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Early risk indicators for special education placement: A developmental epidemiological study using information from birth and early in a child's life.

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EARLY RISK INDICATORS FOR SPECIAL EDUCATION PLACEMENT: A DEVELOPMENTAL EPIDEMIOLOGICAL STUDY USING INFORMATION FROM BIRTH AND EARLY IN A CHILD'S LIFE

by

SANDRA ELLEN CLUETT

A DISSERTATION

Submitted to the graduate faculty of The University of Alabama at Birmingham,
in partial fulfillment of the requirements for the degree of
Doctor of Philosophy

BIRMINGHAM, ALABAMA

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ABSTRACT OF DISSERTATION

GRADUATE SCHOOL, UNIVERSITY OF ALABAMA AT BIRMINGHAM

Degree Ph.D. Program Developmental Psychology

Name of Candidate Sandra Ellen Cluett

Committee Chair[s] Beverly A. Mulvihill and Jan Wallander

Title Early Risk Indicators for Special Education Placement: A Developmental Epidemiological Study Using Information from Birth and Early in the Child's Life

A fundamental problem remains in providing early intervention services for young children at risk for disabilities. In light of limited resources, determining who is most at-risk is of paramount importance; furthermore, developmental epidemiological methods are efficacious in identifying at-risk children. Applications include using (a) birth and school records and (b) family interview data combined with birth and school records to estimate a child's odds for being placed in special education at school age. The present study is the first known study to empirically test the use of developmental epidemiological methods using children's birth records and a retrospective family interview as a means of developing a more efficient and effective method of early identification. Participants were children in first grade special education within one Local Education Agency in Alabama (N = 3,595). Results show when birth and family interview data are incorporated to estimate the odds that a child will be placed in special education, the resulting model provides the best estimate (accounts for the most variability; R-square = .26) as compared with using either the birth or family data separately (R-square = .08, .24, respectively). In sum, this study emphasizes the benefits of using developmental epidemiologic methods and specifically demonstrates the feasibility of using data from a child's birth history and parental perceptions from early in the child's life to estimate risk status. Overall, this research provides a quantitative basis for the accurate identification of at-risk children.

DEDICATION

This dissertation is dedicated to “my kids”: Kyle (“Mr. Kyle”), Anna (“Banana”), Jacob (“J.T.”), Katie, and Emily (“Emmers”). I love each of you with an abiding love. Each of you is the joy in my life. I lift your name up daily in prayer to our Heavenly Father — He Loves you with an everlasting love. Don’t ever forget: “The task ahead of us is never as great as the Power behind us.” Whatever you desire in life, you can achieve it! I will be here for you always! My words of wisdom are as found in Jeremiah 29:11: “For I know the plans I have for you,” declares the Lord, “plans to prosper you and not to harm you, plans to give you a hope and a future.”

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CHAPTER 1

INTRODUCTION

A number of experimental research programs have examined the impact of early intervention services (Infant Health and Development Program, 1990; Ramey & Campbell, 1987; Ramey, Yeates, & MacPhee, 1984; Schweinhart & Weikart, 1981). Comprehensive reviews of early intervention literatures are plentiful (Bryant & Maxwell, 1997; Dunst, 1986; Farran, 1990; Guralnick, 1997; Guralnick & Bennett, 1987; Lazar, Darlington, Murray, Royce, & Snipper, 1982; Ramey, Mulvihill, & Ramey, 1996) and reveal four main points relative to early intervention: (a) early intervention can prevent the potentially harmful effects of various environmental and biological risk factors for young children and provides short-term benefits and long-term effectiveness for children, families, and society at large (Berrueta-Clement, Schweinhart, Barnett, Epstein, & Weikart, 1984; Campbell & Ramey, 1995; Infant Health and Development Program, 1990; McCarton et al., 1997; Ramey & Campbell, 1987; Schweinhart & Weikart, 1981); (b) the earlier the intervention is begun, the more effective it is (Berrueta-Clement et al., 1984; Campbell & Ramey, 1995; Ramey, 1992; Schweinhart & Weikart, 1981); (c) children at greatest risk benefit more from early intervention than children at less risk (Bryant & Maxwell, 1997; Escalona, 1982; Martin, Ramey, & Ramey, 1990; McCarton et al., 1997); and (d) the focus of early intervention research is shifting to concentrate on what works and for which children (Kochanek, Kabacoff, & Lipsitt, 1990; White, 1993).

Yet, because funding and personnel are limited, a key problem remains in provision of early intervention services. The core of the problem lies in three main areas: defining the at-risk population, identifying which children are at risk early in their lives, prioritizing who benefits most from early intervention services, and determining who to serve.

Conclusions regarding the effectiveness of early intervention strongly illuminate the need for identification of children at risk for poor educational and developmental outcomes to begin intervention services as early as possible. Children likely to need special education services can be identified in the first three years of life and targeted for preventive intervention to diminish the likelihood of special education placement and poor developmental outcomes. Such timely identification and subsequent service provision for children at risk for developmental disabilities are critical prevention goals. Further, early identification of children at high risk for later disabilities has several individual and societal advantages (First & Palfrey, 1994; Mercer, Algozzine, & Trifiletti, 1988).

Despite its demonstrated importance, early identification of children at risk for later disabilities remains problematic for two main reasons. First, although the Individuals with Disabilities Education Act (IDEA, 1997) supports a national initiative to establish early identification and service systems for children with special needs, many states have no registry of at-risk children and funding for serving at risk children is limited. In light of these limited funding considerations, determining who is most at-risk is a paramount issue in early identification. In total, only nine states formally serve the 0-3 at risk population (National Early Childhood Technical Assistance System, 1997), all with disparate definitions of at risk (Shackelford, 1997). Clearly, identification of children at risk for later disabilities is not occurring in the majority of states for the 0-3 population, resulting in only a small fraction of at-risk children receiving preventive early intervention services.

Secondly, new cases of disability frequently are first identified when children enter public school, too late to benefit from early intervention and for society to maximize expected gains (First & Palfrey, 1994; Ramey et al., 1996). In fact, nationwide, the majority of infants, toddlers, and preschoolers at risk for a disability are not identified until school age, missing the opportunity to receive intervention services before age five (Carran, Scott, Shaw, & Beydouin, 1989; Meisels & Wasik, 1990). It is reasonable to expect that many children with disabilities first identified at school age had risk indicators that were present and identifiable early in the child's life.

Much literature exists describing factors present early in life which may result in less than optimal educational outcomes. Findings from these studies reveal that single factor risk research is less effective in determining risk than multifactor studies. Rather the number, combination, and interaction of specific biological and environmental risk factors provide the best prediction of later developmental functioning. In particular, these studies show that the strength with which biological risk factors affect children is based on the accompanying level of environmental risk. Nonetheless, there are several limitations of the multiple risk factor approach. First, there is no universally agreed upon definition of risk. Second, research is inconsistent in showing which combination of risk factors is most predictive of later disabilities for certain populations. Third, predictive models have been shown to have limited specificity and sensitivity in determining which child will have a later disability. Fourth, the use of longitudinal designs is not advantageous for studying low prevalence conditions or conditions which have a long onset latency, both of which apply to developmental disabilities. Finally, long-term longitudinal risk research is not always feasible in terms of time or person resources. A research methodology is needed to overcome these limitations and substantiate early and effective identification of children most at risk for later disability and placement in special education.

Developmental epidemiology has been shown to be one such profitable method to accurately identify at-risk children. Scott, Shaw, and Urbano (1994) defined developmental epidemiology as:

> The study of the distribution of behavioral outcomes in infancy and childhood and the indicators of their occurrence. An indicator, or factor, is any characteristic of a person, time, or place that influences outcome for good or bad. They include biological, sociological and environmental factors, characteristics, exposures, or experiences. (p. 352)

One salient application of developmental epidemiological includes the retrospective case-control design with record linkage methodology. By linking extant data bases, researchers can create a longitudinal file without the problems inherent in longitudinal research (Boussy & Scott, 1993; Newcombe, 1988). Record linkage methodology is most beneficial in studying diseases or conditions, such as disability or developmental outcomes, with long latency periods or low prevalence. This approach enables researchers to very quickly gather population-based long-term developmental data. Linking existing independent data sets allows one to obtain population-based long-term data as quickly as the records can be compared and matched without a substantial time lapse in the data gathering phase (Boussy & Scott).

Specifically, research in this area has consistently demonstrated the efficacy of using matched birth and school records to determine special education placement and poor school performance. These linked data sets are powerful tools in quantifying risk associated with a given developmental outcome. As reviewed by Cluett (1998), a number of studies have advanced the use of developmental epidemiology methodology and demonstrate its applicability (Andrews, Goldberg, Wellen, Pittman, & Struening, 1995; Carran et al., 1989; Claussen, Scott, & Hurtado, 1996; Finkelstein & Ramey, 1980; Goldberg, McLaughlin, Grossi, Tytun, & Blum, 1992; Mulvihill, Brezausek, Sullivan, & Cluett, 1995; Ramey, Stedman, Borders-Patterson, & Mengel, 1978).

One such study is Project Early Identification (Project Early ID), which provided the foundation for this study. Project Early ID was initiated to more fully understand the rapid increase in identification of children with mental retardation during the early elementary years (Mulvihill et al., 1995). The overall objective of Project Early ID was to ascertain the feasibility and practical utility of a statewide surveillance system using record linkage methodology to identify children at high risk for mental retardation. In this study, case-control analysis revealed that low maternal education at children's birth placed children at the greatest risk for mental retardation ($p < .05$, odds ratio = 3.48). Further, 5-minute Apgar scores, birth weight, and maternal age were also associated with children's risk of mental retardation (Mulvihill et al.). Through this pilot study, data linking record methodology was tested, modified, and refined for use in the present study.

Project Early ID also piloted a qualitative parent interview. Rojahn et al. (1993) showed that identifying high-risk children appropriate to receive early intervention services based on information available at time of the child's birth and early in the child's life (family interview data) is a viable and powerful approach. Of the population of approximately 8,000 students receiving third-grade special education in the 1994-1995 school year, Project Early ID completed 652 interviews (less than 10%). The third phase of Project Early ID attempted to combine the family interview data to the linked birth and school records. However, because of unforeseen design issues, limitations of the data sharing agreement regarding identifying information, and a small percentage of family interviews being completed, it was not possible in this pilot work to combine the family interview data with the linked birth and school records.

Therefore, no study to estimate risk has been conducted to understand the usefulness of combining birth certificate data and family interview data within a developmental epidemiologic framework. This investigation was designed to demonstrate the practical utility of combining information available early in a child's life (gathered via a retrospective family interview) with information available from the time of the child's birth (gathered via extant birth certificate records) to determine the need for later special education placement (gathered via extant school records) and, thus, determine this method's potential benefits for identifying and prioritizing at-risk children. The study will test three main hypotheses. First, it is hypothesized that family and child risk factors present at the time of a child's birth which are recorded on the birth certificate will increase a child's odds of being placed in special education. Secondly, it is hypothesized that family and child risk factors present early in a child's life gathered via a family interview will increase a child's odds of special education placement. Thirdly, it is hypothesized that by including a more comprehensive set of risk variables from both the child's birth history (birth certificates) and the child's early years (family interview), this model will provide a more comprehensive assessment of risk factors and, therefore, provide the most information in terms of assessing risk status. To fully test the hypothesized models, the study included two main phases: computerized record linkage and parent interviews.

CHAPTER 2

METHOD

Population

The sample includes children from the Birmingham City local education agency (LEA), the third largest LEA in Alabama with 75 elementary schools and 38,451 students (K-12) enrolled in the 1997-98 school year. The study population is children born between 1988 and 1990 and in first grade in this LEA during the 1995-1996 school year in both general (N = 3,385) and special education (N = 210). The overall population (K - 12) is 95% African American and 50% boys. For the first graders, 94% are African American and 53% are males. For the second graders, 94% are African American and 51% are males (L. Contri, personal communication, June 1, 1998).

Procedure and Sample

Phase one--Record linkage. In phase one, children's birth and school records were linked. In part, this linkage occurred because an interagency data sharing agreement was forged as part of a larger statewide initiative on the prevention of disabilities that included the State Departments of Education, Public Health, Mental Health/Mental Retardation, Rehabilitative Services, and the Civitan International Research Center.

Accessing extant education and public health records. The Alabama Department of Education, Division of Special Education Services, forwarded a computer file containing the 1995-1996 Child Count data for children in special education. This data file was used to report the department's special education services to the federal government. It listed first grade children placed in special education as of December 1, 1995, for the Birmingham City LEA. The variables included children's last name, first name, middle initial, date of birth, social security number, race, gender, school code, and exceptionality. Likewise, the Alabama Department of Public Health, Center for Health Statistics provided a data file of individual children's birth certificate records for the 1988-1990 birth cohorts.

The process of record linkage involves two steps: searching step and matching step. Searching involves narrowing the field of all possible comparisons that are necessary for linkage procedures. Boussy and Scott (1993) noted that it is feasible to compare each record of interest (here, first-grade children in special education from Birmingham City Schools in the 1995-96 school year, $\underline{N} = 210$) with the entire master file of birth certificates in the state of Alabama for each of the three birth cohorts of interests (approximately 60,000 births per year in Alabama). However, this is rather inefficient and costly in terms of computer time and wasted comparisons. Linkages are most efficient when the master file is blocked using one or more identifying variables for which there is a high probability of finding a match for the incoming record. For this present study, the linkage blocking process limited the master birth file by only including birth certificates if the county of birth was Jefferson County (in which Birmingham City is located), the city of birth was Birmingham, mother's county of residence was Jefferson County, or mother's city of residence was Birmingham.

To begin matching, the researcher arranged the data set in an orderly sequence using one or more identifying variables. Most often surname or first name was the variables used to sequence files. Yet, because of the high frequency of potential misspellings of a surname, often an alternate phonetic coding of this variable is used. Two of the most commonly used coding systems were Russell Soundex Code and the New York State Intelligence Information System (NYSIIS). In general, both of these codes replace consonants with similar sounds with a standard character to represent that sound, while suppressing vowel information (Boussy & Scott, 1993; Newcombe, 1988). The relative effectiveness of both phonetic codes compared with using the actual surname and first names within the matching step were examined. In the Early ID pilot work, matching was completed using the Soundex Phonetic Code, the NYSIIS Phonetic Code, and the actual surname and first names in the data set. Based on the three different methods of matching, results showed that overall 64%, 63%, and 69% of the records were matched, respectively. Therefore, neither phonetic code resulted in a higher percentage of matches than matches using nonphonetic coding. As a result, in the present study, the matching step was completed using the actual surname and first name within the data set.

Within the record linkage matching step, one other decision was necessary: to use either deterministic or probabilistic matching. In short, in deterministic matching, also known as the all-or-none method, a record pair is considered either a true link or true non-link. In contrast, in probabilistic matching, a record pair is compared by weights assigned to the partial or complete agreement or disagreement of identifiers. A total probability weight is computed for a record pair and compared against weight thresholds. However, because the deterministic approach is simple, economical, reliable and preferred where practical (Baldwin, 1973; Boussy & Scott, 1993), it was chosen for this study.

To begin deterministic record linkage, a "match key(s)" must be defined. This match key provides the linkage variable(s) between the two data sets. It is preferred that a unique identifier (e.g., social security number) be defined as the match key. In the absence of a unique identifier, any combination of identifying items (e.g., gender, data of birth, surname) can be used as match keys. This match key combination of characteristics can be used to determine if records from distinct extant data bases refer to the same individual. For purposes of this study, no unique match key was present. However, six demographic variables were potential match key variables on both children's birth and school records: last name, first name, middle initial, race, gender, and date of birth. Using these variables, an iterative approach with less stringent criterion for each step was implemented. Consecutive passes through the data were made in an effort to locate linkages missed on the earlier match criteria. The actual steps in the data linking process and resulting number of matches are presented in Table 1.

It is important to note that these steps did not include race as an identifier. Based on the pilot work (Mulvihill et al., 1995) and examination of the children's birth and school records, it was noted that children's birth certificates reported maternal ethnicity, whereas school records reported the child's ethnicity. To determine how the differentially reported ethnicity variable affected the data linkage results, two separate full criteria matches on an earlier 1985 cohort were conducted: one including ethnicity and the other

Table 1

Data Linking Results: Birth Certificate and Child Count Data

Category		1988	1989	1990
# of Education Records		92	117	1
# of Public Health Records		11,680	11,900	11,858
Data Linking Steps	Match 1--Exact birth month and day, first and last name, and Gender	60	65	1
	Match 2--Exact birth month and day, last name and gender; plus first 4 letters of first name	3	6	0
	Match 3--Exact birth month and day and gender; plus first 4 letters of first name and 7 letters of last name	0	1	0
	Match 4--Exact birth month and day and gender; plus first letter of first name and 4 letters of last name	8	14	0
	Match 5--Birthdate plus or minus 3 days, exact first and last name and gender	2	1	0
	Match 6--Birthdate plus or minus 3 days, first 4 letters of first name and 7 letters of last name, exact gender	0	0	0
	Total matched (Percentage matched[a])	73 (79)	87 (74)	1 (100)
	Total not matched (Percentage not matched)	19 (21)	30 (26)	0 (0)
	Total correctly matched	73	87	1
	Percentage correctly matched [b]	100	99	100
	Percentage mismatched	0	1	0

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[a] Percent matched calculated: (# of matches)/ (total # of education records). [b] Percent correctly matched calculated: (# of correct matches)/ (# of total matches).

common variables, and another without ethnicity. For the match including ethnicity, 2,157 records were matched. For the match excluding ethnicity, 2,198 records were matched, an increase of 2%. Therefore, the differentially reported ethnicity variable was not used in the final data linkage iterative steps.

Record linkage results. Data linkage was conducted to link Child Count data for each child (school record) with his or her birth certificate data for the 210 first graders enrolled in special education in the Birmingham LEA during the 1995-1996 school year. Six-and seven-year-old first graders included three birth cohorts: 1988, 1989, and 1990. Overall, 161 special education Child Count records were correctly matched with the child's respective birth record for an overall match rate of 77%. Subsequent to the computer linkage, data were visually checked to determine the correct match percentage rate. The sensitivity (number correctly matched divided by the total number of records matched) was 99%. The specificity (the number of correct non matches divided by the total number of non matches) was 100%. Overall, of the records matched, 99% were correctly matched. Five controls were assigned for each study child (case) and matched on day, month, and year of birth, gender, and race.

Phase 2--Parent interviews. The second phase of this study involved conducting interviews with parents of second grade general and special education students.[1] In this phase, parents of children in special education and their matched controls (as determined by record linkage phase above) received a letter describing the project and asking for their participation in the study telephone survey. This letter was then distributed through the teachers and staff at the school level to maintain confidentiality. As part of the agreement with the LEA, it was left to the discretion of the local school how the letters were to be distributed. Based on the limitations of the data sharing agreement and to maintain confidentiality, researchers were unable to directly address letters to the parents of children in special education. Rather, an approximate number of special education students in a particular school was determined from school records. This number of interview information packets was given to the school to distribute to each second grader in special education. In contrast, for the children in general education, because there were no confidentiality issues, we were able to determine which school the child was in (according to the LEA records) and to directly address an interview information packet to the name of the control subject.[2]

Included with the interview information packet was a letter describing the project and a no-postage-required postcard for parents to complete and return. The postcard listed a toll-free number to call with questions; asked parents to indicate if they consented to be interviewed; requested their signature; and asked for the child's name, parents' name, address, phone number, and best day and time to call. If the parent did not consent to the interview, he or she was asked to complete basic demographic information (i.e., age of the child, gender of child, race of child, and county and state of birth) and return the postcard.

After the initial mailing and a subsequent reminder, a third distribution of letters with incentives (e.g., drawing for 1 of 12 gift certificates totaling $500.00) for participation in the telephone interview was completed. To motivate teachers to encourage their parents to participate, the teacher who had the most parents of students in her or his classroom to be involved in the interview won a gift certificate to a local education supply store.

To conduct the family interviews, interviewers were recruited from students in the University of Alabama at Birmingham psychology department. Of the interviewers, 69% were female, and 94% were Caucasian. A larger percentage of African American interviewers were initially recruited to ensure an interviewing staff similar to the study population; however, a number of these students were unable to conduct the interviews because of conflicting school or work schedules. Of the interviewers, two students had a disability (cerebral palsy and hearing impairment corrected with hearing aids). Because of the potentially sensitive topic areas (e.g., disability, income, family history), the interviewer training involved general interviewing skills and techniques specific to telephone interviewing; information on early intervention, disabilities, special education; and practice conducting the actual interview and role-playing mock interviews based on potential situations which may arise. Additionally, the special education coordinator of the Birmingham City Schools conducted an inservice training prior to the start of data collection. This session provided specific information about the group of parents we would be interviewing and additional insights into working with this population. Before an interviewer began interviewing, the principal investigator verified their interviewing ability. Reliability checks were performed on 50% of all interviews to ensure accuracy of the data collected. Reliability checks were conducted by using a 3-way phone line with the parent being interviewed, the interviewer conducting the interview, and the reliability interviewer listening and scoring the interview as well. Immediately after the interview was complete, both interviewers reviewed the recorded data, and noted and resolved any inconsistencies in data collection. Overall, reliability coefficients revealed consistently high interrater reliability on interview data with the average reliability being 97% (range 91% to 100%).

Parent interview results. For each participation consent postcard received, a family interview was attempted.[3] A total of 166 consent forms were received (105 special education, 61 general education). Of the 105 potential special education interviews attempted, 94 were completed (89%). Of the potential interviews with parents of general education students, 49 were completed (80%). In total, 86% (143/166) of the potential family interviews were completed, with an attrition rate of 14% (See Table 2).

Table 2

Reasons for Family Interview Subject Attrition by Education Classification

Reason for attrition	Special education	General education	Total
Refused interview when contacted by phone	3	8	11
Non working number	2	1	3
No answer after repeated calls	2	2	4
No eligible respondent at number	4	0	4
Interview terminated	0	1	1
Total attempted[a]	105	61	166
Total number not completed	11	12	23
Total completed	94	49	143
Total percentage completed)	89	80	86

[a] Total attempted = Total number of interview consent postcards received.

Combining birth and interview data for final data set. The concluding step in creating the data set for analysis involved combining the family interview data with the linked birth and school records. As in Phase 1, record linkage was used to join children's birth and school records with family interview data. A combination of characteristics (e.g., sex, date of birth, surname) was used to determine whether records from extant data bases referred to the same individual as in the family interview data file. Combining the birth and school records with the interview data resulted in 82 records being matched (35 special education and 47 general education; See Table 3). Matches were then visually checked to determine correct match percentage rates. Sensitivity and specificity were 100% and 97%, respectively, revealing high percentages of correct matches. However, the overall percentage of records matched was lower than desired (match rate of 49%) and resulted in a small and unanalyzable sample size.

Table 3

Initial Computerized Match: Birth Certificate-Education Records and Family Interview Data

Education category	Total records linked	Potential matches[a]	Percentage
Special education	35	105	33
General education	47	61	77
Total	82	166	49

[a] Based on total number of interviews attempted.

Because these numbers were unacceptably low, a closer examination of linked and nonlinked records was completed manually. After examining the special education records from the Child Count Data for which a match was not found in the public health file, two main reasons for attrition were determined: (a) according to parental reports, some children were not placed in special education until the second grade; and (b) some students were born before 1988.[4]

Therefore, in an attempt to increase the sample size, an additional data collection step was implemented. In this additional data collection step, two strategies were employed to overcome the above noted predominate reasons for attrition. For special education children whose parents reported the children were not placed in special education until second grade, a copy of the 1996-1997 Child Count data was obtained. From this data set, researchers attempted to locate the nonmatched subjects. For subjects who were reported to have been born before 1988, researchers went back to the Alabama Department of Public Health to attempt to locate the birth certificates of these non-matched subjects. All appropriate data were then abstracted and linked with other available data manually. As a result of this additional data step, an additional 26 special education records were verified as correct matches and subsequently added to the final data set. Results of the additional data collection step are shown in Table 4.

Therefore, the final sample of children who were correctly linked on birth records, education records, and interview data were 108 (61 special education and 47 general education; See Table 5). Reasons for attrition, once the final sample was determined, were examined again and are explained in Table 6.

Of the final sample, 92% were African American and 65% were males. This sample was similar to the Birmingham LEA in percentage of African Americans. However, the sample used for this analysis had a slightly larger percentage of males than the Birmingham LEA. Of the interviews conducted, 91% of the respondents were the child's mother, 5% were the grandmothers, and 3% another relative (e.g., father, aunt).

Table 4

Additional Manual Match: Birth Certificate-Education Record and Family Interview Data

Education category	Total additional records linked	Total records not linked	Total number of possible matches	Percentage matched in additional match[a]
Special education	26	44	70	37
General education [b]	0	0	0	0
Total	26	44	70	37

[a] Percentage matched calculated: (# of total records linked)/ (# total number of potential matches). [b] No additional general education matches were attempted because linkages began with the Child Count data and general education children were used as controls and defined as general education if their record was not in the Child Count data.

Table 5

Final Data Set: Matches on Birth Certificate-Education Records and Family Interview Data

Education category	Total records linked	Potential matches	Percentage
Special education	61	105	58
General education	47	61	77
Total	108	166	65

Instrumentation

The family interview survey was originally developed at the Civitan International Research Center for Project Early ID. The 30-45-minute telephone survey is an in-depth systematic method to gather information at the child and family level. It was designed to

Table 6

Reasons for Subject Attrition of Cases within Final Data Set (Birth, Education, and School Records)

Reason for attrition	N	Percentage
Total matches attempted	105	
Total completed (percentage)	61	58
Total number not matched	44	41[a]
No education record found	30	68[b]
No birth certificate found	7	16[b]
Child in gifted program (ineligible)	1	2[b]
Unable to determine reasons	6	14[b]

[a] Percentage based on percent of total sample (n =105). [b] Percentage based on total number attrited (n = 44).

be sensitive to cultural issues and concerns of individuals with disabilities. Parent input during the development of the instrument was provided from several sources, including parents of children with disabilities. Input was also received from researchers working primarily with African American families.

The beginning of the interview provided a scripted section to introduce and remind the parent about the purpose of the study and their agreement to participate, and to obtain verbal consent to continue with the interview. The interview included 127 questions and six main sections: child and family demographics, birth history and early development, nature of the receipt of early intervention services, education program, quality of the home environment, and children's social and behavioral skills. Answer formats were primarily close-ended responses, although parents had opportunities for open-ended responses, and a chance at the end of the interview to clarify or restate any information.

The quality of the home environment was measured by the Home Screening Questionnaire (HSQ; Coons, Gay, Fandal, Ker, & Frankenburg, 1981). The HSQ is a screening instrument of factors within a child's home which affect development. Items from the HSQ are from the Home Observation for Measurement of the Environment (HOME; Caldwell & Bradley, 1978); however, the HSQ is a parent-answered questionnaire written at a third- or fourth-grade reading level and does not require a visit to the child's home. The HSQ was standardized on a group of low income families. The correlations between the HSQ and the HOME Inventory were .81. Internal consistency is reported to be .80, and test-retest reliability is .86 (Coons et al.). The HSQ score measured at the time of the interview was used as a proxy variable for quality of the home environment early in the child's life.

Study Design

This study utilized a retrospective case-control study design. The use of the retrospective case-control design is identified as an appropriate study design in the developmental epidemiological studies of child outcomes (Scott et al., 1994). The case-control study design compares a group of study cases to a group of noncases with respect to a current study factor level (in this study, for example, children in special education compared with children not in special education). The sample is supported by a comparison group from the same population (school-age children) without the outcome (Scott et al.). For this study, children in special education served as cases and were matched with children not receiving special education, who serve as controls.

Data Analysis

Outcome variables. The primary outcome measure was a dichotomized variable indicating education status (special education or general education).[5] Information for the outcome measures was coded based on the child's school record. The main special education classifications were children with a speech-language impairment (59% of all children in special education), mental retardation (13%), learning disability (11%), and emotional conflict (4%). The remaining 13% of the special education children were classified with other disabilities such as a hearing impairment, orthopedic impairment, or visual impairment.

Potential risk factors. Birth certificate and family interview risk factors were selected on the basis of previous literature regarding risk factors for later special education placement and the pilot Early ID work. Variables from the birth certificate included gender of the child, maternal education, maternal age, mother's marital status, number of previous live births, gestational age of child, 1- and 5-minute Apgar scores, and birth weight. The State of Alabama birth certificate record also includes data regarding paternal education, month prenatal care began, use of alcohol and tobacco during pregnancy, labor complications, medical risk factors to pregnancy, and congenital abnormalities of the child as potential risk factors. Upon examination of the data, however, it was found the reporting rates were too low for use in this analysis.[6] Variables from the family interview included child's race, parental special education placement, family income, length of child's hospital stay after birth, perceived development in the first year of life, parental identification of a problem in the first three years of life, child repeated a grade in school (kindergarten or first), receipt of early intervention services, family size, and quality of home environment. Continuous variables were dichotomized as indicated below in discussing the logistic regression results, using cut points suggested by Project Early ID and reports in the literature.

Statistical analyses. Data analysis involved a series of steps to determine the utility of combining information gathered from the family interview with information available from the child's birth certificate to determine later special education status. Five main areas were examined and are described below: (a) bivariate relationships, (b) multiple logistic regression models, (c) interactions of risk factors, (d) additive effects of risk factors, and (e) attributable fractions.

To examine the distributions of risk factors in the special and general education children, chi square analyses were conducted. Preliminary bivariate analyses were then conducted using logistic regression models for all potential risk factors from the birth certificate and family interview data. Because of the large number of potential explanatory variables, these bivariate analyses were used to reduce the number of explanatory variables. To this end, only explanatory variables ($p < .30$) in bivariate analyses were retained for multiple logistic regression, as recommended by Hosmer and Lemeshow (1989).

While conducting multiple logistic regression analyses, the multi-collinearity of variables was carefully examined to avoid including two separate variables which measure the same construct (Hosmer & Lemeshow, 1989). To begin the examination of the multiple logistic regression models, two separate models were developed: one with the significant birth certificate risk factors and one with the significant family interview risk factors from the respective bivariate analyses. The more commonly used criteria ($\underline{p}$ < .05) is too stringent for this sample ($\underline{N}$ = 108). Therefore the significance criteria, alpha = .10, was used to test for significance. Given the sample size (and alpha =.10), the power to detect an odds ratio of 2.00 is 78%, whereas using the standard criteria (alpha = .05) the power to detect an odds ratio of 2.00 is only 63% (Hosmer & Lemeshow, 1989).

The last step combined the birth certificate and family interview data in a model to determine which risk factors, in the presence of the others, place a child at highest risk for being placed in special education. Within each model, an exposure odds ratios (OR) for child and family risk factors was calculated. The OR also is the standard measure of association in a case-control study. The OR provides the odds of exposure to a risk factor among those who have a disorder (e.g., special education placement) compared with the odds of exposure among those who do not have a disorder. To determine the goodness of fit for each model, the R-square values were calculated (Hosmer & Lemeshow, 1989; SAS Institute, 1995). The R-square value computes the generalized coefficient of determination and measures the variability explained with a given model. Higher R-square values indicate a better fitting model with more variance accounted for on the outcome measure.

To further explore the impact of the significant variables from the birth and family interview data in the final analysis, all possible interactions of variables were examined. Interactions were included to determine how the presence of one risk factor mediates the effects of another.

After examination of the interactions of variables, joint or additive effects of pairs of variables were also evaluated. Examination of the additive effects reveal the cumulative effect of having multiple risk factors on a child's outcome. Additive effects were calculated using the parameter estimates from the multiple logistic regression models. According to Selvin (1996), cumulative odd ratios (or additive effects) are calculated by multiplying the individual odds ratios. Selvin stated that the additivity of effects determined within logistic regression models are equivalent to the multiplicative effects of the two variables.

In addition, attributable fractions (AF) were calculated for each potential risk factor. The AF[7] is an estimate of the proportion of cases that would be prevented if a risk factor was eliminated. The AF is important to consider because if it is found that risk factor A increases the odds for special education placement by a certain percent, we do not know what effect the extinction of risk factor A will necessarily have on overall special education placement. The AF combines the odds ratio and the risk factor prevalence to reflect the fraction of all cases associated with the risk factor. For the AF estimate to be valid, the association between the risk factor and the outcome must be causal (Kahn & Sempos, 1989; Selvin, 1996).

CHAPTER 3

RESULTS

Attrition Concerns

Because of the high rate of non linkages, matched and nonmatched subjects were examined within two primary groups. First, the final data set (special education cases only, N = 61) was compared with subjects in the original birth certificate-education file who did not match in the final data set (N = 134). Child gender, race, birth weight, and Apgar scores at 1 and 5 minutes and maternal marital status at birth, education, and race were examined. No significant differences between the two groups were found on any of these demographic variables (See Table 7). Next, the final data set (N = 108) was compared with subjects in the interview data for whom a match was not found and, therefore, were not included in the final data (N = 58). Child gender and race, maternal mother's age at time of child's birth, education, and income were examined. No significant differences were found for these factors (See Table 8), indicating the characteristics of participants in the final data were not significantly different from those who were not matched and not in the final data set.

Bivariate Relationships

In Tables 9 and 10, the distribution of special and general education children by demographic and family and child risk factors found on children's birth certificates and

Table 7

Examination of Matched and Not-Matched Subjects from Birth Certificate Data Set

Variable examined		Not matched *n* (percentage)[a] *N* = 134	Matched *n* (percentage)[a] *N* = 61	Chi square (*p* value)[b]
Gender:	Male	93 (69)	40 (67)	
	Female	41 (31)	20 (33)	.14 (.70)
Child race:	Caucasian	16 (12)	7 (12)	
	African American	18 (88)	54 (89)	.01 (.93)
Marital status at birth:				
	Married	54 (40)	24 (46)	
	Single mother	80 (60)	28 (54)	.53 (.47)
Maternal education:				
	Less than 8th grade	37 (28)	16 (27)	
	High school education	49 (37)	17 (28)	
	More than high school	48 (36)	27 (45)	10.4 (.49)
Maternal race:				
	Caucasian	19 (14)	7 (12)	
	African American	115 (86)	52 (88)	.19 (.66)
Birth weight (in grams)		3111.8	3008.5	.94 (.35)
Apgar score at 1 minute		7.8	7.9	-.37(.71)
Apgar score at 5 minutes		8.7	8.9	-.84 (.39)

[a] Means for continuous data. [b] T statistic for continuous data.

in the family interviews, respectively, are given. The birth certificate data revealed that a larger percentage ($p < .30$) of children in special education were born at an early gestational age, a first-born child, and lower birth weight and had mothers without a high school education and mothers who were married compared to general education children.

Table 8

Examination of Matched and Not-Matched Subjects from Family Interview Data Set

Variable examined	Not matched n (percentage)[a] N = 58	Matched n (percentage)[a] N = 108	Chi square (p value)[b]
Gender: Male	31 (62)	61 (66)	
Female	19 (38)	32 (34)	.18 (.67)
Child race:			
Caucasian	5 (11)	7 (8)	
African American	42 (89)	85 (92)	.36 (.54)
Maternal education:			
Less than high school	27(24)	44 (48)	
High school education	2 (37)	2 (2)	
Some college	13 (40)	39 (42)	
College degree	6 (13)	7 (7)	3.7 (.29)
Maternal age at birth:			
18 or less	6 (12)	11 (12)	
18-25	20 (40)	44 (47)	
26-40	22 (44)	37 (40)	1.9 (.60)
Income per year:			
Less than $20,000	31 (62)	62 (57)	
More than $20,000	19 (38)	46 (43)	9.9 (.54)

[a] Means for continuous data. [b] T statistic for continuous data.

Results from the family interview data show a larger percentage of children in special education had a parent who previously received special education services, were thought to have been delayed in at least one developmental area during the first year of life, recognized as having an identifiable problem before age three, had a substandard quality of the home environment as measured by the HSQ, received early intervention services before age five, and repeated a grade ($p < .30$). Although the receipt of early intervention services was measured for special and general education children and sig-

Table 9

Birth Certificate Data: Prevalence of Risk Factors for Special Education Enrollment

Category-Variable	Special education n (percentage) N = 61	General education n (percentage) N = 47	p value
Gender of child (male)	40 (67)	29 (62)	.59
Maternal education			
Less than 8th grade	1 (2)	1 (2)	.27*
Education between 8th grade and high school	18 (30)	6 (13)	
High school graduate or some college	25 (56)	20 (74)	
Maternal age (at time of child's birth)			
18 or less	9 (15)	5 (11)	.80
18 to 25	26 (43)	21 (45)	
26 to 40	25 (42)	21 (45)	
Mother's marital status: Single	28 (46)	23 (49)	.23*
Number of previous live births			
None	18 (53)	15 (32)	.15*
One	10 (30)	18 (38)	
Two or more	6 (14)	14 (30)	
Gestational age: Less than 32 weeks	11 (18)	3 (6)	.07*
1-minute Apgar score: Less than 7	7 (12)	5 (11)	.89
5-minute Apgar score: Less than 7	3 (5)	2 (4)	.87
Birth weight (in grams)			
Less than or = 2,500 grams	21 (21)	5 (11)	.14*

* p < .30.

nificantly differed between education groups (41% of special education students received early intervention and 9% of general education children), this variable was not used as an

Table 10

Family Interview: Prevalence of Risk Factors for Special Education Enrollment

Category-Variable	Special education n (percentage) N = 61	General education n (percentage) N = 47	p value
Child race: African American	48 (86)	37(100)	.02*
Mother received Special Education	6 (11)	2 (5)	.32
Father received Special Education	6 (11)	1 (3)	.24*
Family income:			
$20,000 or less	34 (56)	28 (60)	.69
How long child in hospital after birth			
Less than 1 week	43 (77)	31 (86)	.27
1-8 weeks	13 (23)	5 (14)	
Received early intervention services	25 (41)	4 (9)	.001*
Development in the 1st year of life			
Same or more advanced	32 (59)	33 (92)	.001*
Less advanced	22 (41)	3 (8)	
Parent identified a physical, behavior, speech, hearing or emotional problem:			
In the first year of life	11 (18)	5 (11)	.17*
Between 1 and 3 years of age	15 (25)	2 (4)	
Child repeated a grade	23 (41)	2 (6)	.001*
Family size (children & adults)			
Four or more in home	19 (31)	13 (28)	.69
Substandard quality of home environment[a]	35 (57)	22 (47)	.28*

[a] Mean scores on the *Home Screening Questionnaire* were used as a cutoff point.

* $p < .30$.

used as an independent risk factor. It is logical to conclude that the receipt of early intervention services may have been the result of a developmental delay and not a risk factor which would increase a child's odds of special education placement. Similarly, despite the difference between the education groups in the percentage of children who repeated a grade, this variable was not used as independent risk factor.

Table 11 shows the risk factors from the birth certificate data which independently increase the odds of a child being placed in special education. Four variables independently differentiated the educational groups (p < .30): maternal education less than high school, first-born child, gestational age less than 32 weeks, and low birth weight.

Table 11

Birth Certificate Data: Estimates of Special Education Placement--Odds Ratio and Significance Levels

Variable examined	Parameter estimate	Odds ratio	Confidence intervals	p value
Gender of child (female)	-.22	.81	.36, 1.8	.59
Maternal education				
Less than high school	1.1	2.8	1.0, 7.9	.04*
Maternal age (< 18 at child's birth)	.50	1.6	.52, 5.2	.39
Mother's marital status:				
Not married	-.12	.89	.41, 1.9	.75
Number of previous births				
None	1.0	2.8	.86, 9.1	.08*
One	.26	1.3	.38, 4.4	.67
Gestational age: < 32 weeks	1.2	3.2	.85, 12.3	.09*
1-minute Apgar: Less than 7	.09	1.1	.32, 3.7	.89
5-minute Apgar: Less than 7	.15	1.2	.19, 7.3	.87
Birth weight Less than or = 2,500 grams	.82	2.3	.75, 6.9	.15*

* p < .30.

As shown in Table 12, the logistic regression model using family interview data revealed the following variables independently differentiated the education groups ($p < .30$): mother or father receiving special education, length of child's hospitalization after birth, mother perceiving her child's development in the first year of life being lower than other children of the same age, a problem noticed before age three, and substandard quality of home environment.

Table 12

Family Interview Data: Estimates of Special Education Placement--Odds Ratio and Significance Levels

Variable examined	Parameter estimate	Odds ratio	Confidence intervals	p value
Mother received special education	.89	2.5	.47, 12.8	.28 *
Father received special education	1.6	5.0	.58, 43.2	.14 *
Family income: $20,000 or less	-.16	.85	.40, 1.8	.69
Child in hospital after birth (1-8 wks.)	.63	1.9	.61, 5.8	.28*
Lower development in the 1st year	2.0	7.6	2.1, 27.8	.003 *
Parent identified a developmental problem:				
In the first year	.92	2.5	.80, 7.9	.12 *
Between 1 and 3 years of age	2.1	8.6	1.8, 40.1	.01 *
Family size: Four or more in home	.06	1.1	.49, 2.3	.88
Substandard quality of home environment	-.43	.65	30, 1.4	.28 *

* $p < .30$.

Multiple Logistic Regression Models

The variables from the birth certificates which were independent significant estimates of disability status in the preliminary bivariate analyses were placed in a multiple logistic regression model to determine which variables, in the presence of the others, still increase the odds of special education placement. Table 13 shows only one birth certificate variable, in the presence of the others, is marginally significant: being a first-born child. The R-square value for this model was .08. Based on the R-square value, it is clear that this model is only accounting for a small portion of the variance.

Table 13

Birth Certificate Data: Estimates of Special Education Placement from Multiple Logistic Regression--Odds Ratio and Significance Levels

Variable examined	Parameter estimate	Odds ratio	Confidence intervals	p value
Maternal education-				
No high school education	.48	1.6	.46, 5.8	.45
Number of previous live births				
None	.86	2.4	.93, 6.0	.07*
Gestational age				
Less than 32 weeks	-.58	.56	.07, 4.7	.60
Birth weight (in grams)				
Less than or = 2500 grams	.69	2.0	.45, 8.9	.37

Note. R-square = .08.
* $p < .10$.

A similar multiple logistic regression analysis was completed using risk factors from the family interview which were initially associated with disability status. Two risk factors, in the presence of the others, significantly increased the odds of a child being placed in special education: perceiving child's development in the first year of life being lower than other children of the same age, and a problem noticed between ages one and three by caregiver (See Table 14). The R-square value for this model was .24.

Table 14

Family Interview Data: Estimates of Special Education Placement from Multiple Logistic Regression--Odds Ratio and Significance Levels

Variable examined	Parameter estimate	Odds ratio	Confidence intervals	p value
Mother received special education	1.1	3.0	.41, 15	.22
Father received special education	1.6	5.0	.45, 43.9	.16
How long child in hospital after birth				
1-8 weeks	.57	1.8	.44, 5.9	.37
Development in the 1st year of life				
Less advanced	1.9	7.0	1.6, 26.6	.01*
Parent identified a developmental problem:				
In the first year	.15	1.2	.31, 4.8	.83
Between 1 and 3 years	1.6	5.2	1.1, 30.7	.04*
Substandard quality of home environment	-.37	.69	.30, 2.3	.46

Note. R-square = .24.
* p < .10.

For the final model within the data analysis step, a multiple logistic regression analysis was completed using risk factors (explanatory variables) that were significant independent estimates of disability status from both the family interview and birth certificate in a single model. Results from the final multiple logistic regression model which was conducted are shown in Table 15.

Table 15

Combined Birth Certificate and Family Interview Data: Estimates of Special Education Placement from Multiple Logistic Regression--Odds Ratio and Significance Levels

Variable examined	Parameter estimate	Odds ratio	Confidence intervals	p value
Number of previous births				
None	.89	2.4	.79, 7.5	.12*
Development in the 1st year				
Less advanced	1.5	4.3	.97, 19.2	.05*
Parent identified a developmental problem:				
Between 1 and 3 years	1.8	5.9	1.0, 34.3	.05*

Note. R-square = .26.
* $p < .10$.

Risk factors which significantly increase a child's odds of receiving special education were first-born child, child exhibiting lower development in the first year of life, and a problem noticed between ages one and three by caregiver. For the logistic regression model combining the birth and interview data, the R-square value was .26.

Comparing the three models, the results indicate that the final model, which includes both birth and family data, is accounting for the most variability. Therefore, the final model provides the most comprehensive assessment of risk factors and most information in terms of assessing risk status.

Interactions of Significant Variables

Interactions were examined to understand whether the presence of a given risk factor moderated the effect of another risk factor. All possible interactions of the significant variables from the final logistic regression model were explored. However, none of the possible interactions were statistically significant.

Additive Effects of Risk Factors

Cumulative effects of various groups of risk factors were examined to determine which sets of variables place a child most at risk. Table 16 shows that the two risk factors which combine to place a child at greatest risk were a child exhibiting lower development and a problem being noticed between ages 1 and 3 (26 times as likely).

Table 16

Additive Effects of Combinations of Variables

Additive effects	Joint odds ratios
First-born child and lower development	10.3
First-born child and problem noticed	14.2
Lower development and problem noticed	25.4
First-born child and lower development and problem noticed	60.9

The overall distribution of significant risk factors in the two education groups was examined. These results show there was a significant difference between special and general education groups in the number of risk factors experienced ($X^2 = 14.9$, $p < .005$) with children in special education experiencing more risk factors. Of the children in special education, 29% had no risk factors, 53% had one risk factor, 16% had two risk factors, and 2% had three risk factors. For the general education students, percentages were 64%, 32%, 2%, and 2%, respectively.

Figure 1 provides a graphic examination of the occurrence of specific individual and combinations of risk. The most frequently occurring single risk factor for the special education group was being a first-born child. In terms of combinations of risk factors, the most prevalent combination of risk factors for special education children were being first born and exhibiting lower development.

To further examine the impact of the cumulative effect of the number of risk factors on placement in special education, a logistic regression model was built with the number of risk factors present as the independent variable. Results showed that each additional risk factor increases the odds that a child will be placed in special education three times (OR = 3.0, $p < .005$).

Attributable Fraction (AF)

The AF was calculated for each risk factor from the birth certificate regardless of significance status within the logistic regression model,[8] if the risk factor was a factor which could be impacted by intervention. Again, AF is the proportion by which the incidence rate of the unwanted outcome in the entire population would be reduced if the exposure to a risk factor were eliminated, assuming each subject in the population had that particular risk factor. Calculating the AF assumes that the observed association is truly causal; therefore, results must be interpreted with caution. Table 17 shows the

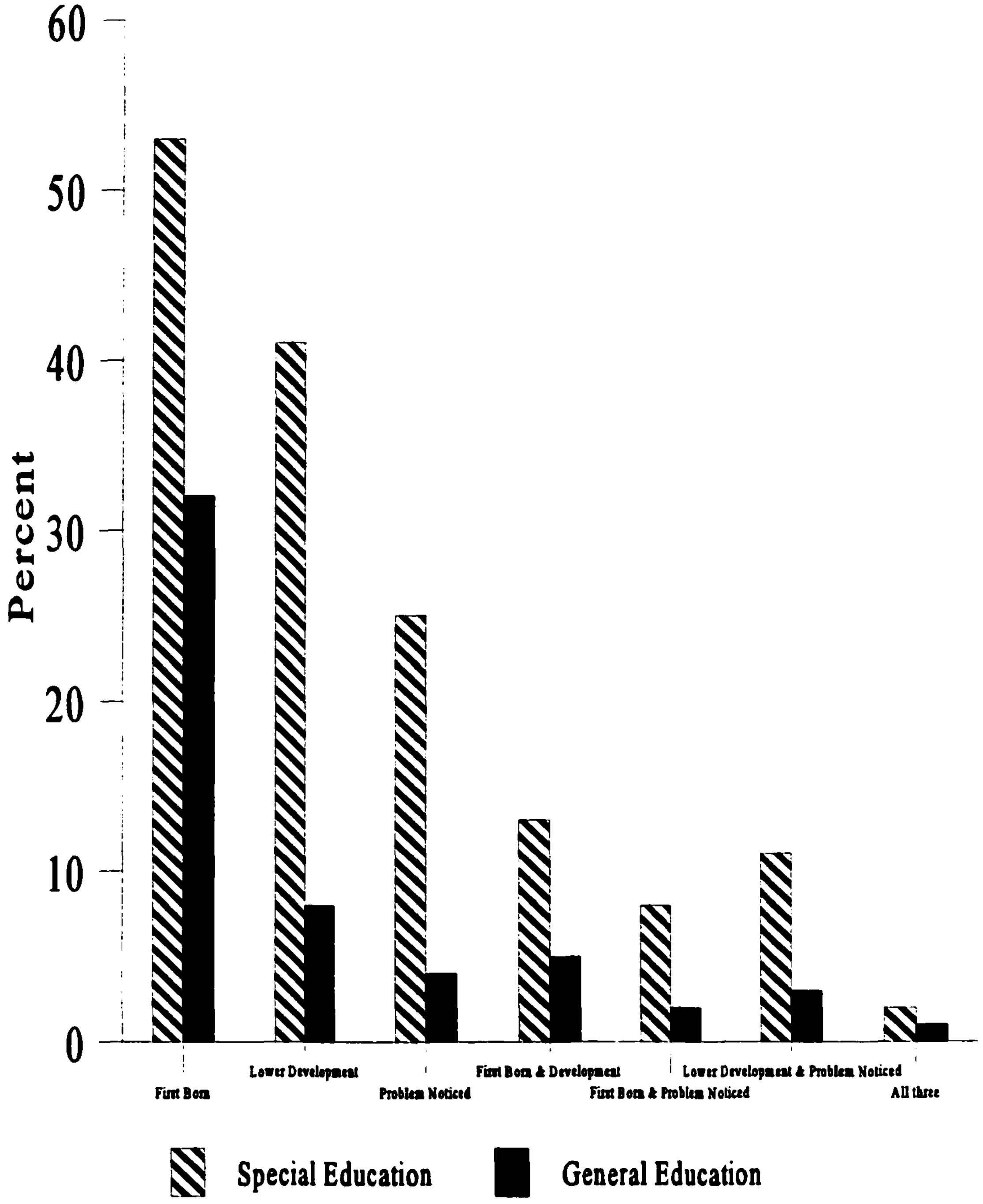

Figure 1. Occurrence of individual and combinations of risk factors by education classification.

factors that appeared to have the most potential impact on special education placement was a combination of environmental and biological risk factors. These included maternal age and education level, gestational age, and birth weight.

Table 17

Attributable Fractions

Variable examined	Attributable fraction (percentage)
Maternal education less than high school	8
Maternal Age (at time of child's birth):	
18 or less	6
Gestational age: Less than 32 weeks	10
1-minute Apgar score: Less than 7	1
5-minute Apgar score: Less than 7	0.5
Birth weight (in grams):	
Less than or = 2,500 grams	12

Note. Attributable fractions were not calculated for data from the family interviews because the population estimates for risk factors could not be determined.

CHAPTER 4

DISCUSSION

Because of diminishing resources, it has become increasingly difficult to provide early identification and screening services for young children with and at risk for disabilities (Diamond, 1993). Effective early identification is a challenging task in terms of defining the at-risk population, identifying which children are at risk early in their lives, prioritizing who benefits most from early intervention services, and determining who to serve. One approach, developmental epidemiology, has repeatedly been shown to be a reliable and cost-effective means of determining which family and child characteristics present at birth place a child at risk (Andrews et al., 1995; Boussy, 1992a; Boussy, 1992b; Claussen et al., 1996; Mulvihill et al., 1995; Mulvihill & Cluett, 1997). However, it has been suggested this method of identifying at-risk children can be enhanced by including information from parents about their child's development early in life (Rojahn et al., 1993). The present study is the first known study to empirically test the use of developmental epidemiological methods using children's birth records and a retrospective family interview as a means of developing an even more efficient and effective method of early identification.

In summary, the results of this research indicate that identifying high-risk children to be screened for early intervention services based on information available at birth (gathered from birth certificate data) and early in the child's life (ages 0-3; gathered from a retrospective family interview) is a feasible and beneficial option. In fact, these results show that the combination of these two data sources provides more accurate identification than either data source used separately. Supplementing birth history data with additional data from parental perceptions about the child's development before age three, provides a more powerful tool to identify at-risk children. This research provides a quantitative basis for the accurate identification of at-risk children. The results of this study are also in accord with the larger body of scientific research studies, demonstrating that it is neither biological nor environmental risk alone, but rather a combination of the two, which is most strongly associated with developmental outcomes (King, Logsdon, & Schroeder, 1992).

Results from the main areas of inquiry in this study convincingly demonstrate that (a) family and child risk factors which are present at the time of birth and recorded on the birth certificate increase a child's odds of being placed in special education, (b) family and child risk factors present early in the child's life and gathered from a retrospective family interview also increases a child's odds of being placed in special education, and (c) combining data from a child's birth history (birth certificate) and the child's early years (family interview) provides a more comprehensive assessment of risk factors and, therefore, renders the most beneficial method for identifying and prioritizing at-risk children.

Determining Risk Factors from Birth Certificate Data

As clearly demonstrated in previous research (Andrews et al., 1995; Boussy, 1995; Claussen et al., 1996; Finkelstein & Ramey, 1980; Goldberg et al., 1995; Mulvihill et al., 1995; Ramey et al., 1978), this research further supports the efficacy of using information present at birth to determine risk status. When risk factors from the birth certificate were considered independently, four variables were significant: low maternal education, being a first-born child, low gestational age, and low birth weight. Based on previous research (Andrews et al., 1995; Claussen et al., 1996; Mulvihill et al., 1995; Mulvihill & Cluett, 1997), it was hypothesized that several other variables from the birth certificate (e.g., low maternal age, low 1-and 5-minute Apgar scores, and gender of the child) would increase the odds of a school-aged child being placed in special education.

However, these variables were not significant in the bivariate comparisons in the present study. In the final risk model, the only birth certificate variable to be marginally significant was being a first-born child. One possible explanation for this finding may relate to the nature of the family characteristics. Several other family risk factors were reported (e.g., low maternal age and education, low family income, substandard quality of home environment). Given the presence of such family stressors, inexperienced parents with inadequate parenting skills may have fewer skills and resources with their first-born child. The child's mother may have learned more about parenting, pursued more education, or been able to provide a better home environment by the time of the birth of the second child. Thus, in this environment, the risk of later developmental problems would be greater for the first-born child. Moore, Cohn, and Campbell (1997) supported this notion and noted that the lower level of positive emotion expressed with first-born children may reflect anxiety and stressors that are associated with the transition to parenthood not evident with subsequent births.

The present findings do not negate the value of birth certificate data nor do they suggest that other risk factors recorded on the birth certificate are unrelated to children's developmental outcomes. Instead, there are alternate explanations as to why these variables did not emerge as significant in the risk model. In this case, because only one LEA was included, sample size from the beginning was limited. Then, because of the necessary numerous data linkage steps and multiple points of attrition, the final sample size was relatively small ($N = 108$). This small sample size and lack of variability for some birth certificate risk factors may have limited the study design's ability to detect small to moderate effects. Further, because of limitations within data collection, bias and self-selection of subjects may have occurred.

Determining Risk Factors from Family Interview Data

The second key finding shows that several family and child risk factors gathered from a retrospective family interview independently place a child at risk. Although Rojahn et al. (1993) coupled family interview data with birth data in a risk equation, previous research provided little evidence to confirm the practical utility of using family interview data in risk models. In Rojahn's work, only two variables were found to be related to risk status: quality of home environment score and a global variable which examined parents' efforts to stimulate the child intellectually. The present study provides the needed confirmation of the validity of using family interview data within risk models.

Determining Risk Factors from Birth Certificate and Family Interview Data

Subsequent to the focal finding of a risk model using birth and family data providing a quantitative basis for the efficient and effective identification of at-risk children, the results of the study also highlight one important point: parental perceptions regarding child development are viable sources of data and can aid in making the identification process more accurate.

Importance of parental perceptions. Another decisive result of this study is the affirmation of the paramount role of parental perceptions in developing a reliable early identification process. The strongest risk factor which increased a child's odds of being placed in special education was the mother's perceptions of her child's development before age 3 in terms of general developmental delays and specific problems. Further, the strongest additive effect for any two risk factors occurred when the mother perceived a child to be developing slower than other children the same age and a problem was noticed between ages 1-3 (joint odds ratio = 25.4). This provides reinforcement for the idea that to facilitate effective and efficient identification, professionals must inquire about parent perceptions of the child's development and listen to the parent as the expert (Bates, 1991). This finding also is similar to the intent of IDEA, which encourages the active participation of parents in the early identification of children.

In the past, profitable parental knowledge about their child's development has generally been overlooked in the screening or decision making process (Henderson & Meisels, 1994). This is often the case because concerns have been raised about the validity of parental reports of their children's abilities and development. Some have considered parents to be unreliable reporters, untrained to assess child development and unable to provide objective estimates of their child's development (Henderson & Meisels). Other researchers have suggested that parental report of perceptions of child development is ineffective because parents' perceptions are complex phenomena which reflect reality as they see it and are confounded by background characteristics, personality characteristics, and possible mother child-relationships (Bates, 1980, 1991).

However, the present findings are congruent with other studies that have reported high rates of agreement between maternal perceptions and the child's developmental status (Barnes, 1982; Bricker & Squires, 1989; Meisels, 1988; Squires & Bricker, 1991; Yuker, 1988). In truth, studies have shown that parents provide accurate and low-cost screening information for infants, toddler, and preschool age children which can be used to supplement standardized testing, screening methods, or both. Parental reports have been shown to be effective in the areas of cognitive abilities, motor skills, and speech and language development (Bricker & Squires, 1989; Bricker, Squires, Kaminski, & Mounts, 1988; Dale, Bates, Reznick, & Morisset, 1989; Diamond, 1993; Sonnander, 1987). Previous research, therefore, provides additional validation of the accuracy of parental perceptions within this sample, as most often the parent identified problems in the areas of motor skills (physical problem most often identified by parents before age 1) and speech and language development (speech problem most often identified between ages 1-3).

Implications

The findings of this study shed new light on prioritizing services for young at-risk children. The findings highlight the potential benefits of using developmental epidemiological methods in risk analysis and interpretation as an alternative research design which can be used in place of or in conjunction with traditional longitudinal studies for predicting risk for later disability. This research extends the body of literature regarding developmental epidemiological methods and decisively demonstrates the viability of creating risk profiles by including information about a child's early years gathered via a family interview to more accurately determine risk status.

These findings enhance the possibilities that atrisk children will be identified and receive appropriate early intervention services at the optimal time. Children born with a set of risk factors known to place them at high risk for school-age special education placement can be enrolled in intervention services in a timely manner. Family interventions, such as assisting the child's mother in completing or continuing her education, could also begin early. This timely identification system will help decrease the large number of students who do not receive intervention until public school and then require special education services. Developing a predictive risk model by using comprehensive information from early in a child's life will provide more accurate early identification methods, receipt of intervention services at the earliest possible time, and successful allocation of limited resources.

Specific policy implications. This study's findings suggest two significant policy changes: (a) creating risk registries in conjunction with developmental epidemiological methods as a means of effective and efficient early identification; and (b) extending the use of risk registries and implementing a statewide computerized tracking system. The first policy implication involves the creation of risk registers within each state. Although it is accepted that a risk registry is a valuable tool, use of such registries has been limited by lack of appropriate means of identifying risk factors. In fact, risk registries alone have been unable to identify most children who will demonstrate later developmental disabilities. However, developmental epidemiological methods facilitate the use of risk registers by providing a means of accurate and efficient early identification of those children who would benefit from monitoring. By knowing the potential risk factors which lead to poor developmental outcomes, children with these risk factors can be entered in the registry immediately after birth and monitored throughout early childhood.

A second policy implication involves the extended use of risk registries over time through implementation of a statewide computerized tracking system. A statewide tracking system allows for longitudinal follow up of at-risk children and periodic monitoring of risk factors which may present negative effects only after a long latency periods. This continual monitoring permits adjustments in provision of services; for example, if a child who was not previously identified as needing services was later determined to be in need of speech services, services could be provided. Such a tracking system would allow case managers to ensure these services are received. With systematic tracking in place, management of cases can alleviate an even greater amount of risk and increase the prevention of need for later special education placement. Success of such a system relies on the commitment, skills, and contact of a number of diverse professionals (e.g., doctors, nurses, social workers, early intervention providers, etc.).

Limitations

Several limitations of the study must be noted. First, use of the birth certificate data base can be limited by the accuracy and completeness of the data entered. However, the quality of reporting of items on birth certificates has been widely studied (Buescher, Taylor, Davis, & Bowling, 1993; Snell et al., 1992; Watkins et al., 1995; Woolbright & Harshbarger, 1995). Results suggest that a number of items are reported and recorded reliably, including birth weight, Apgar scores, tobacco use in pregnancy, gender, and maternal age (Buescher et al., 1993; Lu et al., 1994; Woolbright & Harshbarger, 1995). However, studies also demonstrate that the reliability of items such as congenital anomalies, fetal alcohol syndrome, and labor and delivery complications are inadequate and incomplete. Use of these categories in a research study should be interpreted in light of the knowledge that this information is often highly under reported (Mathis, Lavoie, Hadley, & Toomey, 1995; Snell et al., 1992; Watkins et al., 1995; Woolbright & Harshbarger, 1995).

Another limitation is the use of retrospective family interviews. The disadvantage of retrospective data being susceptible to recall or selective bias is widely recognized. In fact, very often retrospective interview data is often treated as suspect and not interpretable (Moss & Goldstein, 1979). However, other studies (Berney & Blane, 1997; Blane, 1996; Janson, 1996; Maughan & Rutter, 1997) have specifically examined which items of information can be recalled with what degree of accuracy when compared with historical records. Together, this body of research suggests that life-course information can be collected using interviewing methods with levels of recall accuracy at about 80% (Berney & Blane; Casey et al., 1991). Further supporting the efficacy of the use of retrospective family interviews, this body of research shows consistently high rates of accuracy for a period of as much as three, four, and five decades (Berney & Blane).

A third limitation involves linking one or more extant data bases from various agencies. In this case, the data formats often are discrepant or do not have a unique identifier (e.g., social security number). Linkage of these data sets poses challenges to maximize the percentage linked and correct linkages for data analysis and interpretation. For this study, as in any data linkage study, the commitment to collaboration by various parties was a key to the success of the study. The collaboration included the state vital records department, the state special education division, and the local school system. The extent of the collaboration which was available from the school system, however, presented a major limitation. Because of previously existing external state pressures on the LEA to increase test score performance, this study added another task to an already overloaded teaching staff and seemed to add significant strain. Thus, the administrators and teachers may not have encouraged participation as much as possible. One solution to this limitation may be to help administrators and teachers to understand, through personal and direct contact, the direct implications of this research on their classrooms and schools and the individual children. With this understanding, it is hoped that the school systems' investment in and support of the research and encouragement of parents to participate would increase.

One final limitation of this study involves the high attrition rates. Because of the study design, various data linkage steps were necessary. This multi-step approach to linkage caused subjects to succumb to attrition at various points. In the end, the data were representative of the Birmingham LEA. However, because of the multiple potential attrition points, it is important to start with a large enough sample size to overcome disadvantages of subject attrition.

Future Research

There are considerable potential benefits to using integrated information data sources. This methodology also leads directly to future research efforts: (a) extending the types of data which can be used to predict risk, (b) extending the outcome variables to look across and within diagnostic categories, (c) conducting a prospective study to confirm the results in this study, and (d) using linked data sets for program evaluation.

Building upon the successful linkage of birth, school records, and family interview data demonstrated in this study, other extant data bases (e.g., child protective services, early intervention, Medicaid or vocational rehabilitation records) can be combined to widen the range of predictor and outcome variables considered. This will increase understanding of the developmental patterns and interactions of variables over time for at-risk children. For example, linking Women, Infants, and Children (WIC) records with birth and school records can help to understand the effects of maternal and child nutrition in the postnatal period on child outcomes. As shown by Hurtado (1995), cross-linking a third data set is an effective application of developmental epidemiology and can provide an even clearer picture of the developmental progression of risk across the life span. The number of subsequent data bases that can be linked to study the developmental progression of risk is only limited by the number of computerized data sets available and the willingness of the agencies involved to allow this data integration. Inter-agency standards of data integration should be agreed upon, including procedures for ensuring confidentiality, limits on the use of data, presentation of results, and data oversight. In reality, inter-agency data sharing has the potential to be fraught with obstacles which must be addressed for future research to be achieved and successful in a timely manner.

Future research also calls for using similar methodology to examine special education children across different diagnostic categories. This would allow researchers to determine whether different combinations of risk factors act to significantly increase the odds of a child being placed in special education within a given category (Mulvihill et al., 1995; Mulvihill & Cluett, 1997). Further, this methodology could be extended statewide. Such extension would allow for a larger sample size, state representativeness, and potentially the examination of other intervening factors (e.g., urban vs. rural schools settings or environments).

Follow-up research also indicates the need to follow children and their families prospectively. Children born with identified risk factors can be enrolled in a study at the time of birth and followed at regular intervals until school age or early into the school years. This would promote a clear developmental progression of risk factors and allow for advancing in the task of efficient and effective early identification of at-risk children. Use of prospective case-control study design also provides results which can be interpreted in terms of risk factors that predict special education placement (Scott et al., 1994).

Because this study was a retrospective case control study, the interpretation of results was limited to risk factors which increase a child's odds that he or she will be placed in special education rather than the examination of predictive factors.

A final area of future research includes assessing the impact of intervention programs. Once linked data sets are in place among various local or state agencies, evaluation of new intervention programs can be conducted. For example, children in an early intervention program can be identified in the linked data base and compared with a control group of children with comparable risk factors not in a specific early intervention program. Results would allow for evaluation of the impact of early intervention services on children in terms of short- and long-term benefits. This would provide program assessment data in a more timely and less burdensome method than traditional randomized prospective longitudinal studies.

In short, the use of developmental epidemiological methods can provide a potent tool to serve children at risk for later disabilities or special education placement and should not be overlooked as a plausible and efficacious research design within the field of developmental psychology. It is imperative that this knowledge is put to good use in serving the needs of children at risk for disabilities.

ENDNOTES

[1]The sample children during the time of the interviewers were in second grade. The Child Count data (during the data linkage phase) included students in first grade special education during the 1995-1996 school year because of statistics reporting and processing time lines.

[2]Originally, 699 controls subjects were chosen by the matched record linkage. Because of limitations in the data sharing agreement and confidentiality issues, we were unable to directly contact a subject from the birth certificate data. Thus, once control subjects were identified from the birth certificate data file, researchers cross-referenced a list provided by the Birmingham City Schools of all general education students in second grade. This resulted in a total of 214 students being identified as a potential subject from Birmingham City Schools general education pool. Therefore, 214 letters requesting participation were sent to parents of general education students.

[3] Interviews were attempted on all subjects of match status in the data linkage phase.

[4]For children not placed in special education until the second grade, the education records initially used were for the students' first grade year so that these students would not be included in this file nor would we have been able to identify their matching birth certificates. For children born before, the 1988 birth cohort, although they may be in the

education records, their birth certificate was not available because of the initial limit of the birth cohorts to 1988-1990.

[5] Although researchers planned to conduct analyses within major subgroups (e.g., learning disability, mental retardation) of children receiving special education, it was determined that the relevant sample sizes within disability category were too low.

[6] The birth certificate record includes the following variables: main source of payment for birth (proxy for income level), who provided prenatal care, drug use, and family history of hearing loss or deafness at an early age. However, these were not added to the State of Alabama birth certificate records in 1991, and therefore, not available for this analysis.

[7] $AF = Pe\ (OR - 1) / 1 + Pe\ (OR - 1) \times 100$ where Pe is the frequency of exposure in the population of controls only and OR is the odds ratio for that risk factor.

[8] AFs were not calculated for data from the family interview. To correctly calculate an AF, population estimates of the prevalence of risk factors must be determined. For the family interview, available data were judged to not be representative of the population, and, thus, AFs were not calculated.

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Major Subject Psychology

Title of Dissertation Early Risk Indicators for Special Education Placement: A Developmental Epidemiologic Study Using Information from Birth and Early in a Child's Life

I certify that I have read this document and examined the student regarding its content. In my opinion, this dissertation conforms to acceptable standards of scholarly presentation and is adequate in scope and quality, and the attainments of this student are such that she may be recommended for the degree of Doctor of Philosophy.

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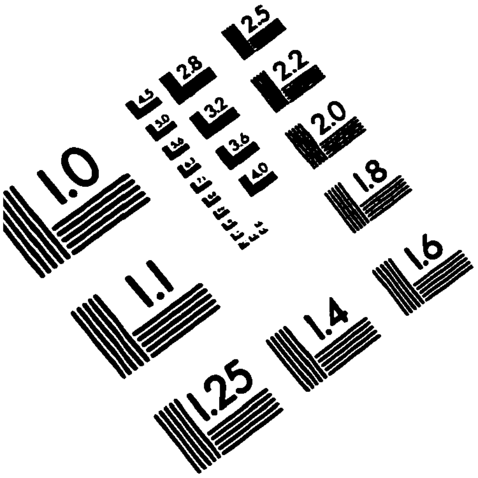
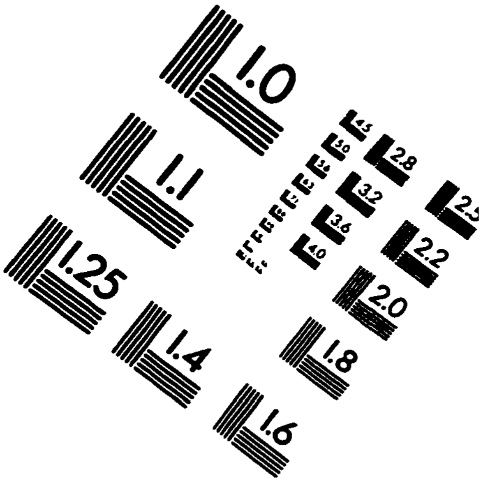
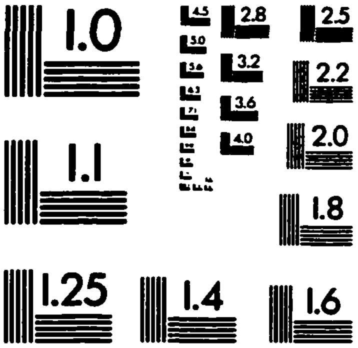
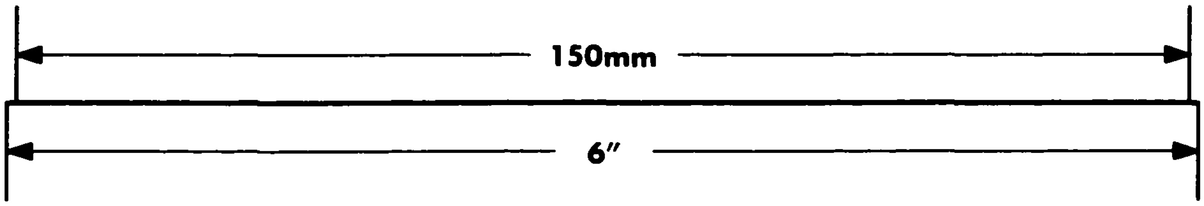
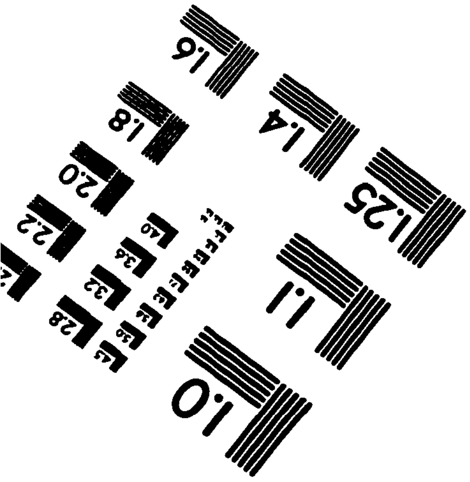
IMAGE EVALUATION TEST TARGET (QA-3)





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