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Research Article

# Developmental Delay Approach in Preschool Children

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## Abstract

Developmental delay occurs when developmental age is less than chronological age. Studies have shown that 1-3% of preschool children have global developmental delay and 10-15% of them have various forms of developmental delay [1]. Developmental delay may be mild, moderate, or severe, though early recognition and intervention are crucial to minimize the burden, prevent deterioration in other developmental domains, and optimize final prognosis. Although it is usually a multidisciplinary team task, pediatricians and frontline medical care staff hold the responsibility of spotting the case and planning the suitable intervention on time [2].

In this article we develop an easy approach for early recognition of all types of developmental delay during the first 6 years of age; suggesting clear and cost-effective guide of management plan. This approach is based on the recommendations of the world health organization (WHO) and major scientific bodies worldwide to avoid geographical variations.

**Keywords:** Developmental Delay; Gross Motor; Fine Motor; Language; Cognition; Emotional Development

## Abbreviation

Children worldwide seem to come across the same sequences of development within similar timetables. However, it is important to remember that each child is a unique human being [3]. There is enough information in pediatric books about developmental skills timetable in normal children of each age group. Nevertheless, recognition and management plan of developmental delay seems indirect, subjective with controversial issue. For this reason, Authorities and professional bodies in most countries started to implement clear plan to approach developmental delay cases with clear landmarks for early recognition and subsequent intervention in this vital age [4]. Neurological examination and developmental assessment are not the same; Neurological assessment is evaluation of: cognitive function, alertness, orientation, memory, cranial nerves, balance, motor and sensory examinations. On the other hand, developmental assessment evaluates specific acquired skills fulfilled by history, different questionnaires and playful demonstrative maneuvers.

Normal Development is the result of maturation, physical growth, education, learning and environment effects [4]. Ataxia, hearing loss and dyspraxia are abnormal neurologic signs, for example, while inability to point to body parts, climbing stairs, building a tower of 3 bricks, or diminished response to social smile on time could be abnormal findings of developmental assessment.

Many developmental scales have been implemented in different countries. However, recent Meta analysis comparative studies about the quality of the known scales (DENEVER –II, B-BAYLEY scale, C-CSBS-DP scale, D-WHO-early development scale, E-Griffith scale, F-MSD motor social developmental scale, and G- Pearson assessment scale) found that all of them need to be modified and validated for inaccuracy and variations [5]. Good Developmental assessment in children begins with obtaining full clinical history and filling special questionnaires by caregivers. Good developmental assessment needs detailed clinical history; namely the progress of developmental skills acquisition, past medical history, and family history. special questionnaires filled by caregivers are helpful at this stage; followed by physical developmental assessment; a combination of observation of the child spontaneous activity, play, and involvement with people and surrounding objects, in addition to age specific playful performance tests with the examiner in a properly equipped examination sitting [4].

## The importance of 4 developmental domains

Developmental skills are classified in 4 main domains according to the anatomy and physiology of each skill to: Gross motor skills, Fine motor skills, Language & cognitive skills, Social and emotional skills [4]. Such subtyping will enable the examiner to determine which kind of developmental disorder is there if any and suggest the accurate management plan [4].

## Developmental assessment schedule

First assessment should be during neonatal period, then every 3 months till the age of one year (at 3, 6, 9 and 12 months), then after 6 months (at 18 months- and 24 months then annually (3, 4 and 5 years) [4].

At each visit the pediatrician is expected to perform full physical examination, evaluate growth, nutrition, predicted developmental skills in each domain according to age at visit [1,4]. For example, during the well child visit assessment at age 6 months, it is recommended to start with good clinical history, asking parents about their notes and doubts regarding their baby, filling developmental questionnaires, reading health medical record to get an idea about past measurements and important notes, then documenting current weight, Hight and head circumference. Screening physical examination from head to toe takes place later, with special attention to squint, new murmurs, hip dislocation, undescended testes. Physical developmental assessment starts by observation of the child posture, if he can sit with support, the shape of his back, can he turn from supine or not. this will give good an idea about his Gross motor skills. Then evaluate his hands posturing is it clenched or closed fist most of the time, is he able to outreach, hold, transfer and bring objects into his mouth? This is enough to estimate the hand eye coordination and fine motor skills in general. For hearing and Language check if he can turn to sound source at ear level, is there any meaningful sounds or vocals or phrases, this may be performed by distraction hearing test. Emotional and social development can be made by observing the baby's interaction with his mother, his reaction to her calming effort and his reaction to the surroundings [6].

Parents questionnaires and notes about the progress of developmental skills are essential but should not be an alternative to the individual physical evaluation. each child has his own developmental achievements in each domain that need to be detected properly using a variety of evaluation maneuvers [6]. A set of toys, color books, cubes, and other utensils might be used. it seems wise always to start to detect skills for age less than the child chronological age and proceed [4].

## Abnormal developmental assessment

The idea of dealing with Developmental delay as a single diagnosis with a given set of investigations and management plan is invalid, impractical and expensive approach. It also might be a dilemma for the patient and the physician. Decisive intervention is to put a clear red flag for each developmental domain to serve early recognition of the case, then implement a convenient and cost-effective investigation plan on time to exclude any treatable or curable cause; and finally suggest the responsible therapeutic team member to help in treatment and follow up [7].

## To investigate or not to investigate

The outcome of any developmental assessment is one of three:

- Normal development (developmental age equals chronological age)
- Borderline developmental delay (developmental age is less than chronological age without any red flags).
- Obvious developmental delay (with red flags of absence of the

minimum acceptable developmental skills for age). While it might be good practice to wait and reevaluate after 3 months in borderline cases, it is highly recommended to start treatment as soon as possible when it comes to the obvious delay [1,3].

## Obvious developmental delay types

The first step in this approach is to verify which developmental domain is affected and whether the minimum acceptable skill for age is absent. Developmental delay can be isolated in one domain only, like gross motor, or global in two domains or more.

According to this, we have 5 types of obvious developmental delay

- Isolated Gross Motor Developmental Delay (GMDD)
- Isolated Fine Motor Developmental delay (FMDD)
- Isolated Language and cognitive Developmental delay (LCDD)
- Isolated Social and Emotional Developmental Delay (SEDD)
- Global Developmental Delay (GDD)

## Isolated gross motor developmental delay occurs when the child is

- **4 months:** Unable to support and control his head.
- **6 months:** Not rolling over.
- **9 months:** Not sitting.
- **12 months:** Not crawling and pulling himself to stand.
- **18 months:** Not walking.
- **2 years:** Unable to squat and get up alone and run.
- **3 years:** Unable to run, jump, and stand on one foot.
- **4 years:** Unable to go up and down stairs as adult.
- **5 years:** Cannot play football and hop on one foot.
- **6 years:** Unable to balance on toes, hop on one foot while skipping [1,3,8,9].

**Evaluation of such case** starts with good clinical history including past medical history, family history of a floppy infant or early infantile death, perinatal and nutritional history [3]. Then physical examination of the locomotor system and nervous system. precisely, the PGALS test (pediatric Gait, Arms, Legs, and spine test), plus motor assessment of upper and lower limbs.

## Suggested investigations

- Blood tests (Creatin Phosphokinase CPK- CBC– FT4 – D3 -Alkaline phosphatase)
- Nerve conduction velocity (NCV) and Electromyography (EMG)
- Muscle and /or Nerve biopsy
- Gene mutation study might be needed for the final diagnosis [8,9].

Early treatment is crucial here to prevent secondary worsening due to mobility restriction, contractions, deformities that may result in long term disability. Therapeutic plan should be implemented and followed by a neurologist, physiotherapist, and pediatrician. They also may make referrals and consultations to other specialties, like geneticist or Metabolist. Contact with specialized social groups, like special muscle disorder or metabolic disease organization, should be encouraged for long term support [1,9].

## Isolated Fine Motor Developmental Delay (FMDD)

Red flags for Fine Motor delay according to most guidelines [10,11,12]

- **4 months:** Does not attempt to hold a presented toy.
- **6 months:** Does not hold his toy by 2 hands. does not reach objects. has fisted hands most of the time.
- **9 months:** Does not transfer his toy from hand to hand and release it to you on request.
- **12 months:** No finger feed no pointing.
- **18 months:** Cannot put objects in a container. Does not assist with dressing by moving limbs properly.
- **2 Years:** Cannot manipulate a pen, color book, and cup. no independent spoon feed.
- **3 Years:** Cannot draw vertical line. cannot unscrew a lid from a jar.
- **4 Years:** Cannot undress himself independently, cannot color within the line, cannot imitate draw a man face (Emoji)
- **5 Years:** Cannot cut paper by scissors properly. cannot unbutton buttons.

- **6 years:** Cannot write online. button clothes [10,12].

It is crucial to avoid mixing up between developmental signs like hand preference and Early hand- preference before 18 months. The latter is abnormal neurologic sign. Asymmetry or significant difference between right and left hands could be due to unilateral weakness or dyspraxia because of central or peripheral damage, like hemiplegia, or brachial plexus injury. Another example is leg stiffness in a 2months old infant with cerebral palsy which makes him stand straight when held in standing position. this finding is abnormal neurologic sign rather than a developmental skill.

Fine motor developmental delay approach

Hands and fingers fine motor skills need high level of hand - eye coordination. this needs adequate maturation of eyes, visual pathway, occipital cortex, and cerebellar structures. That is why it needs a different approach.

In clinical history we must ask about perinatal history, past medical history, and family history of any eye disease, using glasses, seizures, or mobility disorder.

P.E: eyes examination (Visual acuity, optic field, Fundoscopy by ophthalmologist), cerebellar clinical assessment, locomotor PGALS screen test & upper limbs motor neurologic assessment.

Suggested Investigation: (Blood test: CBC, Free T4, Ceruloplasmin, Zinc, ALT, BUN).

Treatment depends on the underlying etiology; the child may need ophthalmologist and optician for vision -aid, occupational therapist for purposeful movement, and neurologist if there is ataxia or dyspraxia [10,12].

## Isolated language and cognitive developmental delay

When it comes to language and cognitive red flags, a significant variation between guideline is noted. For example, the minimum language development red flag at age 18 months in WHO guidelines is 5 words [3]; rises to 8 vocabularies in Malaysian guidelines and to 18 words in the UK -NHS resources [10,13].

The following minimum language and cognitive red flags are approved by most references [3,4,13,14,16]

- **4 months:** Does not stop activity or startle to sudden noise. does not respond to mother speech, no tuned cry.
- **6 months:** No cooing sounds, not interested in parents' speech, does not turn to sounds in ear level.
- **9 months:** No babbling (da da da, agaga), not interested in human sound or music, does not turn to sounds. cannot swallow smooth food.
- **12 months:** Does not respond to his name, cannot say dad-mam, do not point to people or objects when asked, (where is dad-where is cat?), Cannot chew lumps in food.
- **18 months:** Cannot say 10 single words even not clear. cannot response to one order command (open the door). not interested in using headphones or mobile.
- **2 Years:** Cannot say 20 words. cannot combine 2 words. cannot respond to 2 order commands (go to the hall and bring the bag). close family members cannot understand his speech. point to his needs rather than usings words [14].
- **3 years:** Cannot combine 3 words. strangers cannot understand most of his speech. never interact with person outside his family. does not pay attention to a talk or activity for few minutes (other than TV or YouTube). uses body language, like pointing, rather than speech to ask for his needs.
- **4 years:** Parrot-like repeat speech. Uses single unliked words in his sentence. does not understand strangers' speech nor involve in conversation with them. does not ask for causes using (why?).
- **5 years:** Does not combine sentences using (and), excessive grammar mistakes. cannot tell stories [3,4,13].

Evaluation of a child with language and cognition delay needs information about past medical history, (especially hospital admission, parenteral therapy, and recurrent ear infections); in addition to neonatal jaundice, and family history of language delay or hearing loss.

Then physical examination with particular attention to facial features, Cranial nerves, and ears.

## Recommended investigations

- Hearing assessment using suitable hearing test according to age and tympanometry.
- Thyroid function tests.
- socialized assessment to exclude autistic spectrum disorder.
- Barium swallow imaging study might be helpful to exclude associated nasopharyngeal dysmotility [14].

Treatment: This child may need hearing aid, speech therapist, and/or pediatric neurologist. we must keep in mind that isolated language delay could be due to autistic spectrum disorder, and it seems wise to evaluate the child for that if the previous investigations were inconclusive [13,15].

### Social and emotional developmental delay

Could be isolated, or part of global developmental delay complex in most cases. It might be necessary also to remember that severe social emotional delay may cause a social barrier and lead to almost complete isolation. As a result, social pay will be diminished with secondary impacts on language, fine motor skills, and even gross motor skills [4,16].

Red flags for social and emotional developmental delay according to age [2,6,7].

- **3 months:** Does not respond to mother smile or voice. avoids eye contact. refuse to be touched or comforted.
- **6 months:** Does not react to human sounds or faces. not agitated when left alone.
- **9 months:** No reaction to mirror no interaction with human facial expressions. not afraid of strangers. Not agitated if toys taken from him.
- **12 months:** Does not wave or clap hands. No reaction to separation from his mother and reunion with her. Can not open doors using his hand.
- **18 months:** No interest in pretend play, no finger pointing. Does not help in dressing himself, cannot get in with others.
- **2 years:** Cannot point to 4 body parts and name it. No meaningful play always looks detached.
- **3 years:** Unable to indicate toilet need. cannot participate in group play.
- **4 years:** Cannot put on shoes and socks.no social play. Attached to one toy and take it with him everywhere. no sense of danger.
- **5 years:** Unable to know his home address. No interest in making new friends. Cannot recognize left and right. No social attitude, Talkative and interrupts adults. Poor attention span cannot listen to a 5-minute speech or presentation.

Approaching a child with Social emotional delay needs good clinical history regarding; the onset of regression; past medical history of abnormal movements or seizures. Family history of hyperactivity, social isolation, behavioral problem, schooling problems, thyroid disease, or depression. Specific questionnaires regarding childhood autism and hyperactivity need to be completed by parents and examiners at this stage, too. During this, pediatrician may have got enough time to observe the child behavior, attention span, interaction with surrounding people and objects, facial features, and hands movement. Then physical examination from head to toe for any abnormalities, like murmur, skin hyperpigmentation, or organomegaly. finally neurological assessment for focal signs [6,7].

### Investigations for such case

- Hearing and vision assessments.
- Blood tests: CBC, Free T4, KFT, LFT.
- limited genetic study: DNA methylation defects, karyotype, and Fragile -X mutation [2,16].

Treatment of social emotional delay in most cases needs long term supervision and follow up by a psychiatrist, behavioral therapist, neurologist, speech therapist, and pediatrician [15].

Commonly used Medications [6]

- **First line:** Methylphenidate for restlessness and hyperactivity in ADHD, and ASD.
- Clonidine for insomnia and poor sleep.
- Risperidone for antisocial behavior and hyperactivity.
- **Second line in severe cases:** Naltrexone, Aripiprazole and Olanzapine.
- **Chloralhydrate:** for temporary control of aggressiveness [6].

### Global developmental delay (GDD)

GDD is delay in two developmental domains or more. According to the recommendations of Treatable intellectual disability organization, once the clinical diagnosis of GDD has been established, treatable causes should be excluded first before launching the management plan and multidisciplinary team members [16]. Putting things in the correct sequence results in the most cost-effective investigations and optimize the final prognosis [15] about

one third (30%) of global delay cases, a cause can be recognized by clinical assessment only [16]. Good medical history with particular details about family history of hearing loss, vision impairment or developmental problems, perinatal incidents, and past medical history is of crucial importance before moving to careful physical examination for (posture, deformities, syndromic features, autistic behavior, Limbs anomaly, murmurs, and organomegaly). full neurological examination seems mandatory here to complete the clinical assessment [14,16].

Despite that, 70% of cases will show no clear etiology. suggested investigations in such case [4,11,15,16].

### First line investigations: (diagnostic for 15% of cases)

- CBC, Free T4 and TORCH screen.
- Test for treatable metabolic disease: (4.5% of cases)
- **Blood sample:** Lactate, copper, ceruloplasmin, ammonia, folate, N- glycan profilin amino acids, acylcarnitine, very long chain fatty acids
- **Urine sample:** Organic acids, glycosaminoglycans, oligosaccharides, guanidinoacetate.
- **Limited gene study:** Standard karyotype+ DNA Methylation defect+ Fragile- x.

### Second line: (20%)

20% of cases of global developmental delay will be diagnosed by "comparative genome- hybridization array test" (a CGH) to detect unbalanced micro deletion gene mutations. Such genetic minimal alteration may cause global developmental delay with or without minimal phenotypic features nonspecific for a known syndrome.

### Third line: MRI neuroimaging. (4-14%)

14% of global developmental delay cases with abnormal neurological clinical findings have abnormal radiological findings in MRI study. However, only 4% of those with normal neurologic examination might have abnormal imaging findings on MRI [16]. For this reason, MRI is indicated only when there are abnormal or focal neurological signs during the primary neurological assessment [8,14-18].

Management of global developmental delay usually involve multidisciplinary team to deal with malnutrition, feeding and swallowing difficulty, seizure control, spasticity and stiffness, visual and hearing aids, long term rehabilitation, in addition to Social, education, financial, and functional support. Such multi target approach is vital to improve compliance and help the family to be supported most of the time. A team of pediatrician, neurologist, speech therapist, dietician, physiotherapist, and occupational therapist in addition to the social support services is needed in most cases [7,11,16].

## Conclusion

10-15% of preschool children have a form of developmental delay and 3% of children at this age group have global developmental delay. It is always easier to deal with a big developmental problem in small infant rather than to manage a small problem in big child. red flags of obvious developmental delay should well known by practioners to facilitate early recognition and avoid time wasting in useless waiting. such policy should be put in practice in all childhood medical care institutions. However, developmental delay is not a single diagnosis with a set of investigations and therapeutic options. five types of developmental delay have been recognized with specific investigations and treatment options for each. It is recommended to perform extensive clinical assessment first to determine which type of developmental delay the child might have. the journey of evaluation and treatment should wise, cost-effective, and evidence based. The given approach in this paper was built on worldwide guidelines to exclude variations and be helpful in daily practice everywhere.

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