THE RELATIONSHIP BETWEEN PREMATURITY, LOW BIRTH WEIGHT, AND MDI SCORES ON THE BAYLEY

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and MDI Scores on the Bayley

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DEDICATION

This thesis is dedicated to my mother

Melody Lane Shelly

who sacrificed her time and freedom to ensure the

best for all of us.

Thank-you for being my inspiration.

To my brothers and sisters, Charlotte, Darrell, Brandon,

Danny, and Kimberly,

whom I cherish.

And especially, to my husband

Matthew

who has always given me strength and encouragement to move forward.

Thank-you for all your patience and understanding,

I Love You!!

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ABSTRACT

The intent of this proposed study was to research the relationship between prematurity, low birth weight, and cognitive functioning of premature infants, as determined by the Mental Development Index (MDI) on the Bayley Scales of Infant Development (BSID). A second hypothesis looked at the relationship between the at-risk population's age corrected MDI mean and the normal population's overall MDI mean. Bayley (1969) introduced the BSID to assess the current developmental functioning of infants and toddlers ages 2 through 30 months. The diagnostic intent of the instruments is to identify children who are currently developmentally delayed. The Mental Scales assess sensory-perceptual abilities, memory, learning, and problem-solving skill. It was hypothesized that cognitive development would be significantly correlated to birth weight and gestation period. The current study included data obtained from 145 assessment protocols of premature, low or very low birth weight children seen at the neonatal intensive care follow-up clinic of the University of Mississippi Medical Center (UMMC) in Jackson, MS. No significant differences were found among birth weight, gestation period, and age corrected MDI scores, due to the homogenous sample of at-risk infants. The at-risk age corrected MDI sample mean (M = 86.02, SD = 14.52) was significantly lower than the overall mean (M = 100, SD = 16), $t(147) = -11.72$, $p < .001$, suggesting either the age correction was not beneficial or more likely severe medical problems were impacting the infants' cognitive development.

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CHAPTER I

INTRODUCTION

Many studies have emphasized the importance of early identification of neurodevelopmental delays in infants, especially at-risk infants (Bicker & Littman, 1982; Cook, Holder-Brown, Johnson, & Kilgo, 1989; Crowe, Deitz, & Bennett, 1987; Dempsey, 1988; Farber, Shapiro, Palmer, & Capute, 1985; Goldstein, Smith, Waldrep & Inderbitzen, 1987; Klesges & Troster, 1987; Maisto & German, 1986). Early diagnosis and intervention of developmental disabilities are critical for many reasons. Farber and colleagues (1985) state four important reasons for early diagnosis: early diagnosis allows more time for parents to adjust to the special needs of their child; early diagnosis allows for early intervention; early diagnosis allows for a comparison of different treatments and allows clinicians to document the course of problems earlier, especially in neonatal follow-up studies. Lerner (1997) states that intervention early in life is very effective and offers a high payoff for educational efforts.

Early identification of developmental delays is essential to effectively educate parents concerning their child's specific problems. With adequate education, parents are better able to improve the long-term prognosis of their child (Farber et al., 1985; Wasik, Ramey, Bryant, & Sparling, 1990). By increasing their own knowledge of their child's specific disability/disabilities the parents give their child an advantage. Children with disabilities can use their own parents as resources in addition to state or federal resources.

Another benefit for early diagnosis and intervention is the educational opportunities offered the child (Stainback & Stainback, 1996). If the child has been properly identified early in life then he or she may be eligible for government aid for special education. One goal of special education is to maintain a continuum of services for the child with disabilities. That continuum of services should be implemented as soon as possible for the best results to occur (Stainback & Stainback, 1996). The Individuals with Disabilities Education Act (IDEA) mandates that a child must be identified with a disability or must be identified as developmentally delayed in order to be eligible for special educational services within the public school system at public expense. Head Start works with children, 3-5 who fall in the educationally at-risk category at no charge to parents (Whitten, 1993). Early identification is essential for children to receive the special education opportunities that their particular disability requires (Stainback & Stainback, 1996).

The movement for early identification and intervention stems back to the 1960's. During the 1960's the government became convinced that early identification and educational intervention would lower adverse developmental consequences suffered by the at-risk child (McLinden & Prasse, 1991). In 1964 the courts passed the Economic Opportunity Act which mandated extensive educational funding for preschool children and in 1968 the Handicapped Children's Early Education Assistance Act (Public Law 90-538) was passed ensuring further educational support for children with disabilities (Lehr, Ysseldyke, & Thurlow, 1987). Both of these laws have had a tremendous impact on early intervention efforts. The laws provided support and government funding for early education, which increased awareness of special needs for children with disabilities and the need to begin educational remediation at an earlier age. The educational needs of infants and toddlers remain a highly volatile issue today.

In 1986, amendments were added to PL 99-457, (Education of the Handicapped

Act Amendments of 1986) that "...establishes a limited mandate for states to serve children with handicaps between 3 and 5 years of age, and provides incentives to states to develop and implement a comprehensive service delivery system for children birth through age 2," (McLinden & Prasse, 1991, p. 37). In essence, PL 99-457 ensures that certain children (known or suspected of having a disability) qualify for state funded services. In order to qualify for state funding the children must meet certain requirements set forth by their individual states. Early assessment (cognitive, behavioral, and emotional) is a necessity in order to qualify the child as having a need for those state funded services.

The need for early assessment and intervention is well documented in the literature and is now supported by federal and state laws. There has been an increase in the emphasis of assessing populations that are at-risk for developmental delays (Cook et al., 1989; Garwood, 1982; Landerholm, 1982; Maisto & German, 1986). According to Cook and colleagues (1989) and Coutts and colleagues (1987) there are three main purposes for infant assessments. First, they provide a method of screening for infants; second, they give information regarding infants' strengths and weaknesses; and finally, they serve as a base for evaluating intervention programs. The need for infant assessment has been impacted by the decrease in infant mortality and subsequent survival of more infants at-risk for cognitive and emotional difficulties.

Infant Mortality Rate

The mortality rate of premature infants has decreased remarkably in recent years (Finan et al. 1998; Guyer, Martin, MacDorman, Anderson, & Strobino, 1997; Infant Health and Development Program, 1990; Jones, Southern, & Bringham 1998; Kitchen et al., 1982; Low et al., 1985; McCormick 1997; Noble-Jamieson, Lukeman, Silverman, & Davies, 1982; Pape, Buncic, Ashby, & Fitzhardinge, 1978; Siegel et al., 1982; Valvano & DeGangi, 1986). This decrease in infant mortality has been attributed to the efforts of neonatal intensive care units (Jones et al., 1998; McCormick, 1997; Siegel et al., 1982) and advances in medical technology (Epps & Jackson, 1991; Noble-Jamieson et al., 1982). Guyer and colleagues (1997) stated that in 1996 there were an estimated 3,944,953 live births in the United States. Out of that total, 7.4% of the infants were considered low birth weight (birth weight falling between 1501 grams and 2500 grams) which was the highest level of low birth weight survivors since 1975. Unfortunately, it is apparent that as the number of surviving premature infants increases so increases the number of infants at-risk for developmental delays (Jones et al.,1998; Lipkin & Altshuler, 1994; Low et al., 1985; McCormick, 1997; Valvano & DeGangi, 1986). As the at-risk population grows, the need for accurate, predictable, and generalizable neurodevelopmental assessments increases.

Infant Assessment

There is much controversy concerning the usefulness and predictability of infant neurodevelopmental assessment instruments in at-risk populations (Drotar, 1987; Kopp & Vaughn, 1982; Largo, Graf, Kundu, Hunziker, & Molinari, 1990; O'Connor, Cohen, &

Parmelee, 1984). A large segment of the research literature indicates that instruments measuring infant cognitive development are not predictive of future functioning (Bayley, 1969; Crowe, Deitz, & Bennett, 1987; Drotar, 1987). However, some research findings support the assumption that these instruments demonstrate higher predictability for at-risk populations (Kopp & Vaughn, 1982; Largo et al., 1990; Maisto & German, 1986; Siegal et al., 1982; Wallace, Escalona, McCarton-Daum, & Vaughn, 1982) especially when evaluated from a neuropsychological perspective (Whitten, 1993). Research has also indicated that with increasing age the predictive power of cognitive assessments increases (Crowe et al., 1987; O'Connor et al., 1984). O'Connor and colleagues (1984) further state that the predictive power appears to stabilize when the child reaches two years of age.

Research concerning the predictability of neurodevelopmental assessments are primarily conducted on normal populations used in standardization samples. Cook and colleagues (1989) stress the need for more research concerning at-risk populations (primarily the individual characteristics of specific populations and the generalizability of currently used assessment tools for each at-risk population).

Literature indicates that more research needs to be conducted concerning at-risk populations. The current study was designed to evaluate the predictive power of the Mental Development Index (MDI) from the Bayley Scales of Infant Development (BSID) (Bayley, 1969) in at-risk populations of low birth weight and premature infants. Many studies have found that premature infants are at a greater risk for developmental delays (Williams, Lewandowski, Coplan, & D'Eugenio, 1987) than normal children. The current study will focus on the relationship between preterm infants with low or very low birth weights and their respective age corrected MDI scores. Such a study is necessary to examine whether a relationhsip exists, and to begin to investigate how prematurity and low birth weight influence future cognitive development (DeBose, 1976).

Definition of Terms

At-Risk: For the purpose of this study, at-risk infants refer to infants, due to some prior or current condition, who have a greater than normal risk of developing an educational or cognitive disorder.

Preterm infants: Preterm infants refers to infants born prematurely (less than 37 weeks gestation).

Gestational age: This refers to the time between the mother's last menstrual cycle and the time of birth.

Birth weight: For the purpose of this study, birth weight refers to the first weight of the child (measured in grams) taken shortly (between 1-3 hours) after birth.

Low birth weight (LBW): LBW refers to birth weights that fell between 1501 grams and 2500 grams.

Very low birth weights (VLBW): VLBW refers to birth weights that fell on or below 1500 grams.

BSID: The Bayley Scales of Infant Development (Mental scale) were introduced by Nancy Bayley in 1969. This instrument is used to assess the cognitive and motor functioning of infants and toddlers ages 2 through 30 months. The results of the Mental scale yield a raw score, which is the total number of correct items. This raw score is converted to the Mental Development Index (MDI). The MDI score has a mean of 100 and a standard deviation of 16 (Bayley, 1969).

Mental Development Index (MDI): Refers to the Mental Development Index on the BSID, which is a standardized score that reportedly represents the child's cognitive development (Bayley, 1969).

Age Corrected MDI: Refers to correcting the age of the infant for prematurity. Age correction should theoretically counterbalance any gestational age differences between the two populations. The age corrected MDI score reportedly represents the infant's cognitive development.

Limitations

The current study could not control for medical history, complications experienced at birth, gender, or SES of the at-risk sample included. This study may not be generalizable to a larger population due to geographical limitations. The entire sample came from the neonatal intensive care unit at the University of Mississippi Medical Center in Jackson, Mississippi. For these reasons, this study should be replicated to determine it's generalizability to a more geographically diverse population. Furthermore, the results of this study cannot be generalized to a normal population because normal weight babies were not included. Also, the results can only be interpretive of the age categories (2-30 months) used in this study and not expanded to other categories due to the limited age range of the current sample.

Purpose of the Study

The purpose of the current study was to determine if a relationship exists between premature, low or very low birth weight infants and their cognitive functioning as measured by their performance on the Mental scales of the BSID, and to compare the mean age corrected MDI score for the current sample with the overall MDI score mean from the standardization sample.

Research Questions

a) Is there a relationship between premature, low or very low birth weight infants and their MDI scores on the BSID? b) If a relationship does in fact exist, is it a positive or negative relationship? c) How strong is the relationship? d) Is there a significant difference between the at-risk sample's age corrected MDI scores and the MDI scores of the standardized sample?

Hypothesis

Null hypothesis - 1: There will be no significant relationship between premature, low or very low birth weight infants and their respective age corrected MDI scores on the BSID. Specifically, there will be no significant relationship among gestational age, birth weight and cognitive functioning of at-risk infants as measured by the MDI score.

Null hypothesis - 2: There will be no significant difference bewteen the mean age corrected MDI score of the at-risk population and the mean MDI score for the standardization sample.

CHAPTER II

LITERATURE REVIEW

Due to the changing mortality rate of premature infants (Finan et al., 1998; Guyer, Martin, MacDorman, Anderson, & Strobino, 1997) and the subsequent increase in infant medical problems (Jones, Southern, & Bringham, 1998; Lipkin & Altshuler, 1994), greater emphasis has been placed on neurodevelopmental assessment and its predictive power for infants who survive prematurity. Neurodevelopmental research has grown primarily due to the recent findings that many infants who are at-risk for developmental delays tend to exhibit lower scores on assessments of cognitive development (Astbury, Orgill, Bajuk, & Yu, 1985; IHDP, 1990; Johnston, 1995; McCarton, Wallace, Divon, & Vaughn, 1996; Pape, Buncic, Ashby, & Fitzhardinge, 1978; Siegel et al., 1982; Tilford, 1976; Valvano & DeGangi, 1986; Wallace, Escalona, McCarton-Daum, & Vaughan, 1982; Whitaker et al., 1990; Whitten, 1993; Williams, Lewandowski, Coplan, & D'Eugenio, 1987). Are the scores obtained from cognitive assessment instruments predictive of future cognitive functioning in an at-risk population?

Predictability

There is much controversy concerning the usefulness and predictability of infant neurodevelopmental assessment instruments in at-risk populations (Drotar, 1987; Kopp & Vaughn, 1982; Largo, Graf, Kundu, Hunziker, & Molinari, 1990; O'Conner, Cohen, & Parmelee, 1984). A large segment of the literature indicates that instruments measuring infant cognitive development are not predictive of future intellectual functioning (Bayley, 1969; Crowe et al., 1987; Drotar, 1987). However, some research findings support the assumption that these instruments demonstrate appropriate predictability for the at-risk population (Kopp & Vaughn, 1982; Largo et al., 1990; Maisto & German, 1986; Siegal et al., 1982; Wallace et al., 1982; Whitten, 1993). Research also indicates that with increasing age the predictive power of cognitive assessment increases (Crowe et al., 1987; O'Connor et al., 1984). O'Connor and colleagues (1984) further state that the predictive power of cognitive assessment seems to stabilize at about 2 years of age.

Research concerning the predictability of neurodevelopmental assessment focuses primarily on normal populations used in the standardization samples. Cook and colleagues (1989) stress the need for more research concerning at-risk populations, primarily the individual characteristics of that population and the generalizability of the assessment tools for the at-risk population.

<u>Bayley Scales of Infant Development</u>

When determining if a child has a cognitive developmental delay an appropriate assessment instrument should be used. The most commonly used developmental assessment tool is the BSID (Gaiter, 1982; Leguire & Fellows, 1990; Sattler, 1988; Shapiro et al., 1989; Tasbihsazan, Nettelbeck, & Kirby, 1997). The BSID is an individually administered neurodevelopmental measure of cognitive development. Sattler (1988) asserts that the BSID is the best measure of infant cognitive development (and it provides information about early mental development patterns).

Bayley (1969) developed the BSID to assess the developmental functioning of infants and toddlers from 2 months to 30 months of age. According to the manual (Bayley, 1969), the BSID was a melding of three previously published tests: the

California First-Year Mental Scale, the California Infant Scale of Motor Development, and the California Preschool Scale of Motor Development. Ever since its first publication the BSID has been the instrument against which other infant developmental measures are compared (Costarides & Shulman, 1998). Lipkin and Altshuler (1994) used the BSID to validate the cognitive outcome of the Neurodevelopmental Risk Examination (NRE). Boyd Welge, Sexton, & Miller (1989) used the BSID to assess the concurrent validity of the Battelle Developmental Inventory.

Two scales comprise the BSID: the Mental scale and the Motor scale. The Mental scale contains 163 items that assess sensory-perceptual acuities, discriminations, object permanence, memory, learning ability, and problem-solving ability. The Motor scale was designed to assess the degree of control the infant has over his or her own body, including:coordination of large muscles and finer motor skills of the hands and fingers. Both the Mental and Motor scales yield raw scores that are converted to standardized scores, the Mental Development Index (MDI) and the Psychomotor Development Index (PDI) which both have a mean of 100 and a standard deviation of 16. For the purpose of the current study only the MDI will be used.

The BSID was standardized on a nation wide sample of 1,262 low-risk infants and toddlers selected from a stratified-sample representative of the United States as determined by the 1960 United States Census of Population (Bayley, 1969). The sample was divided into 14 age groups ranging from 2 months to 30 months of age. Even though the BSID was not intended to be generalized to populations different from its standardization sample the instrument has been used to assess premature infants (Gaiter, 1982; Williams et al., 1987), high-risk infants (Cook et al., 1989; Dempsey, 1988;

O'Connor et al, 1984), and developmentally delayed infants (Crowe et al., 1987; Farber, Shapiro, Palmer, & Capute, 1985).

The Mental scale yields split-half reliability coefficients ranging from .81 to .93 with a median score of .88. The standard error of measure, or the reliability of scores, for the Mental scale falls between 4.2 and 6.9 (Bayley, 1969). Stability of the BSID was reported in two studies involving high-risk populations. Dempsy (1988) conducted a study to determine the stability of the BSID in high-risk infants (N = 41). His results imply that the stability between the 6-month and 12-month evaluation is fairly high (r = .85) as determined by a Pearson correlation. The correlation observed between the 12-month and 24-month evaluations was slightly lower (r = .79) but still fairly stable. Similar results were found by Cook and colleagues (1989) regarding the test-retest reliability of 6 and 12-month evaluations (N = 80). Results show an overall reliability score for the Mental scale of r = .71 and r = .69 for the Motor scale indicating moderate to strong test-retest reliability.

The long term (ie over one year) predictive ability of the BSID is questionable. A review of the literature suggests variability between studies of the predictive power of the BSID with at-risk populations. Kitchen and colleagues (1982) compared 297 at-risk infants seen at two separate perinatal centers in Melbourne, Australia. Results suggest that the BSID can reasonably identify children with disabilities that are likely to remain permanent but is not so reliable concerning disabilities more amenable to treatment. Siegal and colleagues (1982) compared 80 very low birth weight infants and 68 full-term infants. They concluded that performance at 2 years of age can be significantly predictive of future performance especially in developmentally delayed toddlers. These findings have important implications for diagnostic significance, specifically early intervention to reduce the effects of developmental delays.

Studies using the BSID to assess at-risk populations continue to increase at a noticeable rate (Astbury, Orgill, Bajuk, & Yu, 1990; Wasik et al., 1985). This is a benefit to the generalizability of the BSID as it relates to the at-risk population. For the purpose of the current study the BSID will be used to assess at-risk infants.

Relevant Studies

Low and colleagues (1985) conducted a study to determine if fetal-newborn complications contributed to motor and cognitive deficits. Their sample included 364 preterm (gestation of < 37 weeks) and full-term (gestation > 42 weeks) infants. During the follow-up assessment only 250 infants remained. This was due to missing observations. The remaining sample was considered at-risk due to fetal-newborn complications. Those complications included: immaturity, fetal growth retardation (determined by the birth weight being < 3rd percentile rank for gestation period), major anomalies (genetically determined), major infection, gestational complications (preterm delivery, post-term delivery and multiple pregnancies) and many other complications not pertinent to the current study.

The primary objective of their study was to review the results of follow-up assessment (BSID, and the Uzgiris Hunt Scale of Cognitive Development) for identifying cognitive and motor deficits and to determine if any of the fetal-newborn complications had a primary effect on those deficits. The authors concluded with a regression analysis that gestational age, birth weight, and anomalies did not have a statistically significant relationship with cognitive deficits at one year of age. Based on their results, the authors hypothesized that cognitive deficits are impacted more by other medical complications (respiratory complications, infection, and fetal hypoxia), not just low birth weight and prematurity alone (Low et al., 1985).

Stauffer and colleagues (1988) presented research suggesting that birth weight had no significant relationship with developmental delays but that gestational age was of great importance. Their study included 45 twin pairs followed-up at the Northwestern Memorial Hospital Development Evaluation Clinic. The range of gestational ages fell between 27 weeks and 46 weeks with a mean age of 31.5 weeks. The risk of each infant was measured by the Postnatal Complications Scale and his or her cognitive development was evaluated by using the Brazelton exams and Bayley exams. ANCOVA scores determined that the birth weight of the infant had no significant bearing on the infant's cognitive development.

However, the authors found that the amount of prematurity (weeks of gestation) played a significant role in determining cognitive development. Their results at 24 and 36 months showed that infants born between 26 and 31 weeks performed significantly lower on the Bayley Mental Scales than did infants born between 32 and 37 weeks. These results imply that gestational age is a powerful mediating variable in predicting future outcomes for at-risk infants (Stauffer et al., 1988).

A majority of the literature concerning gestational age (preterm infants) and low birth weight indicates that these factors influence the cognitive development of infants (Astbury et al., 1985; Kopp & Vaughn, 1982). Research involving low birth weight, preterm infants emphasizes that this population may be at-risk for developmental delays

(Astbury et al., 1985; Kopp & Vaughn, 1982; Lipkin & Altshuler, 1994; O'Connor et al., 1984; Pape et al., 1987).

Astbury and colleagues (1985) conducted a study focusing on the relationship of an at-risk population (including 242 very low birth weight (VLBW) babies) and their cognitive functioning as determined by their performance on the Bayley Scales. The authors' primary concern was to determine the effects of Attention Deficit Disorder (ADD), which was one of the influencing criteria for the at-risk population, on psychological functioning. Children diagnosed with ADD had significantly more minor physical/neurological disabilities than normal children. Results revealed that these children had significantly lower birth weights, $t\ (137) = 5.09$, $p < .001$. These results imply an increased vulnerability for attentional disorders in VLBW infants.

Pape and colleagues (1978) conducted a study involving 97 infants whose birth weights were less than or equal to 1,000 grams (VLBW), admitted to the Neonatal Intensive Care Unit at the Hospital for Sick Children. These infants were characterized as "high-risk" by one or more of the following factors: complications during pregnancy and/or during birth, premature birth, low birth weight, and medical history. The resulting sample size was 43 infants. The results suggest that birth weight had a statistically significant association, $r = .72$, $p < .005$, with children diagnosed as having a disability. Nine of the children (21%) were defined as significantly developmentally delayed. This study implies that prematurity and low birth weight may hinder future cognitive development.

Kopp and Vaughn (1982), Lipkin and Altshuler (1994) and O'Connor and colleagues (1984) agree that even when an at-risk population is not found to have significantly lower cognitive abilities when compared with a normal population, the at-risk population demonstrates subtle cognitive differences and below average intelligence scores at five years of age. These findings have important implications on future assessments and interventions concerning the at-risk population. The primary implication of these studies is the need for a follow-up neuropsychological assessment to determine if a developmental delay might exist in the at-risk population. Largo and colleagues (1990) and Crowe and colleagues (1987) agree that cognitive abilities decrease as a function of the severity of the perinatal complications in an at-risk population. When the at-risk factors become more severe cognitive functioning is often affected. This is especially true for children with severe mental deficiencies.

Summary

Cook and colleagues (1989) concluded that the BSID was a relatively stable instrument for predicting at-risk infants who may have developmental delays from 6 to 12 months. Farber and colleagues (1985) found that the long term predictive ability of the BSID for abnormal populations was much stronger than for the normal populations. They also found that the predictive ability of the BSID was particularly strong for mentally retarded infants and toddlers. Maisto and German (1986) agreed that the predictive ability of the BSID is markedly better for children who are handicapped or mentally retarded. Siegal and colleagues (1982) concluded that a strong significant relationship exists between 2-year BSID scores and IQ tests at 3-6 years of age.

In the current study the MDI scores from the BSID were used to assess the cognitive functioning of an at-risk population. Age corrected MDI scores were compared to gestational age and birth weight of a preterm population to determine if a relationship exists. If a relationship is found between gestational age and/or birth weight which may be predictive of future developmental delays, infants may then benefit from early identification and early intervention.

CHAPTER III

METHODS

Participants

Archival data was used for the current study. The data was obtained from 150 assessment protocols of premature, low or very low birth weight children seen at the neonatal intensive care follow-up clinic of the University of Mississippi Medical Center (UMMC). These children were assessed over the first two and a half (2-30 months) years of life. The children were administered the BSID during their follow-up at the Neonatal Intensive Care Unit Follow-up Clinic (NICUC). The infants were seen for prematurity, low birth weight, anemia, hyperbilirubinemia, hyaline membrane disease or any other factor that kept them in the NICUC for over 24 hours after birth.

Instrument

The age corrected MDI scores from the BSID was used to assess the cognitive functioning of the at-risk population. The BSID is used to assess the cognitive and motor functioning of infants and toddlers ages 2 months through 30 months. The results of the Mental scale yields a raw score, which is the total number of correct items. This raw score is converted to the Mental Development Index (MDI). (Bayley, 1969). The MDI score has a mean of 100 and a standard deviation of 16.

Procedure

Archival data was used in the current study. The BSID was administered to 150 infants as part of their routine follow-up visits in the neonatal follow-up clinic (five infant protocols were lost due to missing data). All tests were administered by appropriately trained psychometrists or psychologists on staff at UMMC. The information was coded from hospital records and made available to the researcher via computer files. Data was analysed by a statistical program, SPSS 6.1, to determine if a relationship existed between the three variables: gestational age, birth weight, and cognitive development. Multiple regression using a simple regression equation, one sample t-tests, and the Pearson correlation coefficient were used to determine if prematurity and/or low birth weight were related to the infant's neurological development as measured by the MDI score. The overall age corrected MDI mean of the at-risk population was compared to the standardization mean (via a one sample t-test) to see if a significant difference existed between the two populations.

CHAPTER IV

RESULTS

The total number of cases included in the final analyses was 145 (males = 64, females = 81), five cases were lost due to missing data (missing birth weights or missing MDI scores). The overall means for birth weight, gestation period, and age corrected MDI scores were: 992.96 grams, 28.67 weeks and, 86.02 respectively. The descriptive statistics are presented in Table 1.

Table 1

Descriptive Statistics for At-Risk Sample

Variables	M	SD	n	Range	
				Min	Max
Birthweight	992.96	411.52	145	386	2240
Gestation	28.67	16.87	145	17	35
CorMDI	86.02	14.52	145	49	124

Note: CorMDI is the age corrected MDI score for the At-Risk population.

The results of the regression analysis suggested no significant relationships between birth weight and age corrected MDI scores, $F(2, 143) = .91$, $p = .34$, and gestation period and age corrected MDI scores, $F(2, 143) = .22$, $p = .64$. Pearson correlation coefficients were also computed and no significant relationships were found between birth weight and age corrected MDI scores, $r = .079$, $p = .34$, and gestation period and age corrected MDI scores, $r = -.039$, $p = .637$. These results are presented in Table 2.

Table 2

Pearson Correlation Results

Variables	Birthweight	Gesational Age	Age Corrected MDI Scores
Birthweight	1.000	****	.91 (p = .341)
Gestation	****	1.000	.22 (p = .637)
CorMDI	.91 (p = .341)	.22 (p = .637)	1.000

These findings do not suggest any significant relationships between the three variables and therefore fail to reject the null hypothesis.

A one sample t-test was computed to determine whether there was a significant difference between the mean of the age corrected MDI scores of the at-risk population (M = 86.02, SD = 14.52) and the standardized mean (M = 100, SD = 16). The results suggested a significant difference was found between the at-risk population mean and the normative sample mean, t (147) = -11.72, p <.001, suggesting that the at-risk population performed significantly lower than normal on the Bayley Mental Scales. These results are presented in Table 3.

Table 3

One sample t-Test Between the At-Risk Sample and the Standardized Sample

Variables	M	SD	n	t-value	p-value
At-Risk	86.02	14.52	145	-11.72	.001
Normal	100	16	145	-11.72	.001

CHAPTER V

DISCUSSION

Conclusions

The current study examined the relationship between premature, low birth weight infants and their cognitive development as measured by the MDI score on the BSID. The alternative hypothesis stating that a relationship exists between prematurity, low birth weight and cognitive development was not supported. The current results suggested that birth weight and gestational age did not significantly predict the cognitive development of the infants in this sample when using age corrected scores.

The current sample did not include normal full-term babies to compare the gestational age and prematurity. Had the sample been more heterogenous (included full-term babies) the statistical analysis may have determined that a significant difference existed between gestational age and birth weight of infants overall. If the current homogenous sample had been larger (N > 1000) then there would have been an increase in the overall power and the ability to detect a difference between gestational age, prematurity and cognitive development would have been enhanced. However, these results do support those of Low and colleagues (1985); fetal-newborn complications impacted cognitive functioning in at-risk infants. These results also support findings by Staufer, Burns, Melamed, & Herman (1988); gestational age had no effect on cognitve functioning.

Attenuation of the range of scores tends to depress the correlation coefficient. Had a full range of birth weights and gestational ages been included the correlation coefficient between the two variables probably would have been larger and the predicted relationship may have been found.

Also, the results suggest that there is a threshold effect. That is, birth weights below a certain cutoff point may be affected moreso than birth weights above the cutoff. However, being farther below the cutoff point does not necessarily indicate more impairment of functioning (or lower age corrected MDI scores). In other words, it did not matter how far below the threshold the birth weights fell; once the weights reached the threshold cognitive impairment occurred. This is evident because the mean age corrected score was significantly lower than the normal mean and because of a lack of relationship between gestational age, birth weight, and age corrected MDI scores.

The second alternative hypothesis was confirmed. A significant difference was found between the age corrected MDI mean score of the at-risk population (M = 86.02, SD = 14.52) and the mean MDI score in the standardization sample (M = 100, SD = 16), t (147) = -11.72, p <.001. The results suggest that the at-risk sample had significantly lower MDI scores than the normative sample, suggesting that the current sample of premature, low birth weight infants' medical conditions or some other variable(s) may have affected the infants' cognitive development. These results also suggest that correcting the MDI score for prematurity may not be beneficial to long term prediction of cognitive development in at-risk infants.

Implications for Future Study

Since no significant relationship was found to exist between prematurity, birth weight, and age corrected MDI scores then it is conceivable that prematurity and low birth weight did not influence the infant's performance on developmental assessments, particularly cognition as measured by the MDI. Therefore, as the gestation period and weight decreased the MDI score was not significantly affected or that there was some threshold that few if any of the children passed. Since a significant difference was found between the mean age corrected MDI scores of the at-risk population and the normal population then additional research concerning the BSID with a developmentally at-risk population is needed. The age correction should theoretically counterbalance any gestational age differences between the two populations. The results show that age corrections for the MDI scores did not make the scores comparable to a normal sample.

As mentioned previously, some research supports the notion that MDI scores are predictive of developmental delays in at-risk populations (Crowe et al., 1987; DeBose, 1976). This is particularly important for the current study because the results suggest that this sample is already at-risk for acquiring developmental delays in the future. The current study stresses the need for early assessment leading to early intervention and thus supports existing literature (Bicker & Littman, 1982; Cook et al., 1989; Crowe et al.,1987; Dempsey, 1988; Goldstein et al., 1987; Klesges & Troster, 1987; Maisto & German, 1986).

A future study should include a larger heterogenous (normal and at-risk babies) sample to increase power and ability to determine a difference between gestational age and birth weight of full-term babies and premature babies. Also the study should include more babies at specific ages (8 months, 12 months or 24 months) instead of combining all ages from 2 months to 30 months.

A study conducted by Leguire and Fellows (1990) demonstrated that the BSID was in need of a revision. Sixty infants (54 full-term, 6 premature) between the ages of 6 and 30 months were assessed with the BSID Mental scale. Their overall MDI mean (M = 108.90) and standard deviation (SD = 12.51) was compared with the standardization mean (M = 100) and standard deviation (SD = 16). Results of a t-test indicated that the mean score of the current sample was significantly higher, $t(59) = 5.65$, $p < .001$, than the standardization sample. These findings imply the need for appropriate normative data in the standardization sample, essentially an updated version of the instrument. The BSID was revised in 1993 (Bayley, 1993).

Limitations

Future studies may want to include a more geographically diverse population since this study's sample came from one geographical location. Therefore, the current study may not be generalizable to a larger population. Also, this study did not include a normal population, therefore it should not be generalized to a normal population. The results of this study cannot be generalized to populations whose age categories fall outside the age range of the population used in the current study.

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