

# Strength and Weaknesses of Children with Down syndrome (0-60months) and Comparison with Typically Developing Children

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**Abstract**— This research selected a total of 31 children with Down syndrome in the age of 20-60 months from the database of Down syndrome research center, and 22 typically developing children choosing from the nursery and kindergarten, which matched the cognitive ability with the Down syndrome group. Both groups of samples were measured six aspects of child development (gross motor, fine motor, language, socioemotional, and self-help ability) by the scales adapted from Hawaii Early Learning Profile (HELP) (Corporation, 2004) and Behavioral Characteristics Progression Instructional Activities (BCP). The result showed that children with Down syndrome experienced significant language delay compared with their typically developing peers matched with cognitive ability. Socioemotional and gross motor skill ability were found as the strengths for children with Down syndrome, while their self-help and language ability were relatively weak compared to other developmental aspects. Bigger sample size was suggested for the future study.

**Keywords**— Child Development, Down syndrome, Early Childhood, Typically Developing children.

## I. INTRODUCTION

DOWN syndrome, a common chromosome disorder due to an extra chromosome number 21 (trisomy 21), is characterized by mental retardation, a flat facial profile (depressed nasal bridge and small nose), and multiple malformations. The chromosome abnormality affects both the physical and psychological development of a child, such as cognitive, gross and fine motor, speech and language [1]-[6].

The incident of Down syndrome in western country is approximately 1 in 700 to 800 live births [7]-[9]. The total number of worldwide is more than 200,000 cases per year [8].

Manuscript received 20<sup>th</sup> October 2011; Revised version received 20<sup>th</sup> December, 2011. "The authors would like to thank the Universiti Teknologi Malaysia (UTM) and Ministry of Higher Education (MoHE) Malaysia for their support in making this project possible. This work was supported by the Research University Grant [Q.J130000.7131.02H57] initiated by UTM and MoHE."

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An earlier investigation in a Maternity Hospital, Kuala Lumpur, indicated that the incidence of Down syndrome was 1:959 live births. The incidence for the three major ethnics was one in 987 Malay, one in 940 Chinese, one in 860 Indians respectively [10].

The intellectual disabilities are the major representation of cognitive impairment of Down syndrome. The average Intelligence Quotient (IQ) of Down syndrome is 50, ranging from 30 to 70 [11], [12]. Many previous studies found that the cognitive development of children with Down syndrome is delayed compared with typically developing children, such as processing speed, memory system, reaction time [4], [13]-[15].

More and more researchers tended to develop efficient and appropriate screening technique, database, intervention support system or equipment which applied Radio frequency Identification and computer based technique, for teacher and parents to improve their children's cognitive ability and other developmental abilities [16]-[19].

Despite the cognitive impairment on Down syndrome population, some of their abilities could be developed as children in typically developing rate under appropriate training and intervention in the early childhood, such as socioemotional ability, self-care ability [20], [21].

The impression and expectation of Down syndrome in current social environment have been changed, become positive. A total of 79% community people and 85% teachers reported that children with Down syndrome are more affectionate than children with other disabilities. Around 80% of them believed that they are friendlier while 70% reported they are happier [22]. Chapman and Hesketh (2000) also pointed that the maladaptive behavior on children with Down syndrome was lower than other children with cognitive disability and did not significantly change as they grow up [23]. Parents reported the performance in real-life situations showed that children with Down syndrome performed better in socialization while worse in communication and motor skill, which consistent with laboratory based developmental measure-strengths in visual processing, receptive language and weaknesses in gross motor and expressive language [24].

The strength and weakness of Down syndrome studies mentioned above were all conducted in other countries and areas. The empirical knowledge of developmental profile in current children with Down syndrome in Malaysia context is

limited. As the requirement of quality improvement on special education and school facility in Malaysia, it is necessary to examine the development of Malaysian children with Down syndrome, which may assist the local education system to provide more appropriate intervention and classes for this population. This study will compare the developmental profile between children with Down syndrome and typically developing children with cognitive ability matched to study their strength and weakness.

## II. LITERATURE REVIEW

### A. Cognitive Ability

Cognitive ability is referred to the abilities to perform any of the functions involved in cognition which is the mental process including awareness, perception, reasoning, remembering, understanding, and problem solving [25].

Compared with typically developing children, the unusual performances of cognitive aspects were found by numerous previous researches, such as worse verbal short-term memory [1], [14], [26], [27], auditory short-term memory [28], phonological short-term memory [4], reduced storage capacity of phonological information [29], unusual pattern of errors on Raven's matrices [6]. The deficits of cognitive profile, which is found to be related to expressive language, syntactic/morphosyntactic processing, and verbal working memory, would negatively affect language learning, social interaction, etc. [30]-[32].

Despite the deficits on cognitive ability, other aspects of developmental profile and difficulties such as gross and fine motor skill, language, self-help ability, are also concerned by the researchers and parents.

### B. Gross and Fine Motor Skill

Gross motor skills are large movements involving the larger muscles in the arms, legs and torso. They include rolling, crawling, and walking for infant. For older children and adults, gross motor skills include balance, walking, running, jumping, etc. These skills are also related to body awareness, reaction speed, balance and strength. Gross motor development gives child the ability to move in a variety of ways, the ability to control their body and helps to promote child's self-esteem. Different gross motor activities make multiple demands beyond muscle movements. Assessments of gross motor skills are based on how well children perform actions such as balancing on each foot, hopping on each foot, skipping, and walking backwards in a line [33].

Fine motor skills are the coordination of small muscle movements, such as in coordination with the eyes, fingers. Usually they include grasping objects, reaching out to objects, releasing objects deliberately, and turning the wrist in various directions. Assessments of fine motor skills are based on how well children perform tasks such as constructing forms with wooden blocks, copying basic figures, and drawing a person [33].

Children with Down syndrome are usually found having

problems in the field of motor development in early childhood, such as lack of balance, trunk rotation and abnormal moving patterns [33]. A study to identify the motor growth curves on children with Down syndrome under six years old pointed that motor impairment did have negative effect on the rate of motor improvement but not the upper limit of motor function [30].

Buckley and Bird (2002) reviewed the prior researches and also pointed that the gross and fine motor skills of children with Down syndrome is usually delayed, but can improve by practice [35]. Down syndrome children performed the same motor developmental sequence as their typically developing peers and cost more time to master the skills [2], especially when the complexity of motor skill increases [34], some of them even can master considerable skills in sports, dance and gymnastics [35].

Differently, a study compared the motor skill among children with Down syndrome, developmental disabilities and typically developing children with mental age matched did not find significant difference between Down syndrome and typically developing group, but children with developmental disabilities did perform significantly better than Down syndrome on both gross motor and fine motor skill. There were profound difficulties of prehension, reaching and grasping on children with Down syndrome which may affect their self-help skill [5].

### C. Speech and Languages

Speech is a verbal means of communicating, a process requiring neuromuscular coordination. Language is defined as "a socially shared code or conventional system for representing concepts through the use of arbitrary symbols and rule-governed combinations of those symbols [36]. Language development in early childhood period is quite rapid. Typically developing children begin to communicate intentionally during the eighth month of the first year. They communicate using symbol, such as words around 12 to 18 months, while the same transition happened on children with Down syndrome at the age of 24 to 36 months [37]. Physical and Cognitive deficits on children with Down syndrome, such as hearing and oral-motor structure problems, would impede their language learning and use [38].

Speech and language skills are usually the greatest difficult area for most children with Down syndrome. Mervis and Robinson (2000) explored the expressive language abilities of children with Down syndrome found that the toddler Down syndrome children (two years, two months) showed a notable weakness in their verbal ability [39]. Laws and Bishop (2004) also found that the expressive language on children with Down syndrome were much delayed than non-verbal mental ability, the expressive language skills were more severely affected than the receptive language [40].

Vocabulary studies on children with Down syndrome showed positive results. Laws and Bishop (2003) found similar levels of vocabulary on children with Down syndrome compared with typically developing children with non-verbal mental age matched [41]. A meta-analytic review showed that children with Down syndrome have deficits on expressive

vocabulary, grammar, but their receptive vocabulary skills are better developed [1].

Ferreira and Lamônica (2011) compared Down syndrome children and typically developing children with mental age matched, found that the lexical, receptive and expressive performance on Down syndrome is lower than the typically developing ones [3]. Chapman and Hesketh (2001) pointed that speech and language skills in children with Down syndrome are more delayed than other abilities, the difficulties are mainly on expressive syntax [28].

A study to examine the gesture-language system on Down syndrome found that no significant difference on use of gesture between Down syndrome and typically developing children, but smaller gestural repertoires, no two-word combinations and different information contained in the gesture-word combinations were observed among children with Down syndrome. The findings implied that Down syndrome may specifically delay in making the transition from one- to two-word speech [41]. The whole word complexity and correctness are reduced in Down's syndrome children compared with typically developing children with language age matched [43]. Parents reported language function as their main concern on their children with Down syndrome [47].

#### *D. Socioemotional*

Mahoney, Perales, Wiggers and Herman (2006) defined social-emotional ability as the child's ability to engage in and enjoy developmentally appropriate interactions with parents, adults and other children as well as to comply with reasonable rules and expectations [48]. Social development refers to the ability of young children to interact and sustain relationships with others, including parents, siblings, peers, teachers, and other adults. Emotional development refers not to relationships but to children's feelings about themselves and others. It includes such characteristics as self-control, self-efficacy (i.e. the sense of being able to affect events), and the ability to properly interpret the emotions of others [33].

Buckley and Bird (2002) pointed that the social interactive skills of children with Down syndrome are good; they usually show good empathy and understanding of the emotional states and behave with appropriate sensitivity [24], [35]. Wishart, Cebula, Willis, Pitcairn (2007) also discussed that children with Down syndrome were often perceived as highly social children. However, their research demonstrates that these children's socio-cognitive understanding limits their ability to socialize with others [49].

Compared to other developmental aspects, the social development of children with Down syndrome is a relative strength; they have strong orientation to their social environment and participate the social interactions [20].

But a study review indicated that children with Down syndrome exhibit array of difficulties on social emotional development from infancy and throughout the life span such as interpreting social and emotional cues, communicating about social and emotional experiences, understanding mental states in self and others, acting on cognitions and emotions in an

adaptive way [44]. Cebula and Wishart (2008) compared children with Down syndrome and other children, including typically developing children matched on chronological age, mental age, found that children with Down syndrome performed substantial difficulties on various aspects of social understanding, which are associated socio cognitive skills [50].

Previous researches did find the specific deficits in processing facial expression [45], poorer emotion-recognition ability especially the fearful expression [46], [47].

The peer interaction is another important facet to study the socioemotional ability on children with Down syndrome. Guralnick (2002) did not find differences on frequency of contacts and the characteristics of children's peer social networks between children with and without Down syndrome [20].

Except for the lower level of peer conversation, there is no significant difference on the peer interactions of children with Down syndrome and typically developing children. The difficulties on peer interaction can be conquered by the support from partner-child or adult-capitalizing. The difficulties emerge when less structured and more complex contexts were provided [51]. Contradict to the research mentioned above, a numerous dimensions examination on the peer social network on Down syndrome showed unusual difficulties and less well-developed on peer interaction especially involvement in play, linkages to other settings, control of play [52].

#### *E. Self-help*

Self-help development includes learning the skills needed to function independently in society, such as dressing, bathing, and feeding, wash hands, brush teeth, toileting, buttoning/unbuttoning buttons grooming. Basic skills to take care of one's own needs and daily life

Carr (1995) reported that none of the children with Down syndrome ate without help at the age of 4, more than half of them dressed with considerable amount of assistance, and 60% of children were enuretic [53]. The timing of skill acquisition varied a lot in individual and was not well predicted by IQ at the younger ages. A cross-sectional study from Norway found delayed self-care activities of children with Down syndrome (5 years old) on toileting tasks and management of bladder and bowel. Girls were significantly ahead of boys in the development of bladder and bowel control. The performance of self-care activities were showed more related to the fine motor skills required [54].

Examined the self help skill on school-aged children with Down syndrome found that over half of them (59.7%) needed no help with self-care tasks, the self-care skill improved with increased age, girls performed somewhat better than boys in dressing from the waist down [55].

### III. OBJECTIVES

There are two main objectives in this research. The first one is to compare children with Down syndrome and typically developing children matched with cognitive ability, to study the

development of the other five aspects of children with Down syndrome, including gross motor, fine motor, language, socioemotional and self-help ability.

The second objective is to present the six aspects (cognitive, gross motor, fine motor, language, socioemotional and self-help) of developmental level on children with Down syndrome under the age of 60 months and identify the strength and weakness of children with Down syndrome in their early childhood developing period.

#### IV. METHOD

##### A. Subjects

The sample of children with Down syndrome was get from a special education center for Down syndrome in Johor Bahru. A total of 31 children with Down syndrome in the age of 20-60 months were selected from the database of Down syndrome research center. There were 22 typically developing children choosing from the nursery and kindergarten, which matched the cognitive ability with the Down syndrome group.

Two sample t-test showed that there is no significant difference on the score of cognitive ability between Down syndrome (M=82.14, SD=15.90) and typically developing (M=88.09, SD=12.40) groups ( $t=-1.466$ ,  $p=.149$ ).

Compared the chronological age between these two groups, the average age of Down syndrome children is seven months older than the typically developing ones.

##### B. Measure

The current method of assessment was modified from Hawaii Early Learning Profile (HELP) [56] and Behavioral Characteristics Progression Instructional Activities (BCP), which is used to measure the child development of cognitive ability, gross and fine motor skill, language ability, socioemotional and self-help ability.

Cognitive ability in this measurement contains perception, concentration, logical thinking and memory. This subscale was used to measure the cognitive ability of children with Down syndrome and typically developing children in this study, which aimed to match the cognitive ability for both group of samples.

Gross motor subscale contains items to assess array of activates including head movements, rolling, sitting, standing, crawling, walking, running, jumping, and multi movement.

While fine motor subscale includes visual contact, arm movement, fingers coordination, holding objectives, body movement, locating object, and writing.

Socioemotional subscale is utilized to examine the socioemotional ability via observing the performance of children in social, emotional, and play aspects.

Language subscale which used to examine the language ability, contains vocalize ability, verbalized ability, express thoughts/feeling, communication and understand communication.

Self-help ability is examined via four functioning aspects - feeding, dressing, personal hygiene and daily activities.

#### V. RESULTS

##### A. Compare Down syndrome and Typical Developing Children

Descriptive analysis using mean and standard deviation showed that children with Down syndrome got lower scores than typically developing children in measure of all five child development including gross motor (DS:78.08 < TD: 85.47), fine motor (DS: 76.64 < TD: 83.53), language (DS: 70.84 < TD: 84.48), socioemotional(DS: 80.99 < TD: 86.5), self-help(DS: 53.15 < TD: 67.52).

Further inferential analysis using MANOVA to compare children with Down syndrome and typically developing children regarding to the five child development (gross motor, fine motor, language, socioemotional, and self-help), which used the Pillai's Trace criterion and found a significant difference between these two groups ( $F=4.855$ ,  $P=.001$ ). As showed in Table 1, the source of significant difference between the two groups was in language ability ( $F=8.719$ ,  $P=0.005$ ). Children with Down syndrome performed much worse than typically developing children on language measurement.

**Table 1 MANOVA Analysis of Developmental Profile between DS and TD with Cognitive Ability Matched**

	Mean (SD)		F	Sig.
	DS	TD		
gross motor	78.08(14.13)	85.47(14.71)	1.42	0.239
fine motor	76.64(13.56)	83.53(16.11)	0.658	0.421
language	70.84(17.87)	84.48(17.33)	8.719	0.005
socioemotional	80.99(16.15)	86.5(15.18)	0.085	0.772
self-help	53.15(23.83)	67.52(30.28)	1.62	0.209

DS: Down syndrome group, TD: Typically developing group

##### B. Developmental Strength and Weakness

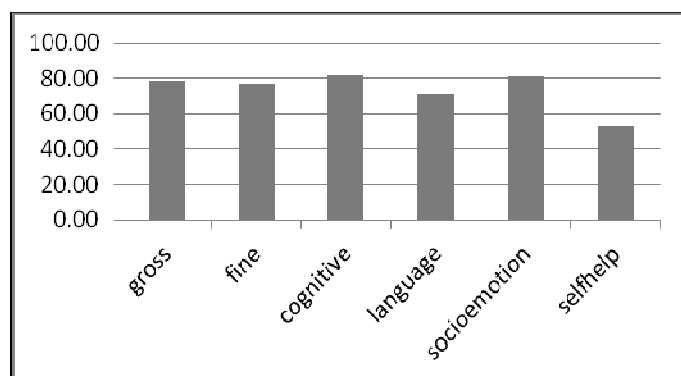
The description data showed that children with Down syndrome achieved highest score in cognitive ability (M=82.14, SD=15.90) compared to other developmental aspects, followed by socioemotional (M=80.99, SD=16.15), gross motor (M=78.08, SD=14.13), fine motor (M=76.64, SD=13.56), language (M=70.84, SD= 17.87) and self-help (M=53.15, SD=23.83) ability (see figure 1).

One-way repeated Measure ANOVA using Greenhouse-Geisser criterion showed that there is a significant difference among the scores of six developmental aspects( $F=76.35$ ,  $P=0.00$ ), which implied an unequilibrium developing on children with Down syndrome

Further post hoc tests using Bonferroni indicated that children with Down syndrome scored significantly lower on self-help compared with other five developmental aspects, followed by language ability which achieved a significant lower

score than other four aspects (gross motor, fine motor, cognitive, socioemotional). Cognitive, socioemotion and gross motor are found as the strengths for children with Down syndrome in this study, which were reported significant higher score than other three developmental aspects.

**Figure 1. Developmental profile of children with Down syndrome**



## VI. DISCUSSION

This study compared the children with Down syndrome and typically developing children matched on cognitive ability across five aspects of child development (gross motor, fine motor, language, socioemotional, self-help), which found that children with Down syndrome performed significantly worse than typically developing children on language. The finding in this study is consistent with the previous research, which considered the language is the most difficulties to Down syndrome [1], [3], [28], [37], [44]. The abnormal cognitive development among Down syndrome would negatively affect language learning and acquisition [30]-[32].

For the other four developmental aspects - gross motor, fine motor, and self-help, socioemotion, although the scores of Down syndrome are lower than their typically developing peers. The further statistic analysis using MANOVA did not showed any significant difference between the two groups, which revealed that the abilities on these four developmental aspects in this study are in the similar level between children with Down syndrome and typically developing children when matched with cognitive ability in their early childhood.

This study examine the developmental profile of early childhood on children with Down syndrome in a Malaysian special education center, the positive finding in this study may due to the early childhood intervention for children with Down syndrome. The samples in this study started to be intervened at early age, some are under 36 months. The findings were supported by previous researches, which noted that children with Down syndrome may get considerable progress if under the efficient and appropriate intervention and training, even achieve to the typically developing level, such as motor skill, socioemotional ability[2],[34],[35],[51]. Children with Down syndrome are developmentally delayed in many aspects

compared to typically developing children [1]-[4]. An effective and efficient early intervention is necessary, when a Down syndrome is found. A longitude and descriptive study which compared children with Down syndrome experienced with early intervention programme (EI) and without early intervention programme confirmed the positive effect of early intervention to children with Down syndrome. The result showed that children with Down syndrome under EI programme have significant higher scores on intellectual and adaptive functioning than those without early intervention [57].

The relative strong socioemotion ability on children with Down syndrome has been well recorded in the prior research [20], [21], [35]. Due to their empathy and strong social ability, children with Down syndrome get a quite good impression from the community and their teacher [22], [23]. The children with Down syndrome in this study also performed better on socioemotional assessment.

Despite the physical deficits in nature, the motor ability will be another strength via appropriate activates and training [34]. This study also found gross motor skills as the second strength on children with Down syndrome.

Previous research indicated that Down syndrome children usually have some difficulties on self-care activates, such as dressing, toileting tasks [53], [54]. Similar result found in this study that children with Down syndrome performed quite worse on self-help tasks, which may due to the younger age of this study sample. Leonard et al. (2002) pointed that the self-help skill may improve as children grow up. Both the between group comparing and within developmental comparing indicated the severe language delayed on children with Down syndrome, which suggest to develop more efficient and effective intervention and training for this population [55].

## VII. CONCLUSION AND FUTURE STUDY

Compared to typically developing children, children with Down syndrome in this study experienced significantly language delay, which is deemed as the weakness in their early childhood period. Socioemotional ability is found as one of the strength in this Down syndrome group, which achieve the typically developing level. For the future study, bigger sample size was suggested, which can invite more school or education center in Malaysia context.

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