxious patient in labor will have high catecholamine levels which

decrease placental blood flow and can cause fetal distress. This is further compounded if the laboring patient hyperventilates, which can further decrease placental blood flow. Music's ability to slow respiratory rates and decrease the stress response is beneficial during labor. It has been shown to have the ability to shorten labor (Winokur, 1984). Even when the course of labor does not speed up when music is utilized, the perceived length of labor decreases (Clark, McCorkle & Williams, 1981). Other studies have shown that when music is played, pain is decreased (McKinney, 1990, Hanser, Larson & O'Connell, 1983). During my wife's first pregnancy, I began to think about the environment of our unborn child. I knew that the fetus could respond to music and sound in the womb and I became fascinated with the implications of the constant exposure of the fetus to placental blood flow sounds. Some earlier studies had been done by Dr. Lee Salk (1973), who noticed that most new mothers exhibited a natural preference for holding their infants on the left side of their chest near the heart. Dr. Salk analyzed a number of then popular books containing a large number of photographs and artistic representations of infants and adults. Almost 80% of these showed mothers holding their infants on the left side of their chests. This preference extended across all cultures. Balancing groups for left and right-sided dominance, Dr. Salk then replicated this left-sided preference in a large group of new mothers and babies (and used these heart sounds to calm newborns in the hospital nursery). He reasoned that there is an imprinting of the placental sound in utero so that similar sounds after birth have a functional connection with the original experience. This would explain some of the rhythmic similarities of modern music to intrauterine rhythms. Others have connected the similarities between womb sounds and the "nonsense sounds" that mothers use in talking to their babies. Some of these calming sounds are hush, hush (English) shah (Yiddish), ushuru (Ethiopian), and Insh' Allah (Egyptian). Perhaps the similarities to womb sounds also explain the spiritual use of similar sounds in different religions, i.e. Om (Buddhism), Shalom (Hebrew), Tibetan overtone chanting, and Gregorian chants. Ultrasound studies have shown that at 16 weeks gestation the fetus can respond to outside sound (Hepper, 1994, Shahidullah & Hepper, 1992). The sounds of the blood flow through the placenta can be heard at a very loud level in the womb. For the lower sound frequencies below 500 Hz, mean sound levels are 80 decibels with peaks to 95 decibels (Gerhardt & Abrams, 1996). This is about as loud as it gets on a crowded dance floor on a Saturday night. A good deal of attention has been given to the so called Mozart Effect where exposure to this music increased spatial IQ in college students (Rauscher, Shaw & Ky, 1995), as well as work with preschool children which showed that music training can enhance language development, spatial and mathematical abilities (Rauscher, et al, 1997). Evidence points to the fact that similar learning benefits extend far back into the prenatal period, and that the sounds and rhythms in the womb may contain information important to the development of the fetal brain (Devlin, Daniels & Roeder, 1997, Shetler, 1989). The newborn can differentiate a recording of his own mother's prenatal womb sounds from a recording of another mother (Righetti, 1996). The newborn can also differentiate emotional content in the recording of his prenatal womb sounds and respond with changes in movement and heart rate (Righetti, 1996). There is a vast amount of potential information available to the fetus that can be given in the playing of just one musical note or in singing or talking a single syllable. The content of this sound is full of informational and emotional content that can be accessed and used by the fetus in many deep, profound ways. The synaptic network in the fetal brain as well as the infant brain undergoes learning dependant reorganization. This process involves synaptic pruning, the regression of neural circuits as well as the synaptic sprouting of the developing brain. This is consistent with the observation of psychologists that infants and children may have enhanced behavioral abilities that diminish later in life (Johnston, 1995). Since fetal hearing is probably the major component of this learning dependent synaptic pruning and sprouting, the fetus is participating in a second and third trimester auditory amphitheater that is perhaps more important than any other classroom. It is apparent that we have only begun to explore the connection between sound and neurobiological development in the fetus and newborn. My interest in the fetal audio environment led to a musical collaboration with Burt and Joe Wolff. We went on to produce a musical recording of womb sounds and female vocal sounds called Transitionsm as well as a subsequent series of

womb sound recordings for pregnancy, childbirth and children.\* It was clear that this type of music was very soothing to the newborn, especially the premature baby. A subsequent study showed that stimulation with the Transitions®, womb sound music was helpful in the care of mechanically ventilated, agitated premature babies with low oxygen levels. Significant increases in oxygen saturation as well as decreased levels of agitation were found with the use of music (Collins & Kuck, 1991). Another study showed that when lullaby music was played in the neonatal intensive care unit (NICU) that there were less episodes of oxygen desaturation (Caine, 1991). There is no doubt that some of the high decibel sounds from alarms and equipment in the NICU are harmful to the neonate. In one study a group of premature babies were insulated from their audio environment with earmuffs (Zahr & Traversay, 1995). They had higher oxygen saturations and more time in the sleep state compared to a control group. Several other studies have shown a doubled daily weight gain when premature babies in the NICU were exposed to music therapy (Caine, 1991, Coleman, Pratt & Abel, 1996). Additional studies using music with premature babies have shown a 3 to 5 day earlier discharge from the NICU (Caine, 1991, Coleman, Pratt & Abel, 1996, Standley, 1996). Some of the critical elements for growth and earlier discharge from the NICU are decreased blood oxygen availability and increased oxygen consumption from stress. The increased stress response also consumes precious calories. It is clear that the use of music therapy not only has a beneficial effect on the growth and development of these premature babies, but may lead to cost savings in their medical care, which is a significant problem for modern society. In the United States alone, the extra cost of intensive care for these low birth weight infants is over 1,000 dollars a day per baby or over 3.5 billion dollars a year. The added costs of special education and continued cost of medical care for these children are larger than the initial costs for their NICU care (Lewit, et al, 1995). Many of these babies suffer hearing and visual disabilities, mental retardation, cerebral palsy or learning disabilities. Ultimately the uncountable costs are those experienced by human beings who are not able to realize their full potential. So it appears that with a relatively small expenditure for music in our neonatal ICU's we can decrease the time in the NICU by over 3 days and save over 3,000 US dollars for every premature baby. Premature birth is the predominant cause of low birth weight and neonatal mortality in the United States (Wegman, 1996). The fact remains that in the US almost one out of every hundred babies dies shortly after birth. (Paneth, 1995). This is the highest rate of all the industrialized countries. Despite all our best efforts, the consequences of premature labor will continue to be a huge problem for society. A large amount of attention has been given to the prevention of preterm labor. Despite a large amount of research and funds dedicated to programs to prevent preterm labor, the incidence of prematurity in the US has not decreased (Paneth, 1995).

**Table 1**  
**Factors Associated with Low Birth Weight**

Age below 18 years	Tobacco use
Drug and alcohol use	Lack of prenatal care
Previous preterm delivery	Maternal stress
Infection	Poverty

A number of factors have been associated with the risk of prematurity and low birth weight (Table 1). Many of these factors are interrelated. In the United States, a large amount of these premature births occur in the adolescents, who as a group have higher rates of poverty, lack of prenatal care, poor nutrition, stress, tobacco use, alcohol intake, and drug abuse (Shiono & Berman, 1995, Hedegaard, Henriksen & Niels, 1996). To gain more insight into premature birth it is interesting to look at some of what we know about how labor is initiated. Thousands of years ago, Hippocrates believed that the baby decides when the birth process begins. There is now good evidence to show that the fetus does initiate labor (Nathanielsz, 1995). Evidence points to fetal initiation of labor about 2 to 3 weeks before birth. In the fetal brain, the hypothalamus increases secretion of CRH (corticotrophin releasing hormone) and this stimulates the pituitary to release ACTH

(adrenocorticotrophin). This stimulates the fetal adrenal cortex to secrete cortisol. The placenta then produces more estrogen and less progesterone and this eventually sets off the contractions of labor. Since we know that the fetus is involved in initiating labor it is interesting to speculate on why the fetus would initiate premature birth. We do know that pregnancies that contain a lot of stress are more inclined to be concluded prematurely. Tobacco and cocaine use increase the stress response in the parturient, and this likely is true also in the fetus. There is a biologic explanation for the fetus being able to react to a maternal stress response by initiating labor. In the human species, our fight or flight stress response was often effective during primitive times for our survival. Although in modern times this response has become more of a catalyst for disease. It stands to reason that for biologic survival of the species there would be a mechanism to allow initiation of labor under stressful conditions. Especially in the past, it was much more common for the pregnant woman and fetus to be exposed to the risk of cataclysmic death from the environment or infectious diseases and epidemics. In these situations, some of these premature babies might survive. For the mother, delivery of the baby would allow her to direct her energies toward survival and future childbearing. As far as other possible mechanisms for initiation of labor, there could be some hormonal transfer from the mother to the fetus through the placenta. Or perhaps a lack of certain nutrients either from poor maternal diet or decreased supply of these nutrients via decreased placental blood flow. Perhaps there is a kind of dialogue that goes on during pregnancy between the mother and her unborn baby that is interrupted in some way by maternal stress. What about the transfer of emotions (or lack of) from the mother to the fetus? It is obvious that the expression of love, nurturing and acceptance is expressed by the mother to the fetus by her voice; through the wide gamut of tonality, rhythm and inflection produced by her talking and singing. It is very possible that this vocal information (or lack of) has an effect on the fetal initiation of labor. It is intuitive that there is a profound interplay of information and emotion involved here and this dialogue is sacred and precious. One possibility is that fetal intrauterine hearing of the maternal placental blood flow sounds is in some way connected to the fetus initiating premature labor. Is there some way in which the fetal brain processes changes in womb sound rhythm or the sound matrix of the womb sound itself? It is known that biologic rhythmicity is a fundamental aspect of healthy human beings. For instance, the rhythm of our heart beat is not like a metronome, but there is a normal beat to beat variability. As we age the variability of our biologic rhythms decrease. And once we reach death there is no rhythm or variability. The fetus in distress usually has a decreased variability of the fetal heart rate. These changes in fetal heart rate variability are sometimes used diagnostically to make clinical decisions during pregnancy and childbirth. Since the predominant rhythmic component of fetal intrauterine hearing is the sound of the mother's blood flow pulsing through the placenta is it not likely that that the fetal brain uses this sound and rhythmic information in deciding to initiate labor? We know that maternal stress often manifests itself as a hyperactive sympathetic nervous system and a decrease in maternal heart rate variability (Ekholm, et al, 1996). So perhaps the fetus perceives decreases in maternal heart rate variability and uses this information as part of the initiation of preterm labor. Another interesting possible cause for preterm labor is an exaggerated maternal apprehension for the safety of the baby as well as the worry that Braxton Hicks contractions are foreboding a premature labor (Cheek, 1995). This will usually provoke a call to the midwife or obstetrician and bedrest and other active treatment to prevent preterm labor. This will often increase the patient's anxiety even more and lead to continuing painful Braxton Hicks contractions. The telepathic communication from the mother to the fetus will be interrupted at this point and the mother's sense of anxiety picked up by the fetus. This maladaptation of the fetal maternal bonding process then sets off the initiation of the labor cascade by the fetus. Successful use of hypnosis during this time has been used to prolong the pregnancy in this situation (Cheek, 1995, Omer, Friedlander & Palti, 1986). What appears to be a common attribute here is that an exaggerated maternal stress response can lead to the initiation of preterm labor. Besides the documented clinical use of hypnosis in the treatment of preterm labor, both the use of hypnosis and meditation have been documented to decrease stress hormone levels in various clinical situations (Sudsuang, Chentanez & Veluvan, 1991). Music alone has been shown to diminish stress-induced increases in stress

hormones (Spintge &Droh, 1987). It has also been shown that music combined with guided imagery decreases stress hormone levels (McKinney, Tims, Kumar &Kumar, 1997), as well as the Bonny method of Guided Imagery and Music (GIM) (McKinney, et al, 1997). The psychological aspects of maternal stress during pregnancy in adolescents have been shown to decrease with music therapy (Liebman &MacLaren, 1991). My interests led me to develop a script of guided imagery with music to affect the maternal-fetal dialog, The Transitions Maternal and Fetal Wellness Program(TM) (Schwartz &McDonald, 1996). The use of this tape, we hoped, would positively influence some of the risk factors related to preterm labor and low birth weight. The tape combines guided imagery and music with the intention to decrease overall stress, strengthen communication between mother and fetus and get mother to center on the here and now. Messages are given to gently reinforce that mother should not drink alcohol, take drugs or smoke, as well as the importance of nutrition and exercise.\* Initial anecdotal reports from a group of low socioeconomic mothers have indicated higher birth weights in the mothers exposed to this guided imagery and music (personal communication, Hetty Watters, RNC, MA). A large multicenter study is being initiated to explore these benefits in various populations. Some of the maternal and neonatal variables that will be studied are gestational age, birth weight, APGAR scores, duration of labor, birth complications and cost of medical care, as well as maternal and paternal-fetal attachment. It may be intuitively clear that this type of therapy will be helpful. However, it is only with data that shows the medical benefits of music that we will see wide scale use of these therapies. The use of perinatal sound and music is very important to the potential for acquiring information that can impart learning, healing and psychological change. Appropriate audio therapy in the perinatal period can positively influence state of consciousness and protect from an inappropriate stress response. This gives us an opportunity to impart our love as well as our wisdom. The implications are that these modalities will lead to physical and emotional benefits to mother and newborn as well as medical cost savings. Footnote \* Editorial Note: Despite this particular mother's own preference, considerable research indicates that the fetal child prefers classical music and lullabies. (I.E. Montemurro, R.N. Singing Lullabies to Unborn Children: Experience in Village Vilamarxant, Spain . Pre-and Perinatal Psychology Journal, 11(1), 9-16.) and Dr. Schwartz's own reference to the Mozart Effect. \* (Web Site: <http://www.mindspring.com/~wombsnd>). \* For the full text of the guided imagery script see Transitions Music Web Site: <http://www.mindspring.com/~wombsnd> References REFERENCES Gaine, J. (1991). The effects on music on the selected stress behaviors, weight, calorie and formula intake, and length of hospital stay of premature and low birth weight neonates in a newborn intensive care unit. *Journal of Music Therapy*, 28(4), 180-192. Cheek, D.B. (1995). Early use of psychotherapy in prevention of preterm labor: the application of hypnosis and ideomotor techniques with women carrying twin pregnancies. *Pre- and Perinatal Psychology Journal*, 10(1), Fall 1995, 5-19. Clark, M., McCorkle, R. &Williams, S. (1981). Music therapy assisted labor and delivery. *Journal of Music Therapy*, 18, 88-100. Coleman, J.M., Pratt, R.R., &Abel, H. (1996). The effects of male and female singing and speaking voices on selected behavioral and physiological measures of premature infants in the intensive care unit. Presented at the International Society for Music in Medicine symposium at San Antonio, 10/96. Collins, S.K., &Kuck, K. (1991). Music therapy in the neonatal intensive care unit. *Neonatal Network*, 9(6), 23-26. Devlin, B, Daniels, M. &Roeder, K. (1997). The heritability of IQ. *Nature*, 388, 468-471. Ekholm, M.K., Piha, S.J., Antila, K.J., and Erkkola, U. (1993). Cardiovascular autonomic reflexes in mid-pregnancy. *British Journal of Obstetrics and Gynaecology*, 100, 177-182. Gerhardt, K. J. &Abrams, R.M. (1996). Fetal hearing: characterization of the stimulus and response. *Seminars in Perinatology*, 20(1), 11-20. Hanser, S.B., Larson, S.C., &O'Connell, A.S. (1983). The effect of music on relaxation of expectant mothers during labor. *Journal of Music Therapy*, 20(2), 50-58. Hedegaard, M. Henriksen, T.B., Sabroe, S.& Niels, J.S. (1996). The relationship between psychological distress during pregnancy and birth weight for gestational age. *Acta Obstetrica et Gynecologica Scandinavica*, 75, 32-39. Hepper, P.G. &Shahidullah, B.S. (1994). Development of fetal hearing. *Archives of Disease in Childhood*, 71, F81-F87. Johnston, M.V. (1995). Neurotransmitters and vulnerability of the developing brain. *Brain &Development*, 17, 301-306. Lewit, E.M.,

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