CHAPTER 3
REVIEW OF LITERATURE

This chapter is organized in five sections. In the first section, the prevalence and correlates of developmental disabilities in India are briefly reviewed. Section two describes some of the important developmental screening and assessment tests used by child health professionals in the West and in India. The section also presents a critique of the psychometric properties and technical adequacy of these tests. Section three describes recent advances in the field of developmental testing in India. The need for developing a comprehensive developmental assessment test for Indian children is presented in section four. Finally, in section five the aims and objectives of the present study are presented.

Prevalence and Correlates of Developmental Disabilities in India

Over the past few decades there has been a distinct improvement in child survival in India. Concern has, however, been expressed that this diminished mortality may simply be adding to the pool of sub standard survivors and that urgent attention should be simultaneously directed towards improving the quality of life of the surviving children (Bodhankar & Shashikala, 1995; Dreze, Khera, & Narayanan, 2007). The World Health Organization (WHO) estimates that about 10% of the world’s population has some form of disability (Boyle et al., 1994).

Statistics from different sources indicate that in India, 3.8% of the population has some form of disability and the same was found to be more common among children of the lowest socio-economic class families when compared with the next-to-lowest class families (Natale, Joseph, Bergen, Thulasiraj, & Rahmathullah, 1992). An all India survey undertaken by the National Sample Survey Organization (2003), showed a prevalence rate of 1.77% disabilities among all age groups. In a house to house survey of 3560 children in Delhi covering the age range of birth to six years, disability was identified in 6.8% of those assessed (Chopra, Verma, & Seetharaman, 1999). In a study of 6 to 14-year-old children in an urban and rural community, the prevalence of mental retardation was reported to be 3.25% (Gaur, Vohra, Subhash, & Khurana (2003). In a recent epidemiological study of child psychiatric disorders sponsored by the Indian Council of Medical Research, Srinath, Girimaji, Gururaj,
Seshadri, Subbakrishna, Bhola, and Kumar (2005) selected 2064 children aged 0–16 years by stratified random sampling from urban middle class, urban slum, and rural areas. The Vineland Social Maturity Scale (Malin, 1971) and the Binet Kamath scale (Kamat, 1967) were used to assess the intelligence of children. The prevalence of any degree of mental retardation was 1.4% in 0 to 3-year-olds and 0.9% in 4 to 16-year-olds. The majority of the children with mental retardation had mild mental retardation (57% in 0 to 3-year-olds and 67% in 4 to 16-year-olds). In a large-scale population study of neurological disorders from south India, crude prevalence for intellectual disability was reported to be 142/100 000 general population (Gourie-Devi, Gururaj, Satishchandra, & Subbakrishna, 2004).

In a recent review of the literature on mental retardation in India, Girimaji and Srinath (2010) have presented data to show that point prevalence of intellectual disability varies widely from a low of 1 per 1000 to 32 per 1000 depending on the sample selected, the age range of the population studied, and the extent of disability measured. The literature on prevalence has also been hampered by lack of indigenously developed reliable instruments available to measure intelligence.

Agarwal, Awasthy, Upadhyay, Singh, Kumar, and Agarwal (1992) examined the effects of nutrition and home environment on behaviour development and intelligence of mild, moderate, and severely malnourished children in population of 196 children born in 1981–83 from 10 villages of Varanasi district, India. Development was followed from the first year of life until 3 years of age. Some of the Caldwell Home Inventory (Caldwell & Bradley, 1984) and socioeconomic measures were used to measure home environment. The developmental quotient (DQ) for motor, adaptive, language, and personal social areas was determined by the Gessell inventory (Gessell & Amatruda, 1965), and the Binet Kulshrestha Intelligence Scale (Kulshrestha, 1971) was used to determine level of cognitive ability at 36 months. Concept development was measured with the Block-Sort test. The findings indicated that all children were below the third percentile for height and weight at all ages. The DQ scores decreased for all, except personal social development, with the severity of malnutrition. Significant differences in language and social development scores were found between Grade II and III malnourished and normal children. Inferior IQ scores were found for 9% of Grade I malnourished and 16.6% of Grade II and III malnourished children. The authors concluded that the most critical period for delay
was 10 to 12 months, when home environment vitally influences physical growth and mental development.

Lahiri, Mukhopadhyay, Das, Ray, and Biswas (1994) studied the role of social, environmental and psychological factors in influencing the physical growth and intelligence of children in Burdwan district of West Bengal. A total of 72 children of 3 to 6 years age group were studied, of which nearly two-third were either normal or having Grade-I under-nutrition and the rest were either Grade-II or Grade-III. Nearly 67% of the children had a Developmental Screening Test IQ score within the normal range (85-115), and the rest had borderline IQ scores. Two children were mildly retarded. The proportion of normal IQ children who have had non-formal schooling was much greater than that of normal IQ children who did not have non-formal schooling (88.6% vs. 45.9%). Children of normal and grade I nutritional status were more likely to have a normal IQ level than those with grade II or grade III malnutrition (75% and 77.3% vs. 57.1% and 20%, respectively). Non-formal education had a significant independent effect on the IQ level, while nutritional status did not have a significant independent effect. The authors recommended the need for a balanced diet and non-formal education to foster child development, especially intelligence, during the first six years of life of poor Indian children.

Kumar et al. (1995) sought to compare the items on the Culture-appropriate Test Battery normed in the state of Haryana, with items in Western standardized tests and found that most items in gross motor were attained by the Indian children within the appropriate age range. Language and concepts were usually delayed. Some of the personal and social skill items were attained earlier and some were attained later than Western standards probably due to lack of stimulation and less importance given towards attainment of these skills in India.

Mathur, Mathur, Singh, Kushwaha, and Lele (1995) conducted a study in the Integrated Child Development Services (ICDS) urban project of Gorakhpur in 10 randomly selected Anganwadi centers. Anganwadi workers (AWW) were given in-service orientation and training to detect various types of disabilities in children below 6 years. The trained AWWs identified disabilities and instituted preventive measures such as immunization and supplementary nutrition, together with the simultaneous independent verification by pediatricians, and a repeat survey after 6 months of
Among the 1,545 children, the AWWs identified disability in 126 subjects which were verified in 118 cases by pediatricians. The disability rate was 7638 per 100,000 population. Visual, mental, orthopedic, speech, and hearing disabilities rates were 4790, 2654, 583, 518, and 453 per 100,000 population, respectively. In the repeat survey, 35 of the 74 children with visual disability, 4 of the 9 with orthopedic disability, and 3 of the 7 with hearing disability could be managed satisfactorily. The authors concluded that the trained Anganwadi’s can help in the early detection and appropriate management of incipient and preventable childhood disabilities.

Kaur, Chavan, Lata, Kaur, Tinku, Arora, and Ratnam (2006) in a retrospective analysis, sought to establish the clinical profile of 100 children attending the Early Intervention Program at the Government Institute for Mentally Retarded Children, Chandigarh. The results indicate that the mean age of these children was 4.0 and the mean IQ was 50. Cerebral Palsy was seen in 50% of the children, Learning Disorder in 24%, Attention Deficit Hyperactivity Disorder (ADHD) in 12% and Autism in 4% of the children. Nearly one-fourth of the children suffered from epilepsy and 66% were unable to communicate verbally.

Malik, Pradhan, and Prasuna (2007) undertook a cross-sectional study of 202 infants and their mothers, residing in an urban slum in Delhi. The Psychosocial Development Screening Test (Vazir et al., 1994) was used to assess the development status of the infants. The authors found that personal skills, hearing, language, concepts, and motor milestones were attained by more than 90% of the infants in time. Vision, fine motor and social skills were achieved in time by a slightly lesser percentage of infants (81 to 88%). Besides, the sex of the infant, the socio-economic status of their family also significantly influenced development in some domains.

Singhi et al. (2007) examined the utility of the WHO Ten Questions Screen (TQS) to find the prevalence of developmental disability in a rural community of North India. The study was done in three villages, in two phases. In phase 1, the TQS was administered to parents of children aged between 2 and 9 years, during a house-to-house survey. In phase 2, all children screened positive and a random sample of 110 screened negative were clinically evaluated in detail. The total population of the three villages was 5,830 with 1,763 children aged between 2 and 9 years. Seventy-six children were positive on the TQS, of these, 38 were found to have significant
disability, 18 had protein energy malnutrition and 19 were found normal on clinical evaluation. All the 110 screen-negative children were normal. Significantly larger numbers of boys were positive on TQS as compared to girls. The sensitivity of the TQS for significant disability was 100%; the positive predictive value was 50% and was higher for boys than for girls. Of the 50% children classified as false positive 23% had mild delays due to malnutrition. The estimated prevalence of disability was 16 per 1000. The TQS was found to be a sensitive tool for detection of significant disabilities among children 2 to 9 years of age. The authors concluded that although the low-positive predictive value would lead to over referrals, a large number of these children would benefit from medical attention.

Ganesh, Das, and Shashi (2008) determined the prevalence and pattern of disability in all age groups in a rural community of Karnataka. This cross-sectional study studied 1000 subjects of all age groups selected randomly from four villages under rural field practice area of a teaching institution. The prevalence of disability was found to be 6.3%. Both physical and mental disabilities were of great concern, and 80% of the disabled were found to have multiple disabilities. In another study, Kumar, Das, Bhandary, Soans, Kumar, and Kotian (2008) assessed the prevalence and pattern of mental disability in a community study of 1000, in all age groups, from four villages in Udupi district, Karnataka. The study was conducted by making house-to-house visits, interviewing, and examining all the individuals in the families selected with pre-designed and pre-tested questionnaire. The overall prevalence of mental disability was found to be 2.3% (22). Among those with mental disability, majority (10) had mild disability. This was followed by severe (6), moderate (4), and profound (2) mental disability. The prevalence was higher among females (3.1%) than among males (1.5%). The authors emphasized the need for community-based rehabilitation of the mentally disabled.

Sidhu, Kaur, and Malhi (2008) reported that that delays and disorders of language are common in Indian children and are frequently associated with cognitive, academic, social, and emotional dysfunctions. A sample of 123 pre-school children aged two and a half to five years were assessed for developmental status using the Battelle Developmental Inventory- II (BDI-II, Newborg, 2005). Twenty one children (17%) were found to have delayed expressive language functioning and in comparison to the controls showed significantly lower scores on the cognitive and
motor developmental functioning as well. There were, however, no differences between the two groups on the adaptive and personal-social developmental domains. It seems that language impairment in children may not be an isolated deficit and delay in one area of functioning may be associated with a broad spectrum of developmental impairments.

Nair, George, Padma, Potti, Elizabeth, and Jeyaseelan (2009) administered the DDST–II to a sample of 2,111 children referred to a developmental evaluation clinic with suspected developmental delay or deviation. Nearly 50% of the referred babies had developmental delay without a specific clinical diagnosis, 13.9% had speech problems, 9.5% had neurological problems and 5.2% had chromosomal anomalies.

Nair et al. (2009) studied 12,520 children under the age of five years in a rural block covered under the Integrated Child Development Scheme (ICDS). Using the Trivandrum Developmental Screening Chart (TDSC; Nair et al., 1991) for children up to the age of two years and the Denver Developmental Screening Test (DDST; Frankenburg & Dodds, 1967) for children above two years of age, the authors found that the prevalence of developmental disability up to two years of age was 2.31% and in the age range of 2 to 5 years was 2.62%.

Several authors in India have emphasized the need to invest in the social and cultural environment in which the child exists for both individuals and nations to emerge from poverty (Kaur, Singh, & Malhotra, 1985; Misra & Tiwari, 1984; Sidhu, Malhi, & Jerath, 2008b, 2008c). The role of socio-cultural disadvantage in influencing cognitive, perceptual, and language development is reported in several studies, all of which show a trend that facilitates the influence of caste, social class, and schooling for those at the upper end of the continuum and negative influence in the case of the disadvantaged (Ghuman, 1978; Majeed & Ghosh, 1981; Misra, 1982, 1990; Misra & Shahi, 1977; Rath & Patnaik, 1979). Ghai (1975) has presented evidence indicating a definite and significant lag in the intersensory integration function of malnourished rural children between 4 and a half to 6 and a half years of age. Singh, Anand, Gupta, and Dhintra (1976) indicated that normally nourished schoolchildren in the age range of 5 to 9 years from all socioeconomic backgrounds had higher IQ’s than malnourished children. Even 10 years later, children who had suffered from kwashiorkor and had received treatment, suffered a lag in mental development.
(Parikh, 1975). Further, the social-emotional development of the malnourished children significantly lags behind the normal children. Researchers have found malnourished children to be less exploratory, less attentive, fearful, socially withdrawn and less active (Bhattacharya, 1981; Chatterjee & Bhattacharya, 1979; Chattopadhyay & Bhattacharya, 1981). Delays in gross motor skills, fine motor skills, personal-social and language skills have been observed in deprived children (Rastogi, Srivastava, Dutt, & Singh, 1987).

In addition, significant differences in the cognition and intelligence of different caste groups have been noted in India (Mona & Das, 1993; Saraswathi & Dutta, 1988) Similar differences between tribal and non-tribal children’s performance have been reported (Bajpai, 1997). Intellectual ability has been found to vary in relation to socioeconomic status, weight, stature, mother’s education, and class (Bilquis & Devi, 1999). In a recent study, Sidhu et al. (2008c) examined the moderating effect of parental education status on the intelligence of school going children from low income groups. One-hundred school going children aged 4 to 8 years from low income groups were recruited for the study. Low income was defined as household income lower than Rs 5050 as per the Kuppuswamy’s Socio-economic Status Scale (Mishra & Singh, 2003). The intelligence of the children was assessed by the Academic Scale of the Developmental Profile II (Alpern et al., 1986). Children with the highest IQ ($M = 117.22$) had parents with 9 or more years of schooling, and the lowest IQ was for children wherein both parents had schooling 8 years or less ($M = 94.23$). Children of parents where only one parent had schooling of 9 years or more had IQs intermediate between the other two groups ($M = 107.73$). Stepwise regression analysis revealed that 32.6% of the variance in the IQ of the child was explained by the education of the father, age of the child, and the education of the mother. More educated the father and the mother and younger the child, higher was the IQ of the child. It seems then that education of both the parents is important for enhancing the intellectual development of children, especially from low income groups. In another study, Sidhu, Malhi, and Jerath (2008a) found that maternal education was an important mediator for enhancing the cognitive development of poor children. Poor children with mothers’ with higher education as compared to children with mothers’ with lower level of education were found to be superior in the acquisition of cognitive and academic skills including auditory memory, auditory working memory,
perceptual motor skills, colour recognition, ability to recognize and write numbers and alphabets, identification of right and left on self and others.

There is considerable evidence to indicate that children exposed to multiple risk factors such as poverty, malnutrition, poor maternal education, poor health are more at a risk for poor developmental outcomes than children exposed to a single risk factor (Nair & Radhakrishnan, 2004; Sameroff, Siefer, Barocas, Zax, & Greenspan, 1987; Sidhu et al., 2010a, 2010b). For instance, Sidhu et al. (2010b) examined the relationship between cumulative biological and environmental risk factors and the language development of children less than 3 years in a urban centre in North India. A sample of 253 children aged 2 to 35 months were evaluated for language development. The main outcome measure was the language quotient (LQ) of the child as evaluated by the Clinical Linguistic Auditory Milestone Scale (CLAMS, Capute et al., 1986). Twelve possible risk factors, 4 biological and 8 environmental, were selected. Biological risk factors included preterm birth, low birth weight, history of birth asphyxia, and history of neonatal jaundice. The environmental risk factors included low income, large family size, minimal father's and mother’s education, disadvantaged caste, low level of occupation of head of the household, absence of father, and higher birth order. A multiple risk score was created and categorized into 3 groups: low risk (0 to 1), moderate risk (2 to 3) and high risk (4 and above). A significant general downward linear trend in the LQ of the child was found as the number of risk factors increased. The difference in the LQ of the children with no risk factor and those with 8 risk factors was 21.21 LQ points and each risk factor reduced the LQ of the children by 2.63 points. The authors argued that although children experience many risk factors but the most detrimental effects on language development are caused when multiple biological and environmental risk factors act on a single child.

Evidence further indicates that parents of children exposed to multiple risk factors also tend to utilize intervention services for their children to a lesser degree further leading to the entrenchment of developmental disability. Padmamohan, Nair, Devi, Nair, Nair, and Kumar (2009) studied the extent of utilization of services and, identification of factors which determined the use of such services in rural families with disabled preschool children. Participants included disabled children in a UNICEF supported cross sectional survey conducted in a rural ICDS block. The
overall proportion of non-utilization of services was found to be 52.1% with the maximum non-utilization among the households with speech and hearing disability. The important explanatory variables predicting non-utilization were low socioeconomic status, poor educational level of father, and poor acceptability of services. It seems then that there is an urgent need for planning and organization of easily accessible, quality rehabilitation services in the community for children which are most vulnerable and marginalized in order to avoid the cycle of intergenerational transmission of poverty (Walker et al., 2007). Children from disadvantaged homes therefore, not only begin their lives from a poorer platform of health but also seem to have a reduced capacity to benefit from the medical, economic, and social services available (Misra, 1990; Najman et al., 2004).

In recent years, investigators have also evaluated the usefulness and impact of interventions on development and intelligence of preschool children through Anganwadi centers. Ade, Gupta, Maliye, Deshmukh, and Garg (2010) selected eight Anganwadi centers out of sixteen Anganwadi centers. Ten children in the age group of 4 to 6 years were selected randomly from each of the eight Anganwadi center in the intervention arm. For each child from intervention arm, one age matched child was selected from the matched Anganwadi center. For each subject, Intelligence Quotient and Development Quotient were assessed. Mean Development Quotient (DQ) and Intelligence Quotient (IQ) values were higher among children in intervention Anganwadi centers (16.2 points for DQ and 10.2 points for IQ). Mean DQ among boys was found to be 10.1 points higher than that among the girls in control arm. Some of the significant determinants of DQ included intervention, age of the child, education of mother, sex of child, and protein energy malnutrition (PEM) grade. The significant determinants of IQ were: intervention, age of the child, and income. The authors concluded that intervention to improve the Early Childhood Education and Development component through Anganwadi centers results can result in significant improvement in Developmental and Intelligence Quotient of children.

It is obvious from the review of the above studies that the data from India regarding the prevalence and correlates of developmental delay and disabilities are limited. Isolated macro- and micro-prevalence surveys report prevalence of developmental disabilities ranging from 2 to 17% (Bodhankar & Shashikala, 1995; Giramaji & Srinath, 2010; Sidhu et al., 2008; Singhi et al., 2007). Although there has
been perceptible progress in addressing the challenges posed by developmental disabilities in India on all fronts, there is still a long way to go in terms of developing a locally and nationally relevant and reliable database, effective implementation of legislation and policies, and development of effective, accessible, and affordable interventions (Dreza, Khera, & Narayanan, 2007; Giramaji & Srinath, 2010).

Moreover, it has been shown that the prevalence of developmental disabilities is higher in the developing than in the developed countries (Aly et al., 2010; Tan & Yadav, 2008). For example, disorders of mental and motor development are the leading neurological problems in Pakistani children (Hussain, Khan, Qazi, & Rahman, 1991). In many developing countries, including India, there is a social stigma attached to persons with developmental abilities and parents often use denial as the most common form of coping (Sequeria, Rao, Subbakrishna, & Prabhu, 1990; Srinath, et al., 2010; Upadhyaya & Havalappanavar, 2008). Generally, there is no provision for the management of childhood disabilities in the healthcare services and families have to bear the brunt of care (Pal & Choudhry, 1998; Rastogi, 1981). Available social and educational services are also scarce and elementary and tend to alienate rather than integrate disabled children into the main fabric of the society (Peshawaria & Menon, 1991; Singhi et al., 1990).

**Developmental Screening and Assessment Tests**

Child development alludes to the enhancement and specialization of a child’s functioning with the achievement of increasingly intricate abilities in the different functional domains. Failure to achieve developmental milestones reflects the complex interactions between the child and his environment (Capute & Accardo, 1996). The well-documented benefits of early intervention are accorded only to those who are the beneficiaries of early identification (Glascoe, 1998; Gulati & Wasir, 2005). In pursuit of this goal, professionals working with children have generated two fairly distinct approaches to early detection: developmental screening and developmental assessment.

Developmental screening includes the application of specific tests or examinations. The means of data collection must be appropriate and reasonable with regard to economics of time, money and resources for dealing with large number of persons (Baird et al., 2001).
Developmental assessment is a complex and individually specific process of gathering information in order to identify areas of strengths and weaknesses and to interpret the findings for effective program planning. In addition to standardized testing, the assessment process places equal importance on information gathered from interview, questionnaires, checklist and observations of the child in his or her environment, thus providing a broader perspective of child's functioning.

In this section, some of the commonly used developmental screening and comprehensive developmental assessment batteries are described and critiqued.

**Developmental Screening Tests**

Several developmental screening tests are available for use with infants and children in the Western countries. There are several well-accepted criteria by which various tests are judged to be appropriate for use in screening programs. It is recommended that screening tests should be simple, brief, convenient to use, cover all areas of development, have adequate construct validity, be applicable to a wide age range, and have referral criteria that are both specific and sensitive (American Academy of Pediatrics, 1994).

The purpose of a developmental screening test is to identify children in need of further evaluation or guidance procedures. A screening test result does not yield an intelligence quotient (IQ) or an equivalent but only a classification of subject into two broad categories: negative/ non-suspect/ non-diseased or positive/ suspect/ diseased. It is recommended that a positive screening result should be followed by a detailed developmental evaluation. It should be noted that developmental screening instruments for early ages have, by necessity, non-specific targets (Sonnander, 2000).

Table 1 presents the characteristics including age range, administration time, domains assessed, number of items and scores generated by the commonly used developmental screening tests. A brief description of the tests is also presented below.

**Vineland Social Maturity Scale (VSMS):** The VSMS (Doll, 1965) is based on the idea that adaptive behaviour is developmental in nature i.e., what is considered to be socially sufficient behaviour is dependent on the age of the person under evaluation. The 117-item scale comprises 8 categories of items i.e., self-help general,
<table>
<thead>
<tr>
<th>Test</th>
<th>Age Range</th>
<th>Administration Time</th>
<th>Domains Assessed</th>
<th>Total number of Items</th>
<th>Standardization Sample</th>
<th>Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vineland Social Maturity Scale (VSMS)</td>
<td>Birth to 18 years</td>
<td>10-15 minutes</td>
<td>Self-Help General, Self-Help Dressing, Communication, Self-Direction, Socialization, Locomotion, Occupation</td>
<td>117</td>
<td>620</td>
<td>Age Equivalent, Ratio Quotient</td>
</tr>
<tr>
<td>Denver Developmental Screening Test (DDST)</td>
<td>2 weeks to 6 years</td>
<td>15-20 minutes</td>
<td>Gross Motor, Fine Motor-Adaptive, Personal-Social, Language</td>
<td>105</td>
<td>1036</td>
<td>Risk Categorization: Normal, Abnormal, Questionable, Untestable</td>
</tr>
<tr>
<td>Clinical Adaptive Test / Clinical Linguistic Auditory Milestone Scale (CAT/CLAMS)</td>
<td>1 month to 3 years</td>
<td>15-20 minutes</td>
<td>Visual-Motor Skills, Receptive and Expressive Language</td>
<td>100</td>
<td>1055</td>
<td>Age Equivalents, Developmental Quotients (M=100, SD=15)</td>
</tr>
<tr>
<td>Developmental Profile II (DP-II)</td>
<td>Birth to 9½ years</td>
<td>20-25 minutes</td>
<td>Physical, Self-Help, Social, Academic, Communication</td>
<td>186</td>
<td>3008</td>
<td>Age Equivalents, Ratio IQ (M=100)</td>
</tr>
<tr>
<td>Denver II</td>
<td>2 weeks to 6 years</td>
<td>15-20 minutes</td>
<td>Personal-Social, Fine Motor-Adaptive, Language, Gross Motor</td>
<td>125</td>
<td>2096</td>
<td>Risk Categorization: Caution, Delay, No Opportunity, Normal, Advanced</td>
</tr>
<tr>
<td>Parents' Evaluation of Developmental Status (PEDS)</td>
<td>Birth to 9 years</td>
<td>2-5 minutes</td>
<td>Questions elicit parental concerns in specific areas of development</td>
<td>10</td>
<td>771</td>
<td>Risk Categorization: low, moderate, or high risk for various disabilities</td>
</tr>
<tr>
<td>Ages and Stages Questionnaire (ASQ)</td>
<td>4 months to 5 years</td>
<td>10-15 minutes</td>
<td>Communication, Gross Motor, Fine Motor, Problem Solving, Personal Social</td>
<td>30</td>
<td>2008</td>
<td>Single pass/fail score for developmental status</td>
</tr>
<tr>
<td>Parents' Evaluation of Developmental Status: Developmental Milestones (PEDS: DM)</td>
<td>Birth to 8 years</td>
<td>5 minutes</td>
<td>Fine Motor, Gross Motor, Social-Emotional, Self-Help, Expressive Language, Receptive Language</td>
<td>6 to 8 items per age range</td>
<td>1619</td>
<td>Bar graph (profile) of strengths and weaknesses</td>
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</tbody>
</table>
self-help dressing, self-help eating, communication, self-direction, socialization, locomotion and occupation. The scale can be administered from 0 to 18 years of age and does not require participation of the individual whose adaptive behaviour is being assessed but only requires a respondent who is familiar with the individual’s behaviour hence allowing for assessment of infants, the severely or profoundly retarded, the severely emotionally disturbed and the physically handicapped. The VSMS was standardized on 620 persons, stratified into 10 males and 10 females at each year, from birth to 30 years of age. Two types of scores are provided by the VSMS: a Social Age (SA) and a Social Quotient (SQ).

The major limitations of the VSMS are its inadequate standardization and limited psychometric properties. Besides, the SQ score is a ratio and, hence, has the same problems that are associated with a ratio IQ (Sattler, 1982).

The Indian version of the VSMS by Malin (1971) is a commonly used test to measure adaptive behaviour functioning of Indian children (Malhi & Singhi, 2005). It measures level of social competence of children from 0 to 15 years. It consists of 89 items and the items are categorized into self help, general, self help eating, self help dressing, self direction, occupation, communication, locomotion, and socialization. A guided interview from parents is used to obtain the information needed to complete the scale. The scale takes 10 to 15 minutes to administer. The score is computed from the total number of items successfully completed by the child. Two types of scores are provided by the VSMS: a social age (SA) and a social quotient (SQ). Scores below 70 are considered as deficient in adaptive behaviour functioning.

**Denver Developmental Screening Test (DDST):** The DDST (Frankenburg & Dodds, 1967) is by far the most commonly used screening test, used to screen children from two weeks through six years of age in four developmental domains: gross motor, fine motor-adaptive, personal-social and language. The test contains 105 items, which were selected from 12 preschool intelligence tests and developmental instruments, e.g., The Bayley Scales of Infant Development, Gesell Developmental Schedule, Griffith Developmental Scale. Only those items are administered to the children, which are appropriate to the child’s age. The manual provides standardized directions for administration of each item. Clear and precise instructions are available for scoring the DDST. Each item is scored pass, fail, refused or no opportunity. A
delay score is given to an item, which is failed by a child that is passed by more than 90% of children in the normative age group. Scores are interpreted as ‘normal’, ‘abnormal’, ‘questionable’ or ‘untestable’ in each sector. The authors have indicated that whenever the results of a child’s DDST are abnormal, questionable or untestable, a re-screening appointment should be scheduled.

Standardization data for the DDST are in the ranges of 83% to 96% for the different kinds of reliability. The sensitivity of the test has been shown to be in the range of 75 to 96 percent and the specificity in the range of 92 to 100 percent (Stangler, Huber, & Routh, 1980). Across a large number of different studies conducted with a variety of age ranges, samples, base rates, time intervals and criterion measures, the DDST has been shown to have a high specificity and low sensitivity (Borowitz & Glascoe, 1986).

The Indian adaptation of the DDST known as the Chandigarh Development Screening Scale (CDST; Puri, Singhi, Pershad, Walia, & Verma, 1995) was constructed and standardized in Hindi, on 821 children between the ages of 3 and 36 months, belonging to urban, middle class families. It consists of 107 items divided into four areas i.e., Gross Motor (23 items), Fine Motor (28 items), Language (26 items), and Personal-Social (30 items). Reliability and validity exercises were carried out on 80 and 60 children in the age group of 3 to 36 months. Test-retest reliability and inter-rater reliability were found to be quiet high (with 97% and above agreement). Various types of concurrent validities were tested and found satisfactory. However, there are no published studies reporting use of the test in India.

The DDST is the most useful in identifying children with moderate to severe motor or cognitive deficits. However, its usefulness in detecting more subtle delays is limited (Chaudhari, 1996; Meisels, 1989). Some studies have shown that the sensitivity of the DDST to antecedent events, socio-economic background and to prematurity is limited (Fleming, 1981; Niparko, 1982; O’Pray, 1980).

**Cognitive Adaptive Test/Clinical Linguistic Auditory Milestone Scale (CAT/CLAMS):** The CAT /CLAMS, also known as The Capute Scales (Capute et al., 1986) were originally developed in the 1970s by Dr Arnold. J. Capute to provide the practicing physician with an instrument to accurately and efficiently assess selected aspects of infant development in the office setting. This test is a screening tool,
specifically developed for use by pediatricians to assess the development in infants and toddlers with ages from 1 to 36 months. The test consists of the Clinical Linguistic and Auditory Milestone Scale (CLAMS, 43 language items) and the Cognitive Adaptive Test (CAT, 57 visual-motor, nonverbal problem-solving items). These 100 items were selected from existing infant assessment batteries on the basis of their ease of administration and of interpretation and scoring by pediatricians with minimal to no background in infant testing. The two scales yield qualitative development quotients for non-language visual-motor (CAT DQ) and language (CLAMS DQ) abilities, as well as a composite score of cognition function. An advantage of this instrument is that the scores help in discriminating children with mental retardation (i.e., both language and visual motor delay) and those with communication disorders (discrepancy between separate score with language DQ below visual motor DQ). The CAT/CLAMS was validated only against measures of intelligence on referred rather than general pediatric samples hence rendering its sensitivity and specificity to be inflated (Kube, Wilson, Peterson, & Palmer 2000).

In 2004, a multisite study standardized the instrument on a population of 1055 typically developing children balanced for age, sex, and race and generated normative tables to document the instrument’s utility. There emerged no significant performance differences by race or sex. The achieved age levels for individual test items and for total scores were accurately predicted by the age levels assigned to the test items. The conversion of age levels to standard scores was found to be unnecessary because the developmental quotients derived from age ratios did not differ significantly from the derived scores (Visintainer, Leppert, Bennett, & Accardo, 2004). The CLAMS has also been recently used in India to document the language deficits in young children encountering multiple risk factors (Sidhu et al., 2010b).

**Developmental Profile II (DP II):** The DP II (Alpern et al., 1986) relies on parent report to assess children from birth to 9½ years of age. The inventory consists of 186 items to assess a child’s development in five areas: Physical, Self-Help, Social, Academic, and Communication. Items on the Developmental Profile were derived from several scales of children’s intellectual, physical, social and language abilities, normative data appearing in the developmental literature, and the multidimensional constructs underlying the test. Administration of the total test results in a functional developmental age level. Each sub-scale produces a developmental age, which is
subtracted from chronological age. The resulting "months differential" is compared with a cut-off that reveals whether children are advanced, normal, borderline or delayed in their development. The score on the Academic subscale can be used to compute an IQ equivalency score.

The test demonstrates adequate reliability indices. However, validation studies recommend caution in the interpretation of IQ equivalence scores as it is a ratio score and tends to overestimate IQ scores for children below the norm and underestimate them for children above the norm. One study reported an error of prediction of up to 15 points on either side of the obtained IQ equivalency score (Macmann & Barnett, 1984). The DP II has been widely used in India, primarily in the clinical setting, and found to be a reliable and a valid test (Malhi, Kaur, Manchanda, & Sidhu, 2006; Malhi & Singhi, 2003; Sidhu et al., 2008c, 2010a).

The IQ Equivalency (IQE) score, although easily understood, has many limitations. First, an IQE score can be computed only if the child obtains a ceiling on the Academic sub-scale. If the child does not obtain a ceiling, the IQE cannot be computed as the child’s skills may go beyond the level of the scale; thus a derived IQ would be an underestimate of the child’s abilities. One of the greatest limitations is that being a ratio IQ, standard deviations are likely to vary from one-age level to the next, implying that an IQ at one age may indicate a different degree of superiority or inferiority than the same IQ at a different age. Thus, the comparability of two scores at different ages is deceptive (Lyman, 1978).

Denver II: Concerns about the inadequate psychometric properties of the DDST prompted a major revision of the test and led to development of the Denver II (Frankenburg, Dodds, Archer, Shapiro, & Bresnick, 1990). The Denver II consists of 125 items which are arranged on the test form in four domains to screen the areas of personal-social, fine motor-adaptive, language, and gross motor. It differs from its predecessors by the addition of 20 new items, most of which tap expressive language and articulation skills. Five separate items enable ratings of behaviour and speech intelligibility. Pass/ fail/ refusal scores are assigned to all items and item performance is then re-interpreted in relation to children’s ages in terms of caution, delay, no opportunity, or normal or advanced performance. Two or more delays produce an
abnormal overall test score while one delay and/or two or more cautions result in a questionable score.

The Denver II was published without information about its validity or accuracy in identifying children with and without problems. Glascoe, Byrne, Ashford, Johnson, Chang, and Strickland (1992) conducted a study to evaluate the accuracy of the Denver II by comparing its performance to standards for screening tests. Results indicated that though the Denver II had a high sensitivity of 83%, it had an unacceptably low specificity of 43% and positive predictive value of 23%. Owing to the exceedingly high over-referral rate, this test has not been extensively used in India. It has also been criticized for its limited psychometric properties (Malhi & Singhi, 1999).

**Early Language Milestone Scale – 2nd Edition (ELMS- 2nd Ed):** The ELM scale (Coplan, 1993) is a screening test of speech and language development for use with children from birth to 36 months. The ELM scale consists of 43 items and covers 3 areas of language function: auditory receptive, auditory expressive and visual language. It takes between 2 to 10 minutes to complete and gathers information through parental history, direct testing, observation, and combination of these three testing strategies. The scale can be scored in two different ways. The pass/fail scoring technique is ideally suited for rapid screening of large number of low risk subjects. The other scoring technique is the point scoring for individual domains. This technique can be performed when the child receives a failing grade and needs to be assessed more thoroughly.

The reliability of the test is high: inter-observer reliability is 0.93 to 0.99 for percentile scores with test-retest correlation coefficients of 0.77 to 0.94 (Coplan & Gleason, 1993). Block, Freeland, Nair, Rubin, and Hutcheson (1988) found that the performance on the ELMs was significantly correlated with performance on the Bayley Scale of Infant’s Development (BSID, Bayley, 1993) at both 14 and 18 months. The ELM demonstrated a sensitivity of 86% and a specificity of 100%.

**Parents’ Evaluation of Developmental Status (PEDS):** This screening and surveillance tool developed by Glascoe (1998) provides evidence based decision support and is designed to both detect and address a wide range of developmental issues including behavioural and mental health problems. It promotes parent –
provider collaboration and family centered practice by relying on 10 carefully constructed questions (2 open ended and 8 yes/no questions) eliciting parents’ concerns. The PEDS need not be administered by a professional, and can be completed by a parent on his/her own. PEDS identifies, using substantial evidence, when to refer, screen further or refer for additional screening, counsel, reassure, temporize or monitor development behaviour and academic progress. The instrument was standardized and validated with 771 children representative of the 1996 US Census. The sensitivity of the screening measure ranges from 74% to 79% and specificity ranges from 70% to 80%.

The PEDS has been extensively used in India. For example, in a hospital based study, Malhi and Singhi (2002) elicited parental concerns from 79 parents of children aged 24 to 60 months from a tertiary care hospital. Using Developmental Profile II (Alpern et al., 1986) the authors found that concerns identified 61.5% of children with delayed development and 65.2% of children with normal development.

In another community study, Kaur, Malhi, and Sidhu (2010) administered the PEDS to 418 parents of children in the age range of 2 to 8 years. Using the Battelle Developmental Inventory –II (BDI-II; Newborg, 2005), the authors found that a little more than one-third of the parents raised one or more significant concerns about their child’s development. Raising a significant concern was only 56% sensitive to developmental delay, though it increased to 68% for the older children. The specificity of raising any significant concern was found to be unacceptably low at 36%, hence leading to over-referrals.

**Ages and Stages Questionnaire (ASQ):** The ASQ (Squires, Bricker, & Twombly, 2002) is a parent completed, child development screening test with 19 questionnaire intervals, ranging from 4 to 60 months, that are identical in format and organized into five 6-item domains (communication, gross motor, fine motor, problem solving, and personal social), for a total of 30 items. ASQ questions are written at the fourth to sixth grade reading level and can be administered as an interview for parents with low literacy levels. Parents indicate “yes”, “sometimes”, or “not yet” in response to each item. The ASQ requires approximately 15 minutes to complete and 2 to 3 minutes to score. The questionnaire has moderate to high sensitivity (0.70 to 0.90) and specificity (0.76 to 0.91) and excellent reliability (test-
retest reliability: 0.95; inter-rater reliability: 0.95), with the 12 and 24 month intervals having the highest sensitivity and specificity in the first 24 months of life.

A significant disadvantage of the test, however, is that developmental ages do not always match the American Academy of Pediatrics periodicity schedule of health maintenance visits, e.g., after six months of age, the American Academy of Pediatrics (2006) recommends visits every three months, but the questionnaires are at every two months at this age, so it raises the dilemma as to if a 14 month questionnaire should be used at a 15 month visit. This might affect the ability of the test to detect subtle abnormalities (Levine, 2006). The test has also not been used in India (Chaudhari, 1996; Malhi & Singhi, 1999).

**Parents’ Evaluation of Developmental Status: Developmental Milestones (PEDS: DM):** Despite empirical support for repeated administrations across well visits of validated and sensitive screening tools, most health care providers prefer the use of non-validated milestones check lists. The PEDS: DM (Glascoe & Robertshaw, 2007) was developed with the rationale of creating an accurate screening and surveillance tools offering validated milestones.

The PEDS: DM is designed for children from birth to 8 years of age and consists of 6 to 8 items per visit/age. Each item represents a different developmental domain: fine motor, gross motor, social-emotional, self help, expressive language, receptive language, and, for older children, reading and mathematics. Age appropriate items for each age range/visit are presented on a single page within a booklet that includes essential visual stimuli. Parents (or professionals) and older children (who may be asked to copy a shape, write words, draw a person, read safety signs, etc) write directly on the page, elicit children’s skills, and then answer the PEDS:DM items via a multiple-choice format in less than 5 minutes. Scoring is done by using a template which is placed on the scoring form to reveal correct and incorrect answers that are then transferred to a longitudinal growth chart. Over time, this builds a bar graph of children’s developmental strengths and weaknesses in each domain and illustrates when referrals are needed.

The authors report sensitivity of 70% and specificity ranging from 77% to 93%. Excellent reliability indices of the test are also reported, e.g., internal
consistency reliability of 0.98, test-retest reliability of 0.99, and inter-rater reliability ranging from 0.82 to 0.96 (Brothers, Glascoe, & Robertshaw, 2008).

**Developmental Assessment Tests**

The objectives of a specialty assessment of young child with developmental delay are several folds including confirming the existence of a delay; precisely categorizing and classifying the apparent delay; establishing, if possible, an etiologic diagnosis for the delay; ensuring the referral to and provision of appropriate local specialty rehabilitation services to lessen the burden of disability; and managing any associated medical complication (American Academy of Pediatrics, 2001, 2006).

Table 2 presents the characteristics including age range, administration time, domains assessed, total number of items, scores generated at the domain level, and at the total test level by some of the comprehensive developmental assessment batteries used for assessment of young children. A brief description of these comprehensive assessment batteries is also presented below.

**McCarthy Scales of Children’s Development (MCSA):** At the preschool level, a well constructed instrument is the McCarthy Scales of Children’s Abilities (McCarthy, 1972), suitable for children between the ages of 2½ and 8½ years. It consists of 18 tests grouped into 6 overlapping scales: Verbal, Perceptual-Performance, Quantitative, General Cognitive, Memory and Motor. The General Cognitive Score, based on 15 of the 18 tests in the battery, comes closest to the traditional global measure of intellectual development. The General Cognitive Index (GCI) is a normalized standard score \( M= 100, \; SD= 16 \) and found within each 3 month age group. Scores on the 5 additional scales are based on the same age groups and have a mean of 50 and an SD of 10.

The average split-half reliability of the GCI is excellent (0.93), while average split-half reliabilities for the other five scales, which range from 0.79 to 0.83, are satisfactory. The GCI has also been found to have adequate stability \( (r = 0.85) \) over a one-year period (Davis & Slettedahl, 1976). The test also reports satisfactory validity indices. However, despite its many strengths, the test also has some limitations (Kaufman & DiCuiio, 1975). It involves much clerical work in the transformation of the 18 separate tests into indexes on the six scales.
<table>
<thead>
<tr>
<th>Test</th>
<th>Age Range</th>
<th>Administration Time</th>
<th>Domains Assessed</th>
<th>Total number of items</th>
<th>Standardization sample</th>
<th>Scores (Domain level)</th>
<th>Scores (Total test)</th>
</tr>
</thead>
<tbody>
<tr>
<td>McCarthy Scales of Children's Development (MCSA)</td>
<td>2½ to 8½ years</td>
<td>40-50 minutes</td>
<td>Verbal, Perceptual-Performance, Quantitative, General Cognitive, Memory and Motor</td>
<td>-</td>
<td>1032</td>
<td>Standard T score (M=50, SD=10)</td>
<td>Standard scores (M=100, SD=16)</td>
</tr>
<tr>
<td>Child Development Inventory (CDI)</td>
<td>18 months to 6 years</td>
<td>30-50 minutes</td>
<td>Social, Self-Help, Motor, Language, General Development Skills</td>
<td>300</td>
<td>568</td>
<td>Age Equivalents, Developmental Quotients (M=100, SD=15)</td>
<td>Developmental Quotients (M=100, SD=15)</td>
</tr>
<tr>
<td>Bayley Scales of Infant Development (BSID)</td>
<td>1 month to 3½ years</td>
<td>25-40 minutes</td>
<td>Mental, Psychomotor, Test-Taking Behaviour</td>
<td>163</td>
<td>1700</td>
<td>Standard scores (M=100, SD=15), Percentiles, Age equivalents</td>
<td>Percentiles</td>
</tr>
<tr>
<td>Mullen Scales of Early Learning (MSEL)</td>
<td>Birth to 6 years</td>
<td>15-30 minutes</td>
<td>Gross Motor, Fine Motor, Visual Perception, Receptive Language, Expressive Language</td>
<td>124</td>
<td>1849</td>
<td>Standard T score (M=50, SD=10), Percentiles, Age equivalents for each domain.</td>
<td>Early Learning Composite (M=100, SD=15), Percentile and Age equivalent</td>
</tr>
<tr>
<td>Griffiths Mental Developmental Scales - Revised</td>
<td>Birth to 2 years</td>
<td>35-60 minutes</td>
<td>Locomotor, Personal-Social, Hearing And Language, Eye And Hand Coordination, Performance</td>
<td>-</td>
<td>Not stated</td>
<td>Standard scores (M=100, SD=15), Age equivalents, Percentiles</td>
<td>Standard scores (M=100, SD=15), Age equivalents, Percentiles</td>
</tr>
<tr>
<td>Battelle Developmental Inventory - II (BDI-II)</td>
<td>Birth to 8 years</td>
<td>1-2 hours</td>
<td>Personal Social, Adaptive, Motor, Communication, Cognitive</td>
<td>450</td>
<td>2500</td>
<td>Standard scores for sub-domain (M=10, SD=3), Domain: Standard scores (M=100, SD=15), Percentiles</td>
<td>Standard scores (M=100, SD=15), Percentiles</td>
</tr>
<tr>
<td>Vineland Adaptive Behaviour Scales - 2nd Edition (VABS-II)</td>
<td>Birth to 90 years</td>
<td>30-60 minutes</td>
<td>Communication, Daily Living Skills, Socialization, Motor skills</td>
<td>297</td>
<td>3695</td>
<td>Standard Scores (M=100, SD=15), Percentiles</td>
<td>Standard Scores (M=100, SD=15), Percentiles</td>
</tr>
<tr>
<td>Developmental Profile 3 (DP-3)</td>
<td>Birth to 13 years</td>
<td>20-40 minutes</td>
<td>Physical, Adaptive behaviour, Social-emotional, Cognitive and Communication</td>
<td>180</td>
<td>2216</td>
<td>Standard scores (M=100, SD=15), Percentiles, Stanines, Age equivalents</td>
<td>Standard scores (M=100, SD=15)</td>
</tr>
</tbody>
</table>
Also the test does not include social comprehension and judgment tasks, and few tasks assess abstract problem solving skills. One of the major limitations of the test is a lack of sufficient ceiling on many of the tests for children aged 7 years and older and a limited floor for evaluating below-average children in the younger age groups.

**Child Development Inventory (CDI):** The CDI (Ireton, 1992) is a revision of the Minnesota Child Development Inventory and is used for testing children in the age range from 15 months to 6 years. It consists of 300 items: 270 items composed of yes/no statements about the child’s development and 30 items evaluating various sensory, physical, motor, language, and behavioural problems. The inventory audits eight streams of development namely, social, self-help, gross motor skills, fine motor skills, expressive language, comprehension, letters, and numbers. The eight streams are grouped to form the following nine scales: social, self help, gross motor, fine motor, expressive language, language comprehension, letters, numbers, and general development. The general development scale is an index of overall development and includes the most age discriminating items from the other scales. The results provide a profile of the child’s development, problems and strengths, and are an aid to comprehensive assessment. The test takes 35 to 50 minutes to complete, requires a seventh to eighth grade reading level, and may thus be impractical for use with large groups of low-risk children (Sutton, 2006).

The CDI is reliable with Cronbach’s alphas exceeding 0.70 and ranging from 0.80 to 0.90 for expressive language, language comprehension and general development scales. A study by Montgomery, Saylor, Bell, Macias, Charles, and Katikaneni (1999) on a high risk population demonstrated a sensitivity of 80% and specificity of 96% leading investigators to conclude that it is a useful and cost-effective measure for determining developmental outcome.

**Bayley Scales of Infant Development (BSID):** An especially well constructed test for the earliest age levels is the Bayley Scales of Infant Development (Bayley, 1993) which assesses the developmental status of children between the ages of 1 month and 3½ years. The BSID has three complementary scales – the Mental Scale, the Motor Scale, and the Behaviour Rating Scale. The Mental Scale samples such functions as perception, memory, learning, problem-solving, vocalization, the beginnings of verbal communication, and rudimentary abstract thinking, habituation
and mental mapping. The Motor Scale provides measures of gross motor abilities, such as sitting, standing, walking and stair climbing, as well as manipulatory skills of hands and fingers; items that assess sensory and perceptual motor integration are also included. At the infant level, locomotor and manipulatory development plays an important part in the child’s interactions with the environment and hence in the development of his or her mental processes. The Infant Behaviour Record is a 5-point rating scale completed by the examiner and is designed to assess various aspects of personality development, such as emotional and social behaviour, attention span and arousal, persistence, and goal directedness.

The Mental and Motor scales yield separate developmental indices, expressed as normalized standard scores with a mean of 100 and a standard deviation of 15. These indices are found within the child’s own age group, classified in 1-month intervals up to 36 months and 3 month intervals thereafter. The Behaviour Rating Scale yields percentile rank scores that are, in turn, categorized as “non-optimal”, “questionable”, or “within normal limits”.

Norms for the test were established on 1700 children. Split-half reliability coefficients within separate age groups ranged from 0.81 to 0.93 for the mental scale; and from 0.68 to 0.92 for the motor scale. The Bayley scales show strong relationships with the Stanford-Binet, Wechsler scales, Piagetian task performance, social class and environmental factors (Gregory, 2005). The Bayley scales require more skill to administer and interpret than comparable instruments. It also takes longer (45 to 75 minutes). Consequently, the Bayley scales are reserved for special assessments and research applications, and are not commonly used in routine practice.

The Indian adaptation of the Bayley Scales, also known as the Developmental Assessment Scales for Indian Infants (DASII; Misra & Phatak, 1996) consists of 67 items for motor development and 163 items for mental development. Excellent psychometric properties of the test and the development of norms for Indian children have made this test the gold standard in assessing development of infants in India (Malhi, 2004).

**Mullen Scales of Early Learning (MSEL):** The MSEL scales (Mullen, 1995) are a revision and combination of the Infant MSEL (Mullen, 1989) and Preschool MSEL (Mullen, 1992). The five scales that comprise the test are based on the author’s
theory of intelligence, which emphasizes gross motor development as the foundation for visual and auditory conceptual development. The gross motor scale is for children birth through 33 months of age. The remaining four scales namely, visual reception, fine motor, receptive language, and expressive language are for children birth through 68 months of age, consist of 124 untimed items measuring cognitive development.

T scores, percentiles, and age equivalents describe the results of each scale. An early learning composite based on the four cognitive scales describes overall cognitive development in terms of standard scores and percentiles. Items are scored on the basis of direct testing, though some maybe scored from parent interviews and parents may help evoke a child’s response on several items.

The internal consistency and test retest reliability coefficients are high, ranging from 0.83 to 0.95 for the Early Learning Composite and slightly below 0.80 for the separate scales of the test. The construct and concurrent validity of the test has been established. However, no predictive validity information is provided.

Bradley-Johnson (2001) in a critique of the test has observed that from birth to 20 months, the item gradients are steep within the average and below-average range. This problem interferes with the ability of the MSEL to discriminate among different levels of functioning in young children. Also, no empirical evidence is provided to support the author’s theory of intelligence of the proposed stages. Besides, the concurrent, content, and construct validity evidence is very limited, and item bias analysis and predictive validity data are lacking.

Griffiths Mental Developmental Scales – Revised: The Griffiths Scales (Griffiths, 1996) comprise the “Baby Scales” for children from birth through 23 months, and the “Extended Scales” for children from 24 months to 8 years. These scales require approximately 45 minutes to administer, and provide an assessment of functioning in five domains: locomotor, personal-social, hearing and language, eye and hand coordination, and performance. The test yields standard scores \( M = 100, SD = 16 \) for each domain and composite general quotient \( M = 100, SD = 12 \). This scale provides a profile of development and analysis of strengths and weaknesses.

Notably, the Griffiths Scales is the only test standardized in the United Kingdom. Whilst the normative sample is large for the infant test, with 665 children
aged 0-24 months, the standardization itself is less impressive and lacks methodological rigour. The psychometric properties of the scales are also poorly detailed (Johnson & Marlow, 2006).

A less considered difficulty with the Griffiths Scales lies in their use at 2 years – the crucial age for follow-up. Whilst the Baby Scales are designed for use with children 0 to 2 years, and the Extended Scales for children from 2 to 8 years, they are not directly comparable, not having been co-normed. Besides, the Extended Scales include a sixth sub-scale (practical reasoning), and either scale must be used separately as both produce separate General Quotients based on different normative data sets.

**Battelle Developmental Inventory - II (BDI – II):** The Battelle Developmental Inventory (Newborg, 2005) is a standardized, individually administered assessment battery of key developmental skills in children from birth through 7 years of age. The battery consists of 450 test items grouped into 5 domains – adaptive, personal-social, communication, motor and cognitive. Within each domain, items are clustered into sub-domains, which represent specific skill areas. The administration procedures are designed to collect data through a structured test format for assessment of a child, interviews with parents, caregivers or teachers and observations of the child in natural settings.

The three-point objective scoring system provides for a sensitive measure which takes into account emerging as well as fully developed skills. It yields a developmental quotient (DQ) for each domain and a total composite score that represents the child’s development across all the domains. Raw totals are converted into scaled scores \( (M=10, SD=3) \) and into age-equivalent scores for the sub-domains. The sub-domain scaled scores are summed and converted into Developmental Quotients (DQs) for the five domains and for the total BDI-2 \( (M=100, SD=15) \).

The standardization sample consisted of 2500 children stratified by age, geographical region, race, socioeconomic status and sex in accordance with the 2001 U.S. Census data. Newborg (2005) has reported that internal consistency reliability co-efficient for the total DQ score as 0.91 and test retest reliability as 0.94, and inter scorer agreement ranging from 0.97 to 0.99. Satisfactory levels of content, construct, and criterion validity have also been reported.
The BDI-II has recently been used in India as a criterion measure for developmental problems associated with parent reported behavioural problems (Kaur, Sidhu, & Malhi, 2009). The same authors have also used the BDI-II to examine the developmental profile of children with motor impairments (Kaur et al., 2010).

**Vineland Adaptive Behaviour Scales – 2nd Edition (VABS –II):** The VABS-II (Sparrow, Cicchetti, & Balla, 2005) finds its origins in the Vineland Social Maturity Scale (Doll, 1965). The VABS assesses adaptive behaviour skills of infants, children and adults from birth to 90 years of age. It requires that an informant (parent, caregiver, or teacher) familiar with the behaviour of the referred individual answer behaviour oriented questions posed by an examiner or complete a questionnaire. This test comes in three forms, which differ in the number of test items and the manner of administration: the Survey Form, the Expanded Form, and the Classroom Edition.

The Vineland-II is based on a definition of adaptive behaviour that focuses on the ability of the individual to perform daily activities required for personal and social sufficiency. All 3 tests examine and assess 4 domains, namely communication, daily living skills, socialization and motor skills. In addition the survey and expanded forms have a “maladaptive section” assessing the number of maladaptive behaviour when compared with children of the same age group. Items are scored using four categories: 2 (usually), 1(sometimes, partially), 0 (never) and DK (don’t know). Raw scores are converted to standard scores \((M=100, \, SD =15)\) and percentile ranks for the four domains and for the adaptive behaviour composite.

The standardization samples for the Vineland-II consisted of 3695 individuals from birth to age 90 years. The samples were stratified by gender, race/ethnicity, community size, geographic region and socioeconomic status, as described by the 2001 Census. Standardization results demonstrate high-test retest reliability \((r = 0.76-0.93)\), internal consistency \((r = 0.76-0.99)\) and inter rater reliability \((r = 0.62)\) and validity (Rosenbaum, 1998; Vig & Jedrysek, 1995).

**Developmental Profile 3 (DP-3):** The DP-3 (Alpern, 2007) is a newer, standardized and updated version of the DP-II (Alpern et al., 1986). The test utilizes input from parents or caregivers (as an interview or a checklist) and provides scores in five key areas of development: physical, adaptive behaviour, social-emotional, cognitive, and communication. Each scale comprises of 34 to 38 items, designed to
assess the development and functioning of children from birth through age 12 years. The DP-3 is normed on a nationally representative sample and can be used for diagnostic purposes. The test yields standard scores, percentile ranks, stanines, and age-equivalent scores.

The reliability evidence, as measured by test-retest and internal consistency studies, supports the use of the instrument as a tool for measuring development. The validity evidence illustrates that the DP-3 is an overall measure of general child development that is broken down into important skill areas for assessment, interpretation and treatment planning.

Developmental Testing In India

In an urgent attempt to direct efforts towards prevention, control, and management of developmental disabilities, the Baroda Development Screening Test for Infants (BDSTI; Phatak & Khurana, 1991) was developed for a door to door survey in the Baroda slums. The test was developed by community workers for the assessment of the motor and mental development of infants by selecting items from the Bayley Scales of Infant Development (Bayley, 1993). A total of 54 items, 22 motor and 32 mental were selected for children less than 30 months of age. Based on a study of 730 records of 130 babies (101 of them ‘at risk’), the authors reported a sensitivity and specificity of 65% to 95%, respectively.

The Trivandrum Developmental Screening Chart (TDSC, Nair et al., 1991) was designed by selecting 17 test items from BSID (Baroda norms) and was validated both at the hospital and community level against the standard DDST. The TDSC has a sensitivity of 66.7% and a specificity of 78.8%. Although the authors constructed the test to serve as a substitute for the DDST, the inadequate psychometric properties and the limited age range of the test has not made it very popular with either pediatricians or child psychologists (Malhi & Singhi, 1999).

Vazir et al. (1994) undertook a multi-centric cross-sectional collaborative study in 3 centers in India with the main aim of developing simple and reliable indicators for the early detection of developmental disabilities in children under 6 years of age. The 66 item ‘Screening Test Battery for Assessment of Psychological Development’ covered 5 domains - gross motor, vision and fine motor, hearing, language and concept development; self-help skills, and social skills. The battery has
been standardized of a large rural, tribal, and urban sample comprising more than 13000 children. Reference values were constructed in the form of curves, used to read off the age centiles of the children’s attainment of milestone at 3rd, 5th, 25th, 50th, 75th, 95th & 97th levels. Very few studies have used this test and therefore, its utility remains limited in the mainstream child development literature in India.

Kumar et al. (1995) developed and field-tested a culture-appropriate and simple test battery consisting of 67 test items in the state of Haryana. Only culture free items were included unmodified from Indian adaptations of the Bayley Scales of Infant Development (BSID, Bayley 1993), and the Gesell Developmental Schedule (GDS, Gessell & Amatruda, 1967). Low cost and familiar materials such as pebbles, sand, and clay were used instead of blocks and plasticene. Trained field workers administered the tests to 3731 preschool children in 47 randomly selected villages. Centile age values were constructed for various developmental milestones included in the culture-appropriate test battery.

Singhania and Sonksen (2004) adapted the Bus Puzzle Test (Egan & Brown, 1984) to develop the Indian Picture Puzzle Test (IPPT). The test has been developed scientifically considering the multilingual, multicultural and variegated Indian population. The IPPT, designed to assess aspects of children’s early development, portrays the inside of a house and courtyard. Fifteen noun labels and eleven questions on illustrated situations explore early language, some aspects of conceptual development and picture interpretation. Thirteen lift-out pieces test some non-verbal performance skills. The standardization sample comprised 616 children in the age range of two to five years. Norms were constructed for three socio-economic groups – advantaged urban group, urban slums and rural group. The test yields results in terms of percentile rank scores. The test has adequate reliability and validity indices.

In order to empower the Anganwadi workers to identify developmental delays in children attending Anganwadis, a Development Assessment Tool for Anganwadis has recently been developed (DATA; Nair, Russell, Rekha, Lakshmi, Latha, & Rajee, 2009). The scale comprises 6 sub-scales namely gross motor, fine motor, cognitive, personal-social, expressive language, and receptive language; with 2 items in each subscale amounting to a total of 12 items. These items have been compiled from existing developmental screening measures including the Denver Developmental
Screening Test (DDST, Frankenburg & Dodds, 1967), Developmental Assessment Scale for Indian Infants (DASII, Misra & Phatak, 1996), Receptive-Expressive Emergent Language Test (REEL, Bzoch & League, 1991), and the Vineland Adaptive Behaviour Scales (VABS, Sparrow, Balla, & Cicchetti, 1984). Although the items of the test were aimed at children from 2 to 3 years, the age range of the population recruited for normative purposes was from 18 to 50 months. The norms for the DATA items were based on a simple linear transformation of the raw data to indicate the level of delay in development.

Bhave et al. (2009) developed the New Lucknow Development Screen for Indian Children aged 6 months to 2 years of age. Screening of children in the community setting is difficult if the child is uncooperative, unwell or asleep, hence the authors developed a screening measure for to be administered to the parent/caregiver. A list of 27 milestones was prepared by selecting items from the Bayley Scales of Infant Development (Bayley, 1993) and Gessell’s Schedule (Gessell & Amatruda, 1965). These milestones covered the domains of gross motor, fine motor, social and language; for children up to 2 years of age. The milestones are placed on the y-axis of a chart and the child’s age is placed on the x-axis. A child failing to achieve any milestone to the left of the chronological age is considered screen positive. The authors report satisfactory inter-rater and test-retest reliability coefficients. Using the Developmental Assessment Scales for Indian Infants (DASII, Misra & Phatak, 1996) as the gold standard, the Lucknow Development Screen showed a sensitivity of 95.9% and a specificity of 73.1%. The predictive value of the test in a community setting has, however, yet to be established. Moreover, since the test has only been recently developed its utility in clinical or the community remains to be seen.

For the purpose of easy comparison, a summary of the common Indian developmental tests is presented in Table 3.
Table 3
Characteristics of the Commonly Used Indian Developmental Tests

<table>
<thead>
<tr>
<th>Test</th>
<th>Age Range</th>
<th>Administration time</th>
<th>Domains Assessed</th>
<th>Total number of items</th>
<th>Standardization sample</th>
<th>Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chandigarh Development Screening Scale</td>
<td>3 months to 3 years</td>
<td>10-15 minutes</td>
<td>Gross Motor, Fine Motor, Language, Personal-Social</td>
<td>107</td>
<td>821 Percentiles</td>
<td></td>
</tr>
<tr>
<td>The Indian version of the Vineland Social Maturity Scale</td>
<td>Birth to 15 years</td>
<td>10-15 minutes</td>
<td>Self help-General, self help- Eating, self help- Dressing, Self Direction, Occupation, Communication, Locomotion, Socialization</td>
<td>89</td>
<td>Not stated Age Equivalents, Ratio Quotient</td>
<td></td>
</tr>
<tr>
<td>Developmental Assessment Scales for Indian Infants (DASII)</td>
<td>Birth to 2½ Years</td>
<td>30-45 minutes</td>
<td>Motor, Mental</td>
<td>230</td>
<td>4141 Age Equivalents, Standard scores (M=100, SD=15)</td>
<td></td>
</tr>
<tr>
<td>Baroda Development Screening Test for Infants (BDSTI)</td>
<td>Birth to 2½ Years</td>
<td>10 minutes</td>
<td>Gross Motor, Fine Motor, Cognitive</td>
<td>54</td>
<td>191 Risk Categorization, Ratio Quotients</td>
<td></td>
</tr>
<tr>
<td>The Trivandrum Developmental Screening Chart (TDSC)</td>
<td>Birth to 2 years</td>
<td>5 minutes</td>
<td>Gross Motor, Fine Motor, Cognitive</td>
<td>17</td>
<td>1945 Risk Categorization</td>
<td></td>
</tr>
<tr>
<td>Screening Test Battery for Assessment of Psychological Development</td>
<td>Birth to 6 years</td>
<td>10-15 minutes</td>
<td>Gross Motor, Vision &amp; Fine Motor, Hearing, Language and Concept Development; Self-Help Skills, Social Skills</td>
<td>66</td>
<td>13000 Risk Categorization</td>
<td></td>
</tr>
<tr>
<td>Indian Picture Puzzle Test</td>
<td>2 years to 5 years</td>
<td>30 minutes</td>
<td>Expression, Comprehension, Recognition of shape, Orientation of piece</td>
<td>-</td>
<td>616 Percentile Rank</td>
<td></td>
</tr>
<tr>
<td>Development Assessment Tool for Anganwadis (DATA)</td>
<td>2 years to 6 years</td>
<td>10 minutes</td>
<td>Gross Motor, Fine Motor, Cognitive, Personal-Social, Expensive Language, Receptive Language</td>
<td>12</td>
<td>429 Standard T Scores (M=50, SD=10)</td>
<td>Risk Categorization</td>
</tr>
<tr>
<td>New Lucknow Development Screen for Indian Children</td>
<td>6 months to 2 years</td>
<td>7-10 minutes</td>
<td>Gross Motor, Fine Motor, Social, Language</td>
<td>27</td>
<td>142 Risk Categorization</td>
<td></td>
</tr>
</tbody>
</table>
Need For Developing a Comprehensive Developmental Assessment Test for Indian Children

The above review clearly indicates that the number of available developmental tests for use with Indian children is small. Most developmental screening and assessment tests being used in India have limited number of items, assess development across a limited age range, have been validated against other screening instruments rather than a gold standard, and hence have inadequate psychometric properties (Bevli, Ghuman, & Dasen, 1989; Malhi & Singhi, 1999; Murlidharan, 1992). In addition, the tests available in India are mere screening instruments, and these focus narrowly on pass/fail categories or a profile pattern description. These tests do not yield standard scores which can be used to compare the performance of the children across ages or at two different points of time. Since, developmental screening tools are first-line measures to identify children who require more detailed assessment; they have little diagnostic utility, particularly for identifying subtle impairments.

As a result, child health professionals in India have tended to use developmental screening and assessment tests standardized in Western countries, (Anadalakshmy, 1982, Bevli, 1990). Several authors have pointed to the dangers of importing Western tests for use in other socio-cultural settings (Bevli, 1990; Mittler & Serpell, 1985; Singhi, 1992). The dangers include the use of culture inappropriate test items; use of irrelevant test items; inappropriate testing methods; and use of scores which have been not standardized on the target population (Gladstone, Lancaster, Jones, Maleta, Mtitimila, Ashorn, & Smyth, 2008; World Health Organization, 1992). Using inappropriate tools to detect developmental problems or as an outcome measure in clinical research have been found to give misleading information about functioning (Gladstone Lancaster, Umar, Nyirenda, Kayira, van den Broek, & Smyth 2010; Olade, 1984). Hence, tests developed in a different culture are not appropriate for use in other cultures. Unfortunately, the limited availability of developmental assessment tests in India leaves investigators little choice but to use tests developed in the developed countries.

There is thus an urgent need for developing a comprehensive test battery which assesses multiple domains in order to obtain a broader record of development
than that provided by most existing tests. More importantly, there is a need for a test that is standardized on a representative and a current sample. Keeping in view some of the above issues, the present study attempts to construct a multi-domain developmental assessment battery for Indian children which provides standardized scores for all the domains of development and also an overall development quotient to help clinicians to identify children with developmental delays and developmental disabilities at the earliest; serve as an intervention instrument, and assists in the longitudinal follow up of children with developmental impairments. It is hoped that the availability of an indigenously developed assessment battery which uses culturally appropriate test items and tasks would add to the repertoire of the child health professionals and provide an impetus to the program of early detection and intervention of children with developmental disabilities.

Aims and Objectives

The specific aims of the study were as follows:

1. To construct a multi-domain Development Assessment Battery for Indian children aged 0 to 7 years and 11 months.

2. To establish norms for children aged 0 to 7 years and 11 months, in terms of percentile rank scores, domain, and total test developmental quotient scores.

3. To establish inter-rater, test-retest, and internal consistency reliability of the Development Battery.

4. To establish content, construct, and criterion related validity of the Development Battery.