Original Article

An Examination of Health-related Physical Fitness Levels in Hong Kong Youth with Intellectual Disability

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The purpose of this study was to compare health-related physical fitness in Hong Kong youth, with and without intellectual disability (ID). A stratified, random sample of 457 youth with mild ID (272 boys, 185 girls, CA 6–18 years) completed 6/9-minute run, sit-up, sit-and-reach, and sum of skinfold evaluations. Fitness data for youth without ID were obtained from previously established norms. MANOVA (age × gender) and trend analysis were used to examine fitness in youth with ID. Sample *t*–tests were used to compare fitness performance between youth with ID, and established norms for youth without ID. Males with ID performed better on the 6/9-minute run ($p = 0.03$), sit-ups ($p = 0.02$) and had lower skinfold measures ($p = 0.01$) than females, while females performed better on the sit-and-reach ($p = 0.01$) than males. The youth with ID demonstrated lower scores on the 6/9-minute run, compared to those without ID ($p = 0.04$), but performances on other test items varied according to age and gender. There were few differences in physical fitness between Hong Kong youth with and without ID; however, both groups appeared extremely unfit compared to peers in other developed countries.

Keywords: fitness, cardiorespiratory, sit-up, flexibility, skinfold, mental retardation

Introduction

The importance of physical fitness to health for all individuals has been well documented (U.S. Department of Health & Human Services, 2002). Research consistently indicates that youth with intellectual disability (ID) demonstrate lower overall physical fitness levels compared to peers without ID (Gillespie 2003; Pitetti et al. 2001; MacDonncha et al. 1999; Eichstaedt et al. 1991). Large-scale studies examining this issue have been primarily conducted with Caucasian samples from North America (Pitetti et al. 2001; Chanias et al.1998; Eichstaedt et al. 1991; Londeree & Johnson 1974). Relatively little is known about the physical fitness of youth with ID from other countries, particularly Asia (Chaiwanichsiri et al. 2000; Yoshizawa et al. 1975), and there are no published data on physical fitness in Hong Kong youth with ID. In addition, most fitness studies including youth with ID have focused on cardiorespiratory fitness and body composition or assessment methodology (Gillespie 2004; Pitetti et al. 2001; Fernhall et al. 1998), and there have been few efforts to conduct large-scale fitness test batteries (i.e. including all components: body composition, muscular strength/endurance, cardiorespiratory endurance and flexibility) in this population (Eichstaedt et al. 1991; Londeree & Johnson 1974).

To date, there appears to be only one published study that has assessed all aspects of fitness (i.e. muscular

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strength/endurance, cardiovascular fitness, body composition and flexibility) in Asian youth with ID. Chaiwanichsiri et al. (2000) compared body composition (triceps, subscapula and abdominal skinfold), cardiorespiratory fitness (VO_2 peak treadmill protocol), leg strength (isokinetic dynamometer) and flexibility (sit-and-reach) in 28 youth with mild to moderate ID (14 males, 14 females) and 14 youth without ID (7 males,7 females) aged 15–18 years. Females with ID demonstrated lower exercise times and leg strength than their peers without ID, while males with ID performed worse than peers without ID on all measures except percent body fat. The authors concluded that youth with ID were less fit and more obese than youth without ID.

It is difficult to generalize research on youth with ID between countries because of different cultural attitudes toward both people with disabilities and physical fitness (Stone 2001; Lindner 1997). Hong Kong presents an interesting model because it has been significantly influenced by Western customs, due to its long colonization by the United Kingdom, yet retains a strong Chinese culture and heritage (Sit et al. 2002). Recognition of disability rights in Hong Kong has increased in the last two decades, but has developed at a somewhat slower pace than in other countries (Kwok 2002; Hung 2001).

Overall, Hong Kong youth demonstrated lower physical activity and fitness levels than peers from Britain, Singapore, the U.S. and mainland China (Hong et al. 1998; Macfarlane 1997). Adab & Macfarlane (1998) stated that Hong Kong elementary school children are some of the most inactive in the world and there had been a decrease in fitness among adolescents in the last five years (Fu et al. 2004). Physical activity is typically not valued by Hong Kong society (Hong et al. 1998) and physical education assigned low curricular status, because time devoted to physical pursuits was believed to detract from academic achievement (Johns & Dimmock 1999). Negative effects of poor physical fitness on health and well-being has impacted the Hong Kong population, as evidenced by increased rates of obesity among youth, as well as obesity and cardiovascular disease in adults (Hui et al. 2003).

Based on the aforementioned information, it can be concluded that Hong Kong youth without ID are less physically fit than youth from other countries, and that youth with ID are typically less physically fit than peers without ID. Therefore, a reasonable prediction is that Hong Kong youth with ID are less physically fit compared to peers without ID.

The purpose of this study was to examine physical fitness levels in a cross-sectional sample of Hong Kong youth with mild ID according to age and gender, and to compare physical fitness levels in this group with established norms based on Hong Kong youth without ID (Fu et al. 2004; Hong Kong Childhealth Foundation 2003). It was hypothesized that Hong Kong youth with ID would demonstrate lower fitness levels than peers without disabilities.

Methods

Participants

A total of 457 youth with mild ID (272 boys, 185 girls, chronological age, CA 6–18 years, 12.2 ± 3.1) from eight special education schools in Hong Kong participated in the study. Hong Kong implements a segregated school system according to learning ability. Schools for children with ID include both primary and secondary grades, and are organized by IQ classifications of mild ID (IQ = 50–70), moderate (IQ = 25–49), or severe ID (IQ = < 25) (Lan 2000). The Hong Kong government promotes the use of broad disability classification schemes to allow flexibility among governmental departments and professional groups, so systems can be developed to meet specific functions or needs (Hong Kong Health and Welfare Bureau 1999).

In general, Hong Kong defines those with ID as demonstrating significantly subaverage intellectual function, existing with deficits in adaptive behavior, and manifested during the developmental period; but actual placement is primarily IQ based (Hong Kong Home Affairs Bureau 2003). This project focused on those diagnosed with mild ID, as these categories account for approximately 95% of Hong Kong citizens with this condition (Hong Kong Health and Welfare Bureau 1999).

There are approximately 2,900 youth with mild ID in Hong Kong schools. A stratified sample method was used to select research sites (8 schools) from a total of 17 schools that admit students with mild ID, or both mild and moderate ID. Children in schools, including students with both mild and moderate ID, attend separate classes,

segregated according to those categories. The final sample represented the major Hong Kong districts of Hong Kong Island (n = 1), Kowloon Peninsula (n = 4), and New Territories (n = 3). The first two districts are considered urban, while the third district is rural, and represents both the largest geographic region and population. Children from the eight sample schools were then randomly sampled and stratified by gender ratio and number of students in each grade level. The sample was delimited to participants diagnosed with mild, idiopathic ID. Access to IQ scores was not provided, but the authors were confident the sample represented youth with mild ID based on the strong adherence to school placement according to IQ by the Hong Kong education system, and feedback from teachers. Those with Down syndrome, other pathologies associated with ID (e.g. William's syndrome), and identified co-occurring conditions (such as autism or physical, sensory or health impairments) were excluded from participation. The schools contacted parents to receive permission for each child to be involved in data collection, requiring a signed informed consent document previously approved by the university research committee.

Procedures

Height and weight measures were obtained from school records, which had been updated at the beginning of the school year. All participants completed four test items in the following order: (a) tricep and medial calf skinfold (sum of skinfold), (b) 1-minute sit-up (muscular endurance), (c) sit and reach (flexibility), and (d) 6-minute (ages 6–9) or 9-minute (ages 10–18) run/walk test (cardiovascular fitness). These test items were chosen because they are used to establish territory-wide fitness norms for all Hong Kong youth (Hong Kong Education and Manpower Bureau 2004), considered valid and reliable (Johnson & Nelson 1986) and are easy to administer. Although there are other fitness tests deemed more appropriate for youth with ID (Pitetti et al. 2001), the purpose of this study was to examine fitness disparities between youth with and without ID, which could only be done by using the same test items. It is important to note these items had also been used to establish fitness norms in U.S. youth with ID (Eichstaedt et al. 1991). Face validity was accepted for the one-minute sit-up; and reliability scores ranged from 0.68–0.94 for youth with and without ID (Pizarro 1990; Johnson & Nelson 1986; AAHPERD 1986). The procedure required feet to be held stationary with arms placed in a crossed position over the chest. The movement was completed when the student was able to sit up and touch elbows to thigh, and scored as the total number of repetitions completed in one trial.

Face validity was also accepted for the back-saver sit and reach test and reliability estimates range from 0.80–0.97 (Pizarro 1990; Johnson & Nelson 1986; AAHPERD 1986). Students sat on the floor with bare feet and one leg extended, foot pushed against a standard sit-and-reach box and the other leg flexed with foot flat on the floor, approximately two to three inches next to the extended leg. Arms were extended with one hand placed on top of the other. Participants were instructed to lean forward as far as possible with palms down, and hold the position for one second. Two separate trials were conducted with each leg extended and the best score was recorded.

Validity and reliability estimates for the 6/9-minute run/walk ranged from 0.50–0.90 and 0.88–0.90, respectively (Graf et al. 2004; Turley et al. 1994; Johnson & Nelson 1986; Vodak & Wilmore 1975). The test was conducted on a measured course (15 by 25 meters), typically set-up on a basketball court at the school. Four cones were placed at each corner with 10 other cones evenly distributed on the course of five meters in between any two. A test administrator paced a group of students. The total distance covered was calculated by the number of laps completed and the number of cones reached in the final lap in the specified time recorded. Children under age nine completed the six-minute test, and all other youth completed the nine-minute test (Graf et al. 2004).

Triceps and calf skinfold thickness is a standard index of body fat in youth (Heyward & Stolarczyk 1996). This item was measured using Harpenden calipers, and the final value averaged over two trials to obtain sum of skinfolds.

Seven individuals were trained to administer the fitness tests. All possessed fitness testing certification from the Hong Kong Physical Fitness Association, and had at least 20 hours of practical experience. Test administrators were provided instruction in how to assess children with ID, and the school physical education instructor was

present at all sessions. One class of 20–30 students from each grade was tested at a time. Activities were divided into stations, so a small group of five to eight children could cycle through each station in the previously specified order.

Participants were familiarized with testing procedures, allowed practice trials (except for skinfold assessment) during physical education classes several days before data collection. Demonstrations were provided during assessment, and verbal cues were used to reinforce correct technique. Verbal encouragement was used to help motivate participants during trials. Familiarization and administration protocol were viewed as successful, since all children were able to complete the entire test battery.

Testing was conducted outdoors on a covered playground, except in two schools which did not have outdoor playgrounds. In these cases, testing was conducted on indoor playgrounds. Most schools scheduled half days for testing. Data collection was conducted over a four-month period from late October to early February.

Data analyses

Multiple analysis of variance and Tukey *post-hoc* tests were calculated to determine age- and gender-related differences in variables among those youth with ID. Trend analysis was also performed to examine changes in fitness with age. Physical fitness and growth data for youth without ID (NID) were obtained from two sources: for Hong Kong children aged 6–11 (Hong Kong Childhealth Foundation 2003; Leung 1995), and for Hong Kong youth aged 12–18 (Fu et al. 2004). Only mean values were available for fitness norms, so one-sample, two-tailed *t*–tests were calculated for planned group comparisons between current data and NID youth fitness norms on all variables, according to age and gender (Kendall et al. 1999). Data were analyzed by SPSS/Windows version 11.0, and are reported as mean ± SD (standard deviation), with effect sizes calculated as partial eta^2. Significance was set at $p < 0.01$.

Results

There were few participants in the six and 18-year-old groups, so these data were combined with the next closest gender specific age group for further analysis (i.e. the 6 and 7-year-olds were combined; and the 17 and 18-year-olds were combined). As a result, only data from youth without ID, aged seven (for the former group) and 17 (for the latter group) were used for comparisons. Since there was no difference between right and left leg backsaver sit-and-reach scores, these values were collapsed to represent an overall score.

Growth measures

Height increased linearly, and reached a plateau at approximately 13 and 15 years in females and males, respectively (Figure 1a). Weight increased linearly throughout childhood and adolescence in males, and did not appear to plateau. In females, with and without ID, weight steadily increased until age 14 and stabilized (Figure 1b). There were small differences in height and weight between groups after age 12 years. Males without ID were taller than peers with ID at ages 12 ($t_{25} = 3.05$, $p = 0.005$), 13 ($t_{27} = 2.70$, $p = 0.010$), and 14 ($t_{31} = 3.52$, $p = 0.001$). Girls without ID were taller than peers with ID at ages 12 ($t_{16} = 2.91$, $p = 0.010$) and 15 ($t_{14} = 3.76$, $p = 0.002$) years (Figure 1a). Girls and boys with ID were heavier than peers without ID at ages 14 ($t_{31} = 3.91$, $p < 0.000$) and 12 ($t_{16} = 2.91$, $p = 0.010$), respectively (Figure 1b).

Youth with ID – physical fitness characteristics

Gender differences existed for the 6/9-minute run ($F_{1,401} = 12.40$, $p < 0.000$, $\eta^2 = 0.03$), sum of skinfold mea-

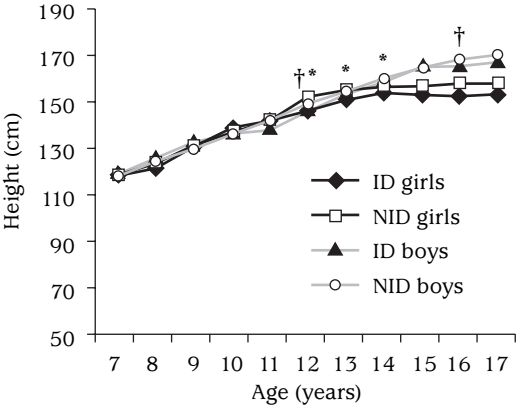

Fig. 1a Height growth trends for youth with (ID) and without (NID) intellectual disabilities.

* Significant difference between boys at $p < 0.01$.
† Significant difference between girls at $p < 0.01$.

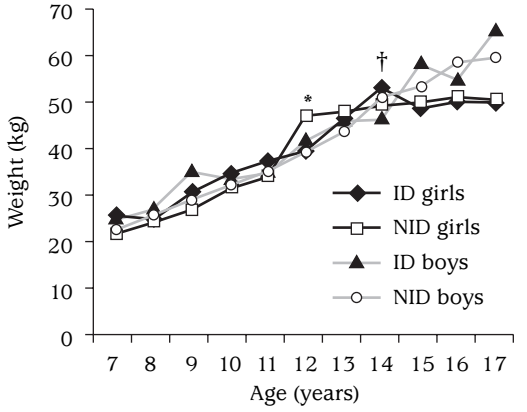

Fig. 1b Weight growth trends for youth with (ID) and without (ID) intellectual disabilities.

* Significant difference between boys at $p < 0.01$.
† Significant difference between girls at $p < 0.01$.

sure ($F_{1,401} = 6.03$, $p = 0.010$, $\eta^2 = 0.02$), sit-up ($F_{1,401} = 5.52$, $p = 0.020$, $\eta^2 = 0.01$) and sit-and-reach ($F_{1,401} = 3.91$, $p = 0.050$, $\eta^2 = 0.01$). Females had higher skinfold measures and performed better on the sit-and-reach than males, while males exhibited better run and sit-up scores than females. There were age effects for the 6/9-minute run ($F_{10,401} = 21.35$, $p < 0.000$, $\eta^2 = 0.36$) and sit-ups ($F_{10,401} = 8.01$, $p < 0.000$, $\eta^2 = 0.17$), which specifically showed performance improvement in these items with age. There were no interactions for any of the variables, so an examination of age × gender effects was not pursued.

Trend analyses revealed gender differences in fitness with age. The mean skinfold increased linearly ($F = 16.08$, $p < 0.000$) with age in girls, but not boys ($F = 0.01$, $p = 0.920$). There were linear improvements in run/walk performance (boys: $F = 163.30$, $p < 0.000$, girls: $F = 47.10$, $p < 0.000$), and sit-up performance (boys: $F = 74.90$, $p = 0.000$, girls: $F = 30.30$, $p < 0.000$) with age across gender. However, neither boys nor girls exhibited trends in sit-and-reach performance with age (Figures 2 to 5).

Comparisons between youth with and without ID

Group differences occurred primarily in the 6/9-minute run as students with ID covered less distance than those without ID across age and gender, with the exception of eight-year-old girls ($p = 0.04$) (Figure 2). There were several group differences in sit-ups between girls aged nine, 10, 11, 13 and 17 years, as well as boys aged seven, eight, 11, 12, 16 and 17 years (Figure 3). The only group differences in sum of skinfold measures occurred among 13-year-old girls, and seven and 17-year-old boys, although youth with ID exhibited tendencies for larger skinfold thickness (Figure 4). Girls without ID aged 13, 14, 15, 16 and boys without ID aged eight, 11, 14 and 17 performed better on the sit-and-reach test item than same age peers with ID (Figure 5).

Discussion

There are few published reports on physical fitness in a large sample of Asian youth with ID, particularly Hong Kong youth with ID. Findings indicated girls with ID were less physically fit than boys across age, which coincided

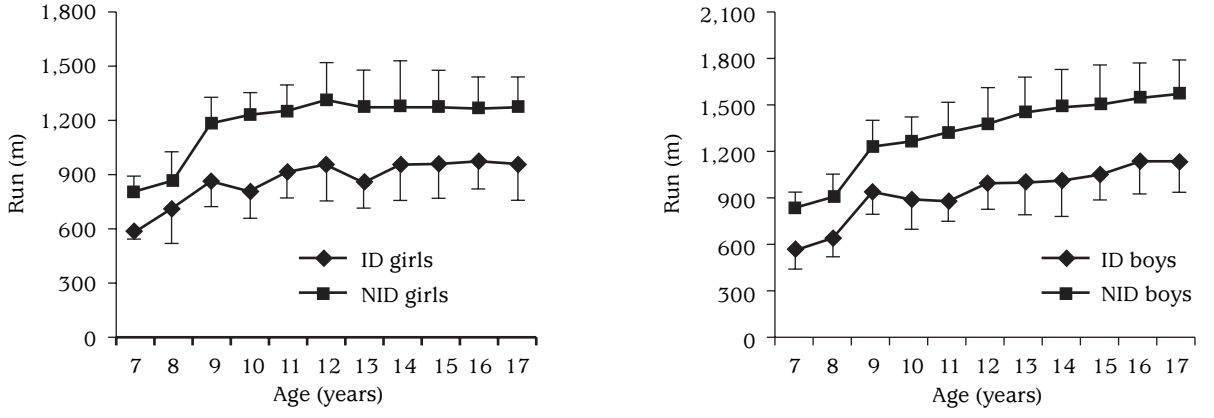

Fig. 2 Gender-specific comparisons of 6/9-minute run performance. Significant differences were found between intellectual disabilities (ID) and no intellectual disabilities (NID) groups across all ages, except for 8-year-old girls.

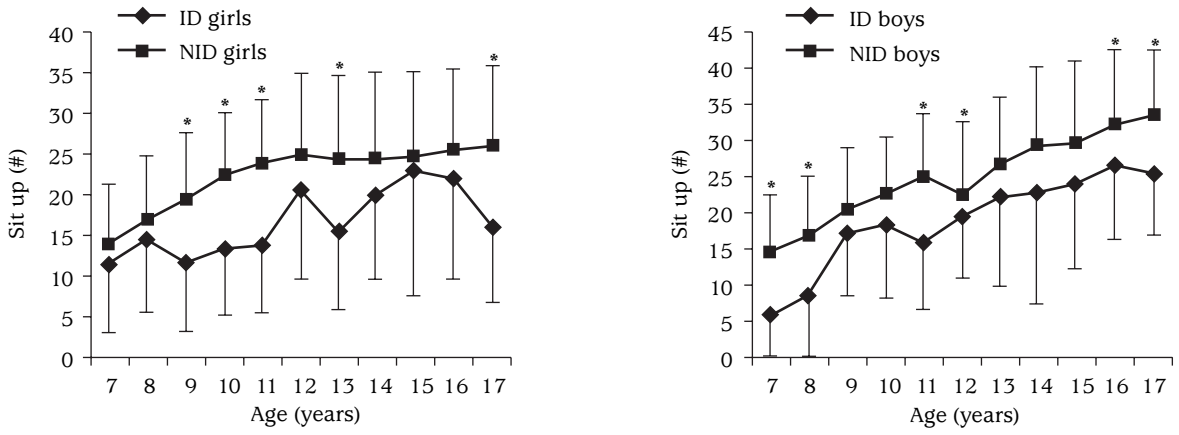

Fig. 3 Gender-specific comparisons of sit-up performance.

* Significant difference between intellectual disabilities (ID) and no intellectual disabilities (NID) groups at $p < 0.01$.

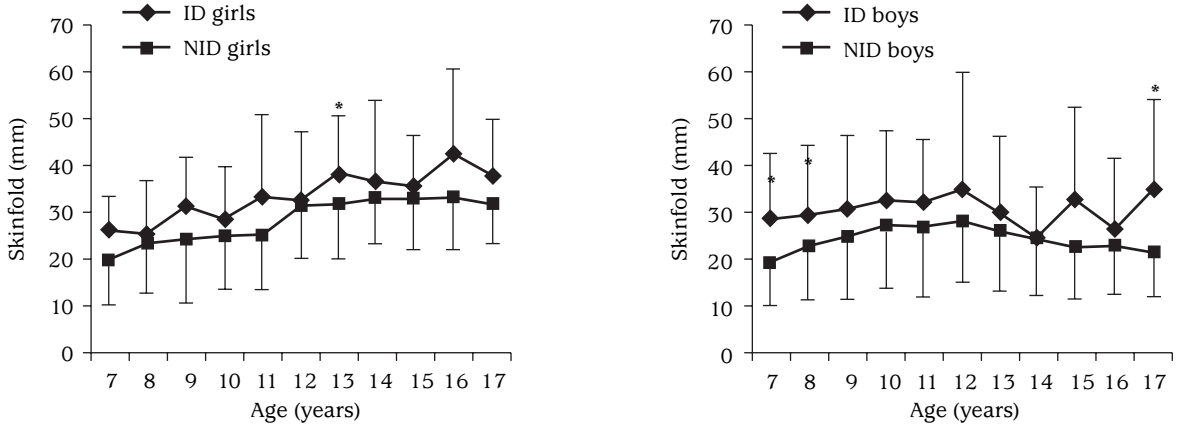

Fig. 4 Gender-specific comparisons of skinfold measures.

* Significant difference between intellectual disabilities (ID) and no intellectual disabilities (NID) groups at $p < 0.01$.

with findings in youth without ID (Pate & Shephard 1989). Growth in Hong Kong youth with ID is similar to peers without ID, but there were differences in physical fitness between groups.

Cardiovascular fitness levels of youth with ID were, on average, 30% lower than peers without ID, while differences in other fitness variables were not consistent, and, when present, varied from 20 to 30% according to age and gender. These results supported previous findings that youth with ID were generally less physically fit, particularly with regard to cardiovascular endurance, than peers without ID (Gillespie 2003; Pitetti et al. 2001; Londeree & Johnson 1974); however, magnitude of discrepancy observed in this study was less than that previously reported by Pitetti et al. (2001) (70%), and Chaiwanichsiri et al. (2000) (40%). Considering Hong Kong youth without ID were viewed as less physically active than those from other countries (Adab & Macfarlane 1998; Hong et al. 1998; Macfarlane 1997), similarities between youth with and without ID observed in this study were not positive.

Cardiovascular fitness is where the most consistent group disparities occurred, and could be attributed to the same factors limiting fitness among all youth in Hong Kong. Physical education is not a valued curricular content area, activity space is limited and typically overcrowded, and free play time is limited or sacrificed for academics (Johns & Dimmock 1999; Johns & Ha 1999; Lindner 1997). Sit et al. (2002) found only 13% of Hong Kong youth with disabilities belonged to segregated sport clubs, and none were members of private or other integrated activity groups. Interestingly, youth with ID

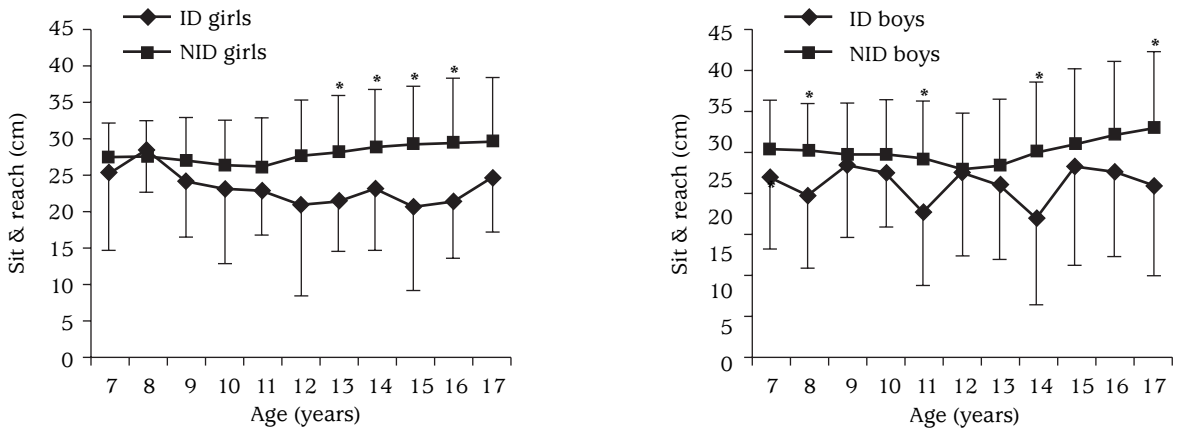

Fig. 5 Gender-specific comparisons of sit-and-reach performance.

* Significant difference between intellectual disabilities (ID) and no intellectual disabilities (NID) groups at $p < 0.01$.

were more involved in segregated sport opportunities (e.g. Hong Kong Sport Association for the Mentally Disabled or the Special Olympics) than those with other types of disabilities, but less active than peers with maladjustments or hearing impairments. Thus, higher reported rates of participation in segregated sports did not impact physical activity in youth with ID (Sit et al. 2002). It appeared that cultural and physical barriers to fitness existing for all Hong Kong youth also impacted those with ID, and were likely more pronounced in this population.

Obesity and cardiovascular disease have increased among Hong Kong citizens over the past decade (Hui 2001). The government has attempted to address this issue by implementing nationwide health promotion programs and emphasizing physical activity.

People with disabilities are specifically mentioned in these programs, but information on health-related fitness in this segment of Hong Kong society has been absent. Findings from this study provide baseline data needed to assist health professionals and educators in developing specific recommendations and effective interventions to improve fitness in this population.

As previously stated, fitness test items used are somewhat outdated and this could be viewed as a study limitation. However, the authors defend these choices for the following reasons: a clear understanding of fitness disparities between youth with and without ID could not be established unless groups were compared according to the same measures, that these items had been previously used to develop fitness norms in U.S. youth with ID (Eichstaedt et al. 1991), that all the items are considered valid and reliable in youth without ID, and that youth with ID in this study were screened for physical or sensory impairments, as well as specific diagnoses that could affect test performances (e.g. Down syndrome), so there was no need to use alternate items (Winnick & Short 1999). Regardless, this study provides meaningful information about health-related fitness of a representative sample of Hong Kong youth with ID. Additional research is needed to understand factors affecting fitness in this population.

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