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ABSTRACT

Eighteen studies (1952-1982) evaluating early therapeutic intervention for children with cerebral palsy are reviewed. Studies are explained to feature provisions of some type of traditional, neurophysiological/sensorimotor, or eclectic therapy and to have excluded pharmacological, dietary, or other specialized treatment procedures. Analysis is purported to reveal that as research paradigms become more rigorous in terms of reseach design and statistical analysis, empirical documentation of program efficacy becomes less likely. This finding is considered in light of two factors: the current levels of technology relating to instrumentation and the manipulation of the many variables thought to affect the effectiveness of therapeutic intervention. (Author/CL)

THE EFFECTIVENESS OF THERAPEUTIC INTERVENTION WITH INFANTS WHO HAVE CEREBRAL PALSY OR MOTOR DELAY

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ABSTRACT

Recently, numerous professionals have questioned the efficacy of early intervention programming for handicapped infants and young children. Therapeutic intervention provided through occupational and/or physical therapy has been increasingly implemented in habilitation settings for children diagnosed as having cerebral palsy, although research justifying this widespread usage is at present inconclusive. This review presents a comprehensive evaluation of 18 studies which evaluated early therapeutic intervention for children with cerebral palsy. An analysis of these studies revealed that as research paradigms become more rigorous, support for therapeutic intervention effectiveness decreases. This finding was explained in light of (1) the current levels of technology relating to instrumentation, and (2) the manipulation of the many variables which have been suggested to affect therapeutic intervention effectiveness.

Early intervention strategies for handicapped infants and young children are being increasingly being implemented in professional settings across the country despite a lack of conclusive documentation of the effectiveness of these efforts[1,2]. These programs typically are designed to provide early intervention programming to targeted children who exhibit, or who are at risk for, any of a variety of conditions which might deleteriously affect human development[3]. Such conditions would include sequelae subsequent to poverty and any of the myriad conditions or diseases currently encompassed under the classification of developmental disabilities.

One type of developmental disability manifested in infants and young children which has received considerable attention in the habilitation literature pertaining to early intervention is cerebral palsy. Numerous individuals have provided descriptions of cerebral palsy and suggested guidelines for treatment[4-10]. In the most general sense, cerebral palsy is the commonly used term for a group of conditions characterized by non-progressive damage to the motor control centers of the brain, usually originating during the developmental period[10]. The clinical pictures of the varying types of cerebral palsy are of primary concern to the medical community due to the inherently abnormal muscle tone. Of secondary concern is the fact that individuals with cerebral palsy may have an inadequate background of normal sensorimotor experiences upon which to build future development[11]. The inherent motor control problems may be further compounded by the later development of contractures and deformities[10,12,13]. In light of these considerations, early intervention has been suggested as critical for many infants and young children who are diagnosed as having cerebral palsy.

An early publication by Bobath[14] noted that intervention initiated prior to the full development of the motor handicap had a preventive effect on the subsequent development of secondary mental retardation. Additionally, it has been suggested that early intervention can provide infants and young children with a foundation of normal sensorimotor experiences which facilitate the acquisition of later motoric skills[15]. A number of other researchers have supported the position that early treatment can enhance normal motor development in children who exhibit cerebral palsy, maximizing their potential for independent functioning in the community[9,16-20].

While a variety of early intervention strategies for this population has been presented in the professional literature, therapeutic intervention provided through occupational and physical therapists may be the most frequently employed. A number of treatment systems differing in underlying philosophy and specific intervention strategies has been advocated by professionals from these disciplines[21-24]. However, as Marks[25] suggests, currently employed therapeutic intervention approaches may be classified as (1) traditional approaches, (2) neurophysiological or sensorimotor approaches, or (3) eclectic approaches. Treatment systems categorized as traditional approaches consist of such techniques as passive stretching to facilitate range of motion, bracing, splinting, and orthopedic surgery. Neurophysiological or sensorimotor systems of treatment emphasize the inhibition or facilitation of muscle groups by stimulating the exteroceptors and proprioceptors of the body. Finally, those treatment systems classified as eclectic employ components of a variety of treatment systems, adhering to the philosophy that there is no single best method of treatment for individuals diagnosed as having cerebral palsy.

Due to recent demands for accountability with regard to early intervention programming[26-29], and in response to critical reviews published recently which question the efficacy of early intervention programming for handicapped infants and young children[1-3,30,31], it becomes necessary to review the existing professional literature pertaining to therapeutic intervention efforts directed at young children who have cerebral palsy. As Ferry[31] noted, pediatricians are being asked with increasing frequency about the potential value of ealy intervention programs. Thus, the establishment of a professional data base upon which to base recommendations to parents of children who have cerebral palsy is a particularly timely concern.

This review will be restricted specifically to the habilitation literature since 1952 reporting on programs providing therapeutic intervention services to young children who have cerebral palsy. Although the duration of services provided in these studies varied dramatically, in each study the children were provided with some type of traditional, neurophysiological/sensorimotor, or eclectic therapy. They were also assessed with regard to changes in motoric functioning. As with a recent critical review of the effectiveness of early intervention programs for neurologically impaired children[2], investigations employing pharmacological, dietary, or other specialized treatment procedures will not be included in the present review. Since there are relatively few published research investigations primarily dealing with the effectiveness of therapeutic intervention, methodological requirements for inclusion in the present review were deliberately minimized to the following three criteria:

have had a potential effect on a child's responsivity to therapeutic intervention programs. Age[26,35,37,39,41,42,44-48] and IQ[32,33,34-40,42,45,47,48] have received the most attention in the studies conducted thus far, followed by the variables of type of cerebral palsy[32,34,36-41,44,48], degree of involvement[32,34,37,39,42,44,46], and degree of parental participation[35-37,42,46,47]. Other factors posited as having potentially significant impact on therapeutic intervention prognosis for this population include emotional factors[32,35,38,39,41], time in treatment[34,36,43,47], and type of intervention[26,42]. It must be noted that in many of the studies these variables were simply suggested to account for the children's responses to treatment, with no statistical analysis of the proposed effects of these variables conducted.

The measurement scales utilized to assess motor progress in the studies reviewed varied markedly. Standardized assessment instruments, which might be expected to yield more objective data, included the Bayley Psychomotor Development Index[26,47], the Denver Developmental Screening Test[26], and the Quick Screening Scale[43]. The use of nonstandardized evaluation instruemnts to document motoric progress among these children is a common characteristic of most research investigations to date, as reflected in the frequent use of both program specific assessment scales[32,35,37,39,41,42,45,47,48] and subjective clinical judgements of therapists[34,36,38,40,44,46]. The use of such evaluative procedures, while perhaps appropriate for any individual research investigation, presents potential problems in both subsequent replication of similar studies as well as generalization of any obtained results.

The second and final question addressed in the present review the study. The amount of data provided by many of the studies, especially those prior to the 1970s, has been often inadequate, thereby limiting the usefulness of the findings presented. The number of individuals which comprised the treatment groups ranged from 12 to 470, although those studies with larger sample sizes also tended towards much greater heterogeneity in age ranges[36,38]. As noted in Table 1, the duration of therapy, or the length of time over which therapy was provided to the children in the studies, varied from a month[48] to two or more years[34,36], with many studies not reporting a specified period of time[35,38,43,44]. The frequency of therapeutic treatment also varied greatly, ranging from daily therapy sessions[32,35,47] to weekly sessions[36] to sessions of unspecified frequency[33,38,41,43,44,46,48].

As Table 1 indicates, therapeutic intervention has typically been provided in a center or clinic, although one report was made of therapeutic intervention services being provided in conjunction with a public school setting[45]. The primary nature of the intervention programming provided in most studies was motoric, although combined programmatic efforts which included training in such areas as activities of daily living and language have also been documented[26,32,33,35,37,39,41,47].

While most studies reported physical therapy to be the foundation for their intervention efforts, other programs report on the effects of occupational therapy[26,47] and a combination of occupational and physical therapies[26,32,33,35,37,39,41,48]. A variety of independent variables which may influence a child's response to treatment has been documented among the studies reviewed. Presented in Table 1 are those variables which either have been correlated with, or which were hypothesized to

(1) the target population in the study consisted of individuals diagnosed as having cerebral palsy, (2) change in motor skill acquisition or status during the duration of the study was noted in the publication, and (3) at least one group of children in the study received early therapeutic intervention prior to three years of age. Each study in the review also contained information of a hypothetical or correlational nature relating to any number of independent variables which have been suggested as potentially affecting a child's response to therapeutic intervention programming. This review will address two major questions pertaining to therapeutic intervention efficacy studies for infants and young children who have cerebral palsy. First, how are therapeutic intervention efforts structured in terms of programmatic characteristics? Second, what empirical evidence exists to support therapeutic intervention with this population?

RESEARCH REVIEW AND ANALYSIS

A comprehensive review of the habilitation literature from 1952 through 1982 generated 18 studies which met the parameters established for inclusion in the present review[32-48]. A summary of the findings of an anlaysis of these studies is presented in Tables 1 and 2.

With regard to the first question concerning significant programmatic characteristics of research investigations of therapeutic intervention effectiveness, several observations can be made. As other investigators have reported[1,2], criteria for inclusion in these studies have been far from rigid. Typically, all children who had cerebral palsy living within a specified geographic region, or all those receiving treatment in a particular habilitation center, were selected for concerns the research methodology employed in the various investigations evaluating the overall efficacy of therapeutic intervention programming. An analysis was conducted on the experimental rigorousness of the aforementioned 18 studies based upon two factors: (1) type of research design employed in the study, and (2) statistical bases for conclusions of therapeutic intervention effectiveness.

The research designs employed by the 18 studies were classified in the following manner. First, those studies which were _ex post facto_ in nature were categorized as no control group/descriptive designs. A second group of studies was classified as contrast designs (two or more experimental groups without a control). A final group was categorized as control group designs (both with and without random assignment).

As indicated in Table 2, the preponderance of studies reporting on the effectiveness of therapeutic intervention for infants and young children who have cerebral palsy have relied on a purely descriptive approach, the least stringent research design[33-40,44,48]. Relatively fewer investigations have employed more rigorous research design elements such as the use of a contrast group or groups[26,32,43,46] or a control group[41,42,45,47]. Of the 18 studies, 4 (22%) used a control group, another 4 (22%) used one or more contrast groups, while 10 (56%) used a no control group/descriptive approach. Interestingly, of the 10 studies which utilized a no control group/descriptive design, 9 (90%) concluded therapeutic intervention effectiveness. Of the 4 studies which used a contrast group with no control, all 4 (100%) also reported effectiveness of therapeutic intervention. However, of the

4 studies which used the more experimentally rigorous control group design, only 1 (25%) concluded that therapeutic intervention was efficacious.

Also presented in Table 2 is the frequency of statistical analyses in the reviewed studies. Of the 18 studies, statistical results were not reported in 10. While 9 of these 10 studies (90%) concluded that therapeutic intervention was effective, only 5 out of the 8 studies (62.5%) which did conduct statistical analyses drew a similar conclusion.

Thus, one may draw the potentially disturbing conclusion that, as research investigating the effectiveness of therapeutic intervention becomes increasingly rigorous in terms of (1) research design and (2) statistical analysis, empirical documentation of program efficacy becomes less likely.

SUMMARY AND RECOMMENDATIONS

Before drawing the conclusion that therapeutic intervention is less than effective with infants and young children who have cerebral palsy, a number of factors must be considered. First, only four studies could be identified as meeting minimal design standards. Thus, at this point, the drawing of any sweeping conclusions and generalizations regarding therapeutic intervention effectiveness would be ill-advised. Second, while a number of independent variables have been identified as potentially affecting children's responses to therapeutic intervention, to date however, no study has systematically controlled for the effects of many of these simultaneously. It may very well be that significant interactions may be discovered between such variables as age, IQ, type of cerebral palsy, degree of involvement, parental participation, emotional disturbance, intensity of treatment, and type of therapeutic intervention which are currently being masked in present research paradigms. Third, as other researchers have speculated[2], the present amount of data supporting therapeutic intervention effectiveness may be an underestimation of its total impact. A number of hypotheses may be offered to support this underestimation theory. It may be that children with cerebral palsy who are in therapeutic intervention programs made motoric progress but the instrumentation utilized was not sensitive enough to detect significant changes in motoric functioning, thereby affecting statistical significance. Unfortunately, efforts to employ similar instrumentation across the numerous studies reviewed have been nearly non-existent. One might speculate that those studies which failed to document the effectiveness of therapeutic intervention may have used instrumentation not sensitive to the subtle motoric progress which may be exhibited in these children. It may also be that therapeutic intervention results in significant gains in non-motoric areas such as emotional status, family and sibling adjustment, language development, and cognitive development which are typically not evaluated. A more comprehensive assessment battery, administered on a pretreatment-posttreatment basis, may more accurately reflect the influence of therapeutic intervention on the global developmental profile of the child diagnosed as having cerebral palsy. Additionally, while therapeutic intervention programs may enhance the overall _quality_ of the motoric functioning in their target populations (e.g., the development of more normalized movement patterns), the too-frequent evaluative dependency upon motoric progress scales, which typically assess only such quantitative achievements as motor milestones, may result in these qualitative motoric gains being obscured. Another potential instrumentation difficulty may arise in working with severely impaired children, for whom the maintenance of present levels of motoric functioning (e.g., the avoidance of contractures) may be a reasonable programmatic goal. Measures of program effectiveness based upon gain scores thus may not accurately assess therapeutic intervention efficacy in these cases. These instrumentation problems, along with other as of yet unidentified measurement difficulties, may account for the finding that therapeutic intervention effectiveness is reported subjectively much more frequently than is justified by purely objective measures.

A final factor to be considered in the evaluation of experimental research on the effectiveness of therapeutic intervention concerns the limitations of control group design, an excellent review of which is available elsewhere[1]. For example, the limitations of the current early diagnostic process are such that a significant proportion of infants identified as having severe motoric impairments during the first year of life subsequently demonstrate spontaneous recoveries independent of any intervention attempts[3,49-51]. Because of this phenomenon, until the early diagnostic process achieves a level of sophistication such that professionals reliably may distinguish between those infants likely and not likely to exhibit spontaneous recovery, research into the effectiveness of therapeutic intervention with this population, utilizing control group methodology, will continue to generate a significant proportion of spurious findings. In response to this, it might be expected that continued research in this area utilize such alternatives as nonparametric research designs[1] and increasingly sophisticated single-subject methodologies[52,53].

To attempt to draw substantive conclusions regarding the effectiveness of therapeutic intervention programming from presently available data would be premature. Perhaps increasing refinements in both diagnostic and intervention procedures, as well as increasing sophistication in experiemntal research efforts, will combine to make the question a more answerable one in the near future. For the present, the following considerations may serve as general guidelines when consulting with families who have infants and young children diagnosed as having cerebral palsy. (1) The pediatrician should assume special responsibility for those health problems, whether they are related to the cerebral palsy or not, which might be anticipated to have a potentially deleterious effect on the child's response to early intervention attempts. (2) To most effectively serve as a resource to the families of these children, the pediatrician should be knowledgeable about the effectiveness of programs in that community, so as to be able to make recommendations from an informed perspective. (3) Once a child has begun receiving services from an early intervention program, a major function of the pediatrician becomes the ongoing monitoring of the child's developmental progress, realistically differentiating for the parents progress due to maturational effects from that due to the intervention efforts[3,54].

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TABLE 1. Frequency of Programmatic Characteristics Reported by Therapeutic Intervention Studies.

Variable	No.	%
Duration of Treatment		
Less Than 1 Year	4	22
1-2 Years	3	17
2 or More Years	2	11
Varied	4	22
Unspecified	5	28
Frequency of Treatment		
Daily	3	17
Twice per Week	3	17
Varied	5	28
Unspecified	7	39
Intervention Setting		
Home	1	6
Center/Clinic/School	13	72
Home and Center	4	22
Primary Nature of Program		
Motor	10	55
Combined	7	39
Unspecified	1	6
Specific Therapeutic Regimens		
Physical Therapy	10	55
Occupational Therapy	2	11
Combined	8	44
Independent Variables		
IQ	14	78
Age	11	61
Type of Cerebral Palsy	10	55
Degree of Involvement	8	44
Parental Participation	7	39
Emotional Disturbance/Motivatio	6	33
Intensity of Treatment	4	22
Type of Therapeutic Intervention	2	11
Motoric Assessment Documentation		
Quick Screening Scale	1	6
Bayley PDI	2	11
Denver	2	11
Program Specific	9	50
Subjective Clinical Judgment	6	33

TABLE 2. Type of Experimental Design and Bases for Therapeutic Intervention Effectiveness

	Frequency		Statistical Results		Statistical Support for Effectiveness		Authors Conclude Intervention Effectiveness	
	No.	%*	No.	%*	No.	%*	No.	%*
No Control Group/Descriptive	10	55.6	2	11.1	2	11.1	9	50
Contrast Group	4	22.2	2	11.1	2	11.1	4	22.2
Control Group	4	22.2	4	22.2	1	5.6	1	5.6
Total	18	100.0	8	44.4	5	27.8	14	77.8

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*Percent of 18 studies reviewed.