POVERTY NEURODEVELOPMENT & VISION

A DEMONSTRATION PROJECT WITH AN ADOLESCENT POPULATION

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Abstract

The biosocial consequences of poverty, such as malnutrition, low birth weight, teenage pregnancy and maternal complications of pregnancy, can be related to central nervous system maturation and therefore, to visual development and school achievement. Continuing risks for additional damage to the central nervous system accrue as these children are raised in an impoverished environment. A vision screening of 625 adolescent inner city students demonstrates the vision and learning outcomes associated with poverty. Fifty two percent of the students failed the screening. Of 23 students with hyperopia greater than 2 diopters, 18 or 78 % were special education students. Various intervention strategies were developed to address diagnosed visual dysfunctions, but compliance in this population was very poor. A partnership of optometry, education and public health will be required to develop new programs to identify students with vision problems and provide them with the services they require.

Key words

adolescent, compliance, hyperopia, neuro-development, poverty, public health, special education, vision screening

Introduction

The impact of poverty on the health and development of children is readily acknowledged. However, the extent of accompanying functional visual and visual-perceptual disorders has not received adequate attention. Although well designed optometric research involving this population of children is lacking, there is extensive research on the impact of biosocial consequences of poverty on neurodevelopment. In particular, malnutrition, low birth weight, teenage pregnancy and maternal complications of pregnancy can all be related to central nervous system maturation and therefore, to visual development and school achievement. These children are born of poverty into poverty. In this hostile environment, we must not overlook the continuing risks for additional damage to the central nervous system,[1] decreased stimulation to developing sensory systems and reduced access to medical care. The results of an expanded vision screening of an adolescent inner city population demonstrates the impact of vision and learning outcomes associated with poverty. It further provides an example of inadequate compliance to address diagnosed visual dysfunctions, and indicates a vital role for optometry, as a member of the school health care team, to render appropriate treatment to economically impoverished and socially disadvantaged children.

BIOSOCIAL FACTORS

Malnutrition

The neonate is expected to survive in the same hostile environment that the mother endured during pregnancy. If we consider adequate nutrition as the engine that drives the child's mental and physical development, then we can appreciate the vicious cycle as a generation of poorly nourished individuals rear their children under conditions predictably destined to produce future generations of malnourished and poorly functioning individuals.[2] Maternal malnutrition increases the risk of a neonate with a low birth weight (LBW), and continued malnutrition reduces the child's resistance to infection.[3] Undernourished hungry children are less alert and offer a diminished response to their environment.[4] Among children ages 2 to 5 years, 13% of those from families below the poverty line were below the 5th percentile in height compared to just 5% of those above the poverty line.[5] When neurointegrative tests were administered, poor children who were short performed below average. Stature was not a factor among children with normal nutrition.[6]

Optometrists are more likely to treat children with subclinical malnutrition, which manifests less severe neurointegrative disorders, but sufficient to produce an impact on classroom performance. Providing 3rd and 4th grade children with breakfast in school resulted in significant improvements in verbal fluency among a population of undernour-

ished children.[7] In addition, malnutrition usually does not occur alone, but in conjunction with low income, substandard housing, familial disorganization, and a climate of social apathy.[8]

Low Birth Weight

The combined effects of low income, inadequate education, and the absence of early prenatal care lay the foundation for adverse birth outcomes among mothers of low socio-economic status (SES). When income is less than 1.5 times the poverty level, the prevalence of LBW is 24% higher than with incomes three times the poverty level.[5] Mothers without high school diplomas have 67% more LBW children than those who attend college.[5] Inner city mothers are 3.3 times more likely to smoke and 3.7 times more likely to use alcohol, when compared to a control group.[9] Cigarette smoking and alcohol consumption have been associated with LBW, prematurity, reading and arithmetic problems, and lower APGAR scores.[10,11]

LBW children who survive have a high prevalence of visual perceptual and cognitive defects. IQ scores decline with decreasing birthweight as do visual-motor integration skills.[12,13] Other visual problems with increased prevalence include strabismus and amblyopia[14] and severe reductions in sight associated with retinopathy of prematurity.[15]

Teenage Pregnancy

The problems accruing from LBW babies are abetted by the persistence of teenage pregnancies. Teenage mothers represent an increased risk of having LBW babies, premature babies and, when compared to 25-29 year old mothers, 68% more babies who die during the first year of life.[16] Thirty-nine percent of teenage girls who are from families who live below the poverty line have a child, compared to 10.4% of those with family incomes at three or more times the poverty line. Poor adolescents are more likely to become pregnant and when they do, they are more likely to have the baby and remain unmarried.[17] The consequences of teenage pregnancies have the potential to manifest the same array of developmental and visual problems that result from low birthweight and malnutrition. These children must face an unfavorable environment from which the survivors are unlikely to emerge unscathed.

Maternal Complications of Pregnancy

Maternal complications of pregnancy such as toxemia, hypertension, and bleeding during pregnancy yield a continuum of reproductive casualties which range from fetal and neonatal death and cerebral palsy, at one extreme, to learning disabilities at the other. Towbin stressed that hypoxia is the most common cause of cerebral damage and the degree of damage is related to the extent of the hypoxia.[18] Therefore, the emergent patterns of clinical disability and aberrant academic performance may be more subtle. However, near term, the cortical sites most at risk are those that govern cognition, sensory and fine-motor activity.

The marked effects of SES on complications of pregnancy were reported by Pasamanick, et al.[19] The incidence of bleeding and toxemia increased from 5% to 10% to 22% as one moved from white upper economic fifth to white lower economic fifth to the non-white group. Kawi and Pasaminick[20] compared the hospital records of 205 boys with certified reading disabilities with a matched group of normal readers. In this sample, 16% of the mothers of the disabled readers had two or more complications of pregnancy compared to only 1.5% of the normal readers.

Impact on Visual Development

From the evidence that has been provided, it is reasonable to conclude that malnutrition and undernutrition, low birth weight and prematurity, teenage childbearing, and maternal complications of pregnancy can influence neurointegrative development and functioning. In his review of pre- and peri-natal factors on intelligence, Vernon[21] recommends that specific events should not be viewed in isolation because these variables seem to operate in a multifactorial fashion and interact with both genetic predisposition and environmental factors. Damage to the CNS continues to accrue via mechanisms associated with an impoverished environment, such as a higher incidence of illness, lead poisoning, incomplete immunizations[22] and inequalities in access to appropriate health care services.[23]

The developmental aspects of intersensory and sensory-motor integration in the primary grades have been well documented.[24] Birch and Belmont[25] focused on auditory-visual integration as a neurointegrative task that involves both simultaneous and successive processing and is dependent upon the integrity of the CNS. The ability to treat auditory and visual information as equivalent representations significantly correlates with reading in grades 1 to 6 and is also related to nutritional risk.[26] When combined with the measurement of accurate eye movements (a sensory-motor activity), Solan[27] was able to account for 35% of the variance in reading performance in a population of reading disabled 4th to 6th graders. Kramer's study[28] strongly supports the association between visual-perceptual and academic functioning in children with sociodemographic, family, and health characteristics. Lower scores on cognitive tests such as the Weschler Intelligence Scale for Children-Revised (WISC-R) Block Design and Reading and Arithmetic subtests of the Wide Range Achievement Test (WRAT) were associated with minority status, lower income, and lower educational level of the parent. General health status, history of birth complications and prenatal exposure to smoke were also predictors, but to a lesser extent. In a recent study, Kattouf and Steele[29] found that lower-income public school children scored significantly lower on subtests of the Test of Visual Perceptual Skills (TVPS) than children in private school.

The impact of neurointegrative disorders may not be evident until the child fails to respond to educational challenges in the classroom. Often, the teacher suggests an eye exam, and evidence of these defects are revealed during the visual analysis. Strabismus , numerous less severe binocular anomalies, accommodative disorders and other visually related developmental delays may result from insult to the integrity of the central nervous system.[30]

Vision Screening of an Adolescent Inner City Population

A vision screening project undertaken at an inner city high school in New York City serves to illustrate the visual sequelae of poverty's continuing assault on the our nation's youth.[31] From 1985-87, a vision screening program was performed on 625 high school students as part of a drop-out prevention program. In addition to providing information about students' visual status to parents and teachers, the program was also aimed at educating the teachers

about the role of vision in classroom learning and developing effective intervention and compliance strategies.

Subjects

The 625 students attended inner city high schools in underserved communities in the Bronx and Manhattan. As a service project aimed at drop-out prevention, priority was given to students classified as learning disabled. Hence, 285 (58 %) of the students were enrolled in special education programs. The remaining students were referred either by a teacher, parent or self, on the basis of suspected visual problems or poor academic performance.

Methods

The screening procedures used were based on existing clinical procedures (the Orinda study)[32] and then modified to reflect the greater visual demands, especially near visual activities, inherent in the high school curriculum. The final pass-fail criteria were therefore, more stringent than those that would be applied in the typical elementary school screening program.[33]

Two manpower days per week were devoted to this program from October through May over three school years (1985-88). One of the doctors utilized the time for screening, and consultation with students, teachers and parents, while the second doctor utilized the time for screening, consultation, program administration and development of lectures and workshops.

Results

A total of 327 or 52.3 % of the students failed the vision screening. A higher percentage of the special education group failed (56.6 %) than the non-special education group (48.7 %), but the difference was not statistically significant. The greatest number of failures were in the refractive category. Forty-four percent of all the students participating in the screening potentially required glasses, either for distance viewing, reading or both. Of major concern was the large number of uncorrected hyperopic students, who are at great risk for symptoms associated with reading, such as blurred vision, headaches, inability to sustain at reading, and poor comprehension. When "priority cases" of hyperopes (those with uncorrected refractive errors exceeding 2 diopters) were separately considered, 18 of 23 (78 %) of these high hyperopes were special education students. Indeed this difference was statistically significant ($p < .01$).

During the first year of the screening, 126 letters were sent home informing parents of their children's failure and requesting a complete vision examination. Two letters were returned with information from the examining practitioner. During the next school year, more aggressive intervention strategies were developed and targeted at the students classified as priority cases. A paraprofessional and two family workers contacted parents and made appointments for them to speak with the optometrists. Of 37 students classified as priority, 14 appointments were made, seven of these appointments were kept and all seven students received comprehensive vision examinations. During the final year of the screening, priority students were offered appointments at the State University of New York, State College of Optometry's University Optometric Center. Of 13 students for whom appointments were made, 10 received care. Seven received glasses through Medicaid and two were given fee reductions based on financial need. After three years of modifying strategies and focusing our intervention resources on the most needy cases, only 17 of 62 (27 %) of the students received the vision care they required.

Discussion

Traditional models of vision screening programs focus on casting a wide net, identifying children with potential vision problems, and notifying parents of the need for further care. When considering this adolescent population, the conceptual model was changed to reflect a need to concentrate on students at high risk of dropping out because of academic failure. Therefore, we (Suchoff and Mozlin) focused on those students either classified as learning disabled or identified as high risk. As we provided teachers with opportunities to learn about and discuss the visual prerequisites for classroom learning, we defined the mechanism to identify the high risk students. The number of referrals to the vision screening program increased as the teacher education component of the program was accomplished. Our success at identifying students with potential vision problems was confirmed by the high failure rate.

Our model of vision care delivery was far less successful at providing the follow-up care these students required. Our interactions with other professionals indicated that our experience in terms of compliance was not unique. Rather, this represents a public health issue that still has not been sufficiently recognized. In the long run, how this problem is conceptualized will determine the direction and success of remedial efforts.[34] Simply improving access to appropriate healthcare services will not eliminate visual deficiencies in the poor and underserved communities. The appropriate investment will require new partnerships to develop programs that provide health, social and educational programs that stress the importance of compliance. Successful programs such as Head Start must be expanded to provide services to older children. Appropriate infrastructures and systems will be required to ensure coordination and continuation of services. Innovations and strategies, such as school-based programs,[35] must make these services available to the children, rather than waiting for parents to seek care for their children. A partnership of optometry, public health, and education might well have an impact on the high school drop-out rate by identifying students with vision problems, and providing them with the services they require.[31]

In 1954, the United States Supreme Court, in the landmark case Brown v. Board of Education of Topeka, struck down the concept of "separate but equal." Chief Justice Warren wrote," In these days, it is doubtful that any child may reasonably be expected to succeed in life if he is denied the opportunity of an education. Such an opportunity, where the state has undertaken to provide it, must be made available to all on equal terms….Separate educational facilities are inherently unequal."[36] Forty-seven years ago, the Supreme Court justices understood the need to invest in the future of all American children. Although our nation's school systems are no longer physically segregated, inequalities still exist which have been created by poverty's continuous assault on neurological integrity and development and the barriers it creates to academic achievement.

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