https://doi.org/10.1016/j.ridd.2010.10.005

Title: Determinants of activity and participation in preschoolers with developmental delay

Authors:
Grantiana P K Leung (Msc)[1,2]
Chetwyn C H Chan (PhD)[2]
Raymond C K Chung (PhD)[2]
Marco Y C Pang (PhD)[2]

Affiliations:
1 Central Para-medical Support Service Unit, Social Welfare Department, The Government of the Hong Kong Special Administrative Region, Hong Kong, China.

2 Department of Rehabilitation Sciences, The Hong Kong Polytechnic University, Hong Kong, China.

Corresponding author:
Dr. Marco Pang, Department of Rehabilitation Sciences, Hong Kong Polytechnic University, Hong Kong.
Fax: 852-2330-8656
E-mail: rsmpang@inet.polyu.edu.hk

Keywords:
Developmental delay, activity, participation, preschool, rehabilitation.

Word Count:
Abstract (239 words)
Main text (3019 words)

ABSTRACT

Objective: To compare the activity performance and school participation of preschool children with developmental delay (DD) and age-matched typically developing children, and to identify the determinants of activity and participation in preschoolers with DD**.**

Design: This was a case-control exploratory study.

Setting: Mainstream preschools with integrated program units.

Patients: Fifty-four children with DD (37 boys, 17 girls; mean age: 66 months) were recruited. A group of age-matched typically developing children served as controls (34 boys, 20 girls; mean age: 65 months).

Intervention: Not applicable.

Main outcome measures: Activity performance and school participation were measured according to the Vineland Adaptive Behavior Scales (VABS) and School Function Assessment (SFA). Different aspects of body functions (i.e. sensory, motor, mental) were evaluated with the Kindergarten Sensory Integration Checklist (Chinese Version), the Bruininks-Oseretsky Test of Motor Proficiency: Long Form, and Conners' Teacher Rating Scale – Revised: Long Form. Other information on personal and environmental factors (e.g., gender, household income, etc.) was also obtained.

Results: Children with DD had significantly lower VABS ($p<0.001$) and SFA ($p<0.001$) scores than controls. Multiple regression analysis revealed that deficits in social and

motor skills, and in inattention/hyperactivity, were significantly associated with activity and participation in children with DD, accounting for approximately 35-37% of the variance in the VABS and SFA scores ($p<0.001$).

Conclusion: Deficits in social and motor functioning, and attention-deficit hyperactivity disorder-related symptoms, are important determinants of activity and participation in preschoolers with DD. Interventions may consider targeting these specific areas to enhance activity and participation amongst these children.

INTRODUCTION

Developmental delay (DD) is a clinical term used to describe significant lag in the achievement of developmental milestones in two or more domains (e.g. gross/fine motor proficiency, cognition, speech/language, social skills).[1] According to the International Classification of Functioning, Disability and Health (ICF) model endorsed by the World Health Organization (WHO), a disorder or disease may lead to changes in three different aspects, namely, body functions and structures (physiological and psychological functions of body systems), activity (the execution of a task or action by an individual), and participation (involvement in a life situation).[2]

Many children with DD encounter difficulties integrating into the school environment (i.e. activity and participation). In addition to impairments of body functions, the ICF model states that various contextual factors, including environmental (e.g. availability of support service) and personal factors (e.g. age) can have a significant influence on activity and participation.[3] However, few studies of the functional status of children have adopted the ICF model.[4-6] Furthermore, while several studies have examined activity and participation amongst school-aged children with developmental disabilities,[4,7-9] research on preschool children is scarce. The integration of preschool-aged children with DD into the early education environment is an important area of research. The early identification of poor activity and participation and other

associated factors at the preschool stage is essential to promoting the successful transition and integration into the elementary school setting.[10] To date, the influence of different body impairments and contextual factors in restricting activity and participation amongst preschoolers with DD remains largely unknown.

In Hong Kong, children aged two to six years with mild disability typically attend mainstream preschools known as integrated kindergarten-cum-child care centers (KG-cum-CCCs). Although an integrated program designed to provide extra support for children with disability is in place at these centers, no major changes have been made to the content of the curriculum or to pedagogy.[11] Culturally, children in Hong Kong are expected to strive for academic excellence, be obedient to teachers and cooperate with classmates.[12] In light of these unique educational and cultural factors, the determinants of activity and participation of children with DD in Hong Kong are likely to be very different from those observed in western countries. A local study on this important topic is thus warranted.

The objectives of this study were to: (1) compare various aspects of body functions (i.e., sensory, motor, mental), activity and participation between preschoolers with DD and age-matched typically-developing children (i.e. control group); and (2) identify the determinants (e.g., body functions and contextual factors) of activity and participation amongst preschoolers with DD.

METHODS

Study design

This was a cross-sectional exploratory study.

Participants and sampling

Children in the DD group had to fulfill the following inclusion criteria: (1) be formally diagnosed with DD by an interdisciplinary team at a child assessment centre of the Department of Health, with DD defined as having a score ≥ 1 standard deviation (SD) below the mean as measured by the Griffiths Mental Developmental Scale (i.e., developmental quotient <80)[13]; (2) Chinese in origin; (3) use Cantonese as the first language; (4) aged from 5 years to 5 years 11 months, as these children will soon face the transition to elementary school; and (5) at least six months of attendance at the existing integrated preschools. Children were excluded if they had other serious illnesses that precluded participation in the study. The control children also had to fulfill the above criteria, except inclusion criterion (1).

All sample size calculations were based on a statistical power of 0.80 and alpha of 0.05. Several studies involving parent- or teacher-completed developmental questionnaires have reported an attrition rate ranging from 9.5% to 28% due to withdrawal of consent or questionnaires that are either not returned or not fully completed.[14-16] Considering the previous findings and the fact that this was only a

cross-sectional study with no follow-up evaluation required, an attrition rate of 15% was deemed acceptable in this study. In Hwang et al., the School Function Assessment (SFA) scores of children with learning disabilities and a control group were 73.85 (SD=19.56) and 97.86 (SD=3.43), respectively, which translates into a large effect size (1.62).[17] Assuming a large effect size (convention: 0.80), the minimum sample size to detect a significant between-group difference in outcomes (objective 1) is 30 for each group (children with DD and controls).[18] Regarding correlation analysis (objective 2), Liss et al. showed that adaptive functioning had a moderate to strong correlation with various cognitive impairments (r=0.35-0.79) amongst school-aged children with developmental disorders.[19] Therefore for multiple regression analysis with 3 predictors and effect size of 0.3 (medium to large), a minimal sample size of 48 for the DD group would be required.[18]

In Hong Kong, children aged two to six years with mild disability typically attend mainstream preschools known as integrated kindergarten-cum-child care centres (KG-cum-CCCs), where they attend classes in regular classrooms together with typically-developing children. All participants were recruited from these centres. The ratio of the number of integrated programme units in the three geographical regions of Hong Kong, namely, Hong Kong Island, Kowloon, and the New Territories, was approximately 1:2:3. In the first stage of sampling, based on the aforementioned ratio and the minimum sample size required as calculated above, a total of 54 integrated

programme units were randomly selected (Hong Kong Island, 9; Kowloon, 18; New Territories, 27). In the second stage, for each of the 54 selected centres, the preschool teacher randomly chose one child with DD and one typically-developing child by drawing ballots. A total of 108 preschoolers (54 children with DD and 54 controls) were successfully recruited. This two-stage cluster sampling method was used to ensure the representativeness of the sample and avoid bias towards a particular programme unit/geographical region.

Ethical approval for the study was obtained from the ethics committee of the university. Informed written consent was also obtained from all participating teachers and parents.

Procedures

A review of potential measuring instruments was conducted using the Outcome Measures Rating Form.[20] The measurement tools chosen had to: (1) address the ICF components; (2) measure the variables concerned; (3) have adequate psychometric properties; (4) have adequate clinical utilities; (5) be culturally/contextually relevant; and (6) be commonly used in pediatric settings in Hong Kong. After having reviewed the potential measuring instruments, the following tools were determined to have fulfilled the criteria and thus used for the study: the Vineland Adaptive Behavior Scales

(VABS) – Classroom Edition (Chinese Version),[21] School Function Assessment (SFA)(Chinese Version),[22] Kindergarten Sensory Integration Checklist (KSIC) (Chinese Version),[23] Bruininks-Oseretsky Test of Motor Proficiency: Long Form (BOTMP),[24] and Conners' Teacher Rating Scale – Revised: Long Form (CTRS).[25]

All of the assessment procedures strictly followed the guidelines in the respective test manuals. The teachers and parents were given training on the administration of the measurement tools. Each child underwent the following evaluation.

Contextual factors

A supplementary information form was completed by the teacher to collect relevant information on personal factors (e.g. age, gender, co-morbidity, etc.), and environmental factors (e.g. availability of rehabilitative training, etc.).

Body functions/structures

The parents assessed sensory functioning using the 50-item KSIC.[23] This encompasses five different types of sensory integration dysfunction: (1) Vestibular-Bilateral Disorder; (2) Tactile Defensiveness; (3) Developmental Dyspraxia; (4) Visual Perception Disorder; and (5) Gravitational Insecurity. Each item was rated on a 5-point scale (1=never, 5=always), with a higher score indicating more problems with

sensory integration. The KSIC total score was used for subsequent data analysis. The test-retest reliability of KSIC has been shown to be satisfactory (r=0.62-0.74).[23]

The BOTMP was administered by an experienced pediatric occupational therapist to evaluate the motor proficiency of each participant.[24]The BOTMP consists of eight subtests, each measuring different aspects of the participant's gross and fine motor skills. The sum of scores from various subtests yielded a BOTMP total score. The BOTMP has been shown to have good test-retest reliability (ICC=0.68-0.89).[24]

The 59-item CTRS was administered by the teachers to assess mental functioning in the classroom setting.[25] Each item was rated on a four-point scale (0=not true at all/never, seldom, 3=very much true/very often, very frequent), with higher scores indicating more severe deficits in mental functioning. The CTRS provides six subscale scores (Oppositional, Cognitive Problems/Inattention, Hyperactivity, Anxious-Shy, Perfectionism, Social Problems) and an index score [Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition Symptoms: Total (DSM-IV Index)]. The index score is based on the scores from the Inattentive and Hyperactive-Impulsive subscales and evaluates attention deficit hyperactivity disorder (ADHD) related symptoms. All subscales of the CTRS are examples of temperament and personality functions under the mental functions domain of the ICF checklist.[2] The Cronbach's alpha and test-retest reliability values for the various subscales range from 0.77 to 0.96 and 0.47 to 0.88,

respectively.[25]

Activity and participation

The teacher of each child was required to complete the VABS, which measures adaptive performance in Communication, Daily Living Skills, Socialization and Motor domains.[21] Each item was rated on a 3-point scale, with a better score indicating better adaptive performance. The total adaptive performance score was used for data analysis. VABS has good test-retest (r=0.91) and inter-rater reliability (r=0.89).[21]

The teacher was also required to complete part I of the SFA (Participation score).[22] This evaluates participation in six school activity settings using a 6-point scale (1=participation extremely limited, 6=full participation): (1) Regular or Special Education Classroom; (2) Playground/Recess; (3) Transportation; (4) Transitions; (5) Bathroom/Toileting; and (6) Mealtime/Snack Time. Although the SFA is mainly used to assess school-aged children,[22] we felt it was appropriate to use it on preschoolers in this study. First, the class routines and activities in the integrated KG-cum-CCCs were very similar to those in elementary schools. Indeed, the sampled children were exposed to all six activity settings outlined in the SFA. In addition, the Chinese Version of the SFA is largely adapted from the original English version of the SFA, which is designed to measure the school participation of children from kindergarten to the sixth grade.[26] The

SFA – Chinese Version has been shown to have good internal consistency (Cronbach's alpha = 0.94-0.98) and test-retest reliability (ICC=0.87-0.98).[26]

Statistical analysis

For all of the outcome measures, raw/point scores were used for analysis because normative values on Hong Kong preschool children were not yet available. To avoid the increased probability of making a Type I-error, multivariate analysis of variance (ANOVA) was performed to compare the main outcome measures between the children with DD and controls. Pearson's correlation coefficients or Spearman's rho were used to examine the bivariate association of the VABS and SFA scores with other variables amongst children with DD, depending on whether the assumptions for parametric statistics were fulfilled. Any factors that were significantly correlated with the VABS or SFA would be entered as independent (predictor) variables into separate regression analyses to identify the determinants of the VABS and SFA scores. All of the data were analyzed using SPSS 16.0 for Windows. A significance level of 0.05 (2-tailed) was set.

RESULTS

Comparison of contextual factors

Children with DD attended classes in regular classrooms, with other typically

developing children. The KG-cum-CCCs have open-plan classrooms with several theme-based learning corners. As stipulated by the government, the minimum floor space is around 1.8m^2 of net indoor activity area per child. All of the children in the DD group received training provided by special child care workers. Support services, including occupational therapy, physiotherapy and speech therapy, were also available in all the sampled preschools. The contextual factors are outlined in Table 1. No significant between-group difference was found in any variables.

Comparison of body functions, activity and participation

Children with DD had a significantly lower VABS composite score and SFA participation score than controls ($p<0.001$), indicating poorer adaptive performance and lower level of school participation (Table 2).

Children with DD also had significant deficits in body functions. Specifically, they had a significantly higher KSIC total score and lower BOTMP total score, indicating poorer sensory integration and motor proficiency (Table 2). Children with DD had significantly higher scores in most CTRS subscale and index scores than controls, indicating deficits in mental functioning. In particular, the between-group differences in Social Problems ($p<0.001$), Cognitive Problems/Inattention score ($p<0.001$) and DSM-IV index score ($p=0.001$) were highly significant (Table 2).

Determinants of activity and participation in preschoolers with DD

The variables that were significantly associated with the VABS or SFA scores in bivariate correlation analysis (Table 3) were used in subsequent multiple regression analyses for predicting the VABS and SFA scores. However, amongst the various subscale scores of CTRS, Social Problems, Cognitive Problems/Inattention, Hyperactivity, and DSM-IV index were all significantly associated with the VABS and SFA scores (Table 3). In addition to Social Problems, the DSM-IV index was also chosen as one of the predictor variables in lieu of the Cognitive Problems/Inattention and Hyperactivity scores, as it incorporated the scores from these two subscales. Moreover, as Social Problems and the DSM-IV index score were highly correlated with each other ($r=0.631$, $p<0.001$), these factors were entered into separate regression models to avoid multicollinearity.

The first regression model used the BOTMP: Total score and Social Problems score to predict the VABS scores. Both factors were significant predictors ($p=0.001$), and combined to account for 36.7% of the variance in VABS scores (Table 4, model 1). The second regression model used the BOTMP: Total score and DSM-IV index score as predictor variables. Similarly, both factors were significant predictors ($p<0.05$), and collectively explained 36.5% of the variance in the VABS score (Table 4, model 2).

Another two regression models were constructed to predict the SFA scores (Table 5).

The KSIC: Total score and BOTMP: Total score were used as predictors in both models. In addition, the Social Problems and DSM-IV index scores were entered into models 1 and 2, respectively. Both regression models were significant ($p<0.001$), accounting for 35.3%-36.6% of the variance in the SFA scores. The significant predictors identified were the BOTMP: Total score (model 1), Social Problems score (model 1), and DSM-IV index score (model 2).

DISCUSSION

Lower activity and participation in preschoolers with DD

Preschoolers with DD had significantly poorer adaptive functioning and school participation than controls. Our results are in line with the findings from previous studies of school-aged children.[4,8] For example, Eriksson et al. found that school-aged children with various types of disabilities or conditions (motor impairment, learning disabilities, ADHD) had lower participation levels than typically-developing children in both structured (e.g., mathematics and science classes) and unstructured (e.g., recess) school activities.[8] Similarly, Schenker et al. found that elementary school children with cerebral palsy in fully inclusive and self-contained classes demonstrated significantly lower levels of participation than typically-developing children in all six activity settings as measured by the SFA.[4] Our results thus extend the findings from previous studies of school-aged

children, showing that difficulties in activity and participation amongst children with DD exist well before the elementary school years.

Determinants of activity and participation

Motor proficiency was identified as a significant determinant of activity and participation in preschoolers with DD. The association of motor impairments with activity and participation has also been shown in children with a variety of conditions (e.g. cerebral palsy, spina bifida).[9] The strong correlation between motor proficiency and activity/participation is not entirely surprising, given that the various school activity settings evaluated in SFA all demand a fairly high level of motor skills. For instance, participation in the Regular Classroom setting requires children to possess the ability to use different types of materials (e.g. pencils, pencil sharpeners and scissors).[27] Furthermore, optimal participation in the Playground setting requires the ability to efficiently perform a variety of body movements associated with different recreational activities.[27]

The Social Problems score was also a significant determinant of activity and participation in our study. The Social Problems category contains good examples of impairment in temperament/personality functions under the ICF model. High Social Problems scorers are likely to have few friends, low self-confidence and may feel more

socially detached from their peers.[25] Previous studies indicated that Taiwanese adolescents with deficits in social function also had feelings of anxiety, frustration and hurt.[28-30] A strong relationship between social skills and adaptive functioning amongst children with various disabilities has been demonstrated by Merrell and Popinga.[31] Successful participation in the preschool setting requires social competence, especially in the Regular Classroom, Mealtime/Snack Time and Playground settings as evaluated in the SFA. Positive interaction, effective communication and compliance with rules are essential in these settings.[27] Moreover, the emphasis on social harmony and "human heartedness" (e.g., empathy and understanding of others) in Chinese culture may further add to difficulties with activity and participation in school.[12]

It is interesting that preschoolers with DD exhibited substantial ADHD-related symptoms, which turned out to be a significant determinant of activity performance and participation. Previous studies have also identified the co-existence of DD and ADHD-related symptoms.[32-34] In fact, Voigt et al. have shown that ADHD-related symptoms are more common in children with borderline-to-mild intellectual disability than those without intellectual disability (odds ratio: 6.3).[33] The ability to cooperate with teachers/peers and the control of temper during conflicts with others are particularly important for children's success in the preschool setting.[35] Similar to our findings in preschoolers, Egilson and Coster found that school-aged children with

cognitive/behavioral disorders have particularly pronounced deficits in the Regular Classroom and Playground settings.[9] This is probably due to the fact that these two school settings require a high level of positive interaction and behavioral regulation.[27]

It is intriguing that none of the various contextual factors examined were independently associated with activity and participation. This is in contrast with previous studies, which show that factors such as age, family income, and school environment are related to school participation.[36-38] The homogeneity of the physical setting and participant characteristics may partly explain the discrepancies in results. The design of the physical setting and the availability of various support services at the integrated KG-cum-CCCs are stipulated by the government, and are thus quite similar across the different centers. Additionally, participants are from a highly selected group, with limited variance in age (60-71 months).

Limitations

The study has several limitations. First, our sample only included preschool children at the integrated KG-cum-CCCs. The findings may not be generalizable to non-integrated preschools. Second, our regression models accounted for only 35-37% of the variance in activity and participation. Other factors that may potentially affect activity and participation were not measured (e.g., autonomy, locus of control, teacher and peer

acceptance).[39-40]

In summary, our results showed that activity performance and school participation were suboptimal in children with DD and were independently associated with deficits in motor proficiency, social skills, and ADHD-related symptoms. More experimental studies are required to test the feasibility and efficacy of intervention programs in enhancing activity and participation in preschoolers with DD.

Conclusion

Children with DD have significantly poorer activity participation than their typically-developing counterparts. Deficits in social and motor functioning, and attention-deficit hyperactivity disorder-related symptoms, are important determinants of activity and participation in preschoolers with DD. Interventions may consider targeting these specific areas to enhance activity and participation amongst these children.

REFERENCES

1. **Petersen MC**, Kube DA, Palmer FB. Classification of developmental delays. *Semin Pediatr Neurol* 1998;**5**:2–14.
2. **World Health Organization**. *International Classification of Functioning, Disability and Health (ICF)*. Geneva; 2001. See http://www.disabilitaincifre.it/documenti/ICF_18.pdf (assessed 17 July 2007)
3. **Mihaylov SI**, Jarvis SN, Colver AF, *et al*. Identification and description of environmental factors that influence participation of children with cerebral palsy. *Dev Med Child Neurol* 2004;**46**:299–304.
4. **Schenker R**, Coster WJ, Parush S. Neuroimpairments, activity performance, and participation in children with cerebral palsy mainstreamed in elementary schools. *Dev Med Child Neurol* 2005;**47**:808–14.
5. **Battaglia M**, Russo E, Bolla A, *et al*. International classification of functioning, disability and health in a cohort of children with cognitive, motor, and complex disabilities. *Dev Med Child Neurol* 2004;**46**:98–106.
6. **Law M**, Finkelman S, Hurley P, *et al*. Participation of children with physical disabilities: relationship with diagnosis, physical function, and demographic variables. *Scand J Occup Ther* 2004;**11**:156–62.
7. **Schenker R**, Coster W, Parush S. Participation and activity performance of students with cerebral palsy within the school environment. *Disabil Rehabil* 2005;**27**:539–52.

8. **Eriksson L**, Welander J, Granlund M. Participation in everyday school activities for children with and without disabilities. *J Dev Phys Disabil* 2007;**19**:485–502.

9. **Egilson ST**, Coster WJ. School Function Assessment: performance of Icelandic students with special needs. *Scand J Occup Ther* 2004;**11**:163–70.

10. **Wong DKP**. Struggling in the mainstream: the case of Hong Kong. *Int J Disabil Dev Educ* 2002;**49**:79–94.

11. **Opertti R**, Belalcazar C. Trends in inclusive education at regional and interregional levels: issues and challenges. *Prospects* 2008;**38**:113–35.

12. **Phillipson SN**. *Learning diversity in the Chinese Classroom: contexts and practice for students with special needs.* Hong Kong, China: Hong Kong University Press 2007.

13. **Griffith R**. *The Abilities of Young Children*. Hong Kong: The Test Agency Limited; 1984.

14. Rajkmar AP, Yovan S, Raveendran A, et al. Can only intelligent children do mind reading: The relationship between intelligence and theory of mind in 8 to 11 years old. *Bev Brain Funct* 2008;4:51.

15. Hong Kong Christian Service. *A report on a study on the adaptive behaviours of disabled children in integrated child care centres*. Hong Kong: Hong Kong Christian Service, 1991.

16. Squires JK, Potter L, Bricker D, et al. Parent-completed developmental questionnaires: Effectiveness with low and middle income parents. *Early Child Res Q* 1998;13:345–54.

17. Hwang JH, Davis PL, Taylor MP, et al. Validation of School Function Assessment with elementary school children. *Occup Ther J Res* 2002;22:48–58.

18. Portney LG, Watkins MP. *Foundations of clinical research: Applications to practice* (3rd ed.). Upper Saddle River, NJ: Pearson/Prentice Hall, 2009.

19. Liss M, Harel B, Fein D, et al. Predictors and correlates of adaptive functioning in children with developmental disorders. *J Autism Dev Disord* 2001;31:219–30.

20. CanChild Centre for Childhood Disability Research. *Outcome Measures Rating Form*. Ontario, Canada; 2004. See canchild.icreate3.esolutionsgroup.ca/en/canchildresources/resources/measrate.pdf (assessed 3 Aug 2009).

21. **Wu WT**, Chang CF, Lu TH, *et al*. *Vineland Adaptive Behavior Scales – Classroom Edition manual (Chinese Version)*. Taipei: Psychological Publishing Co. 2004.

22. **Hwang JL**. *School Function Assessment (Chinese Version).* Taipei: Chinese Behavioral Science Corporation 2008.

23. **Lee YC**, Jung SS. *Kindergarten Sensory Integration Checklist*. Taipei: Psychological Publishing Co. 1996.

24. **Bruininks RH**. *Bruininks-Oseretsky Test of Motor Proficiency: examiner's manual.* Circle Pines, MN: American Guidance Service 1978.

25. **Conners CK**. *Conners's Rating Scales – Revised: technical manual.* Toronto, ON: Multi-Health Systems 1997.

26. **Coster W**, Deeney T, Haltiwanger J, *et al*. *School Function Assessment*. San Antonio, TX: The Psychological Corporation 1998.

27. **Mancini MC**, Coster WJ. Functional predictors of school participation by children with disabilities. *Occup Ther Int* 2004;**11**:12–25.

28. **Kuo PH**, Lin CCH, Yang HJ, *et al*. A twin study of competence and behavioural/emotional problems among adolescents in Taiwan. *Behav Genet* 2004;**34**:63–74.

29. **Yang HJ**, Chen WJ, Soong WT. Rates and patterns of comorbidity of adolescent behavioral syndromes as reported by parents and teachers in a Taiwanese non-referred sample. *J Am Acad Child Adolesc Psychiatry* 2001;**40**:1045–52.

30. **Yang HJ**, Soong, WT , Chiang, CN, *et al*. Competence and behavioral/emotional problems among Taiwanese adolescents as reported by parents and teachers. *J Am Acad Child Adolesc Psychiatry* 2000;**39**:232–9.

31. **Merrell KW**, Popinga MR. The alliance of adaptive behavior and social competence: an examination of relationships between the Scales of Independent Behavior and the

Social Skills Rating System. *Res Dev Disabil* 1994;**15**:39–47.

32. **Dekker MC**, Koot HM. DSM-IV disorders in children with borderline to moderate intellectual disability. I: prevalence and impact. *J Am Acad Child Adolesc Psychiatry* 2003;**42**:915–22.

33. **Voigt RG**, Barbaresi WJ, Colligan RC, et al. Developmental dissociation, deviance, and delay: occurrence of attention-deficit-hyperactivity disorder in individuals with and without borderline-to-mild intellectual disability. *Dev Med Child Neurol* 2006;**48**:831–5.

34. **Yochman A**, Ornoy A, Parush S. Co-occurrence of developmental delays among preschool children with attention-deficit-hyperactivity disorder. *Dev Med Child Neurol* 2006;**48**:483–8.

35. **Lane KL**, Stanton-Chapman T, Jamison KR, *et al*. Teacher and parent expectations of preschoolers' behavior: social skills necessary for success. *Top Early Child Spec Educ* 2007;**27**:86–97.

36. **Simeonsson R**, Carlson D, Huntington GS, *et al*. Students with disabilities: a national survey of participation in school activities. *Disabil Rehabil* 2001;**23**:49–63.

37. **Law M**, King G, Kertoy M, *et al*. Patterns of participation in recreational and leisure activities among children with complex physical disabilities. *Dev Med Child Neurol* 2006;**48**:337–342.

38. **Eriksson L**. The relationship between school environment and participation for students with disabilities. *Pediatr Rehabil* 2005;**8**:130-9.

39. **Almqvist L**, Granlund M. Participation in school environment of children and youth with disabilities: a person-oriented approach. *Scand J Psychol* 2005;**46**:305–14.

40. **Eriksson L**, Granlund M. Perceived participation: a comparison of students with disabilities and students without disabilities. *Scand J Disabil Res* 2004;**6**:206–24.

Table 1. Comparison of contextual factors

	DD (n = 54)	Controls (n = 54)
Mean age (SD), months	66 (3.9)	65 (3.9)
Gender, n		
Boys/girls	37/17	34/20
Comorbidity		
Epilepsy	1	0
Allergy	1	0
Eczema	2	0
Glucose-6-phosphate dehydrogenase deficiency	2	1
Father's Education Level, n		
Secondary or below/Post-secondary	42/12	46/8
Mother's Education Level, n		
Secondary or below/Post-secondary	45/9	46/8
Household Monthly Income, n		
<HK$30,000/≥HK$30,000	40/14	43/11
Siblings, n		
No/Yes	22/32	26/28

Table 2. Comparisons of body impairments, activity and participation

Variable	DD (n = 54)	Controls (n = 54)
VABS Composite (Activity performance)**	251.3 (55.5)	314.4 (46.9)
Communication**	68.6 (16.9)	85.8 (13.4)
Daily Living Skills**	86.7 (22.1)	109.2 (20.3)
Socialization**	48.3 (16.5)	68.3 (15.1)
Motor*	47.7 (6.8)	51.1 (4.8)
SFA (Participation)**	25.1 (4.7)	28.9 (3.9)
Regular Classroom**	4 (0.9)	4.7 (0.8)
Playground/Recess**	4.2 (1)	5 (0.9)
Transportation**	4.1 (1.1)	4.8 (0.8)
Transitions*	4.3 (1)	4.7 (0.9)
Bathroom/Toileting*	4.3 (1)	4.9 (0.8)
Mealtime/Snack Time*	4.3 (1.1)	4.7 (1)
KSIC: Total (Sensory functioning)**	104.3 (29.8)	83.3 (18.3)
Vestibular- Bilateral Disorder**	23.5 (6.9)	18.1 (4.9)
Tactile Defensiveness*	38.4 (10.9)	33.6 (8.2)
Developmental Dyspraxia**	17.5 (6.4)	13.1 (3.9)
Visual Perception Disorder**	9.4 (3.3)	6.3 (2.2)
Gravitational Insecurity*	15.5 (6.7)	12.4 (4.2)
BOTMP: Total (Motor proficiency)**	59.6 (17.6)	79.5 (15.5)
Gross Motor**	25.2 (9.1)	34.7 (8.4)
Upper-Limb Coordination**	4.5 (2.9)	7.4 (3.4)
Fine Motor**	29.8 (8.4)	37.4 (7.6)
CTRS (Mental functioning)		
Oppositional*	5.3 (3.8)	3.7 (3.5)
Cognitive Problems/Inattention**	10.5 (5.8)	6 (4.7)
Hyperactivity	6.5 (4.8)	4.8 (4.7)
Anxious-Shy*	7.6 (3.8)	5.4 (3.3)
Perfectionism	5.1 (2.3)	5.6 (2.6)
Social Problems**	5.7 (3.7)	1.6 (2.7)
DSM-IV Index*	23.3 (10.5)	16.4 (10.8)

VABS=Vineland Adaptive Behavioral Scales; SFA= School Function Assessment; KSIC=Kindergarten Sensory Integration Checklist; BOTMP= Bruininks-Oseretsky Test of Motor Proficiency; CTRS=Conners' Teacher Rating Scale
Mean (SD) presented.
**$p < 0.001$
*$p< 0.05$

Table 3. Correlations with activity performance and school participation in children with DD (n = 54)

Variables	VABS	SFA
Body functions		
KSIC (Sensory functioning)	-0.121	-0.305*
BOTMP (Motor proficiency)	0.472**	0.434*
CTRS (Mental functioning)		
Oppositional	0.034	-0.206
Cognitive Problems/Inattention	-0.469**	-0.320*
Hyperactivity	-0.433*	-0.473**
Anxious-Shy	0.219	0.145
Perfectionism	0.232	0.059
Social Problems	-0.474**	-0.465**
DSM-IV Index	-0.540**	-0.507**
Contextual Factors		
Age	0.264	0.070
Gender	0.114	0.143
Father's education level	-0.021	0.000
Mother's education level	0.120	0.058
Household monthly income	0.146	0.037
Siblings	0.047	0.019

VABS=Vineland Adaptive Behavioral Scales; SFA= School Function Assessment; KSIC=Kindergarten Sensory Integration Checklist; BOTMP= Bruininks-Oseretsky Test of Motor Proficiency; CTRS=Conners' Teacher Rating Scale
**p<0.001
*p < 0.05

Table 4. Regression analyses for predicting Vineland Adaptive Behavioral Scale (VABS) Score

Predictors	B	95%CI	β	p for each predictor
Model 1 F(2,51)=14.800, p<0.001, R^2=0.367				
BOTMP: Total (motor proficiency)	1.219	0.497, 1.941	0.387	0.001*
Social Problems	-5.912	-9.394, -2.430	-0.389	0.001*
Model 2 F(2,51)=14.680, p<0.001, R^2=0.365				
BOTMP: Total (motor proficiency)	0.940	0.163, 1.717	0.298	0.019*
DSM-IV Index	-2.194	-3.497, -0.891	-0.415	0.001*

BOTMP= Bruininks-Oseretsky Test of Motor Proficiency
B=unstandardized regression coefficient
CI=confidence interval
β=standardized regression coefficient
*p<0.05

Table 5. Regression analyses for predicting School Function Assessment (SFA) score

Predictors	B	95%CI	β	p for each predictor
Model 1 F(3,50)=9.639, p<0.001, R^2=0.366				
KSIC: Total (sensory functioning)	-0.030	-0.067, 0.007	-0.190	0.107
BOTMP: Total (motor proficiency)	0.083	0.020, 0.146	0.311	0.011*
Social Problems	-0.481	-0.781, -0.181	-0.373	0.002*
Model 2 F(3,50)=9.100, p<0.001, R^2=0.353				
KSIC: Total (sensory functioning)	-0.031	-0.068, 0.006	-0.197	0.098
BOTMP: Total (motor proficiency)	0.062	-0.006, 0.130	0.232	0.074
DSM-IV Index	-0.170	-0.283, -0.057	-0.380	0.004*

KSIC=Kindergarten Sensory Integration Checklist; BOTMP= Bruininks-Oseretsky Test of Motor Proficiency
B=unstandardized regression coefficient
CI=confidence interval
β=standardized regression coefficient
*p<0.05