Original Article

Issues Related to Obtaining Intelligence Quotient-Matched Controls in Autism Research

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ABSTRACT

Background: Intelligence Quotient (IQ) is considered to be an index of global cognitive functioning and has traditionally been used as a fulcral measure in case-control studies in neuro-developmental disorders such as autism. **Aim:** The aim is to highlight the issues of "matching for IQ" with controls in autism research. **Materials and Methods:** Percentile scores on the Coloured Progressive Matrices of 20 children with autism in the age range of 5 to 12 years have been graphically compared with 21 age matched typically developing children. **Results and Conclusions:** The percentile scores of the so-called high functioning children with autism from special schools were well below that of typically developing children. There are many challenges when using IQ in case-control studies of autism. Alternative approaches need to be considered.

Key words: *Autism spectrum disorders, case-control study, intelligence quotient, nonverbal*

INTRODUCTION

Autism is a neuro-developmental disorder that results in impairments in communication, interaction and imagination.[1] It is seen to be heterogeneous in nature manifesting across a wide spectrum of behaviors and abilities. One of the primary aspects of heterogeneity lies in the global cognitive functioning or intelligence.

Intelligence quotient (IQ) is considered to be an index of global cognitive functioning and has traditionally been used as a fulcral measure in case-control studies in neuro-developmental disorders such as autism. However, any IQ score in a neuro-developmental disorder postdates the condition and is closely intertwined within the course of the condition and cannot be separated from the effects of the condition.

The nature of intelligence in autism has been researched extensively. That it is different from the normative population is something that most researchers agree upon. Several researchers have suggested the existence of an intellectual profile that is unique with well-developed nonverbal skills and poorly-developed verbal skills.[2,3]

The performance IQ is reported to be better than the verbal IQ in individuals with autism.[4] But, a verbal-performance discrepancy alone cannot be used to describe the unique profile since performance in picture arrangement (performance scale) is often poor, while digit span (verbal scale) is good.[5]

The processing speed has been considered as one of the aspects of differences in the autistic profile. Scheuffgen *et al*.[6] have reported on a study where children with autism having IQ's one standard deviation (SD) lower than average (with the control group being one SD above average) showed faster processing speeds on an inspection time task.

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Mullen IQ scores have been classified using latent class analysis and taxometric methods to determine if there was more than one subtype of autism based on IQ.[7] The four groups according to this include the following:

a. Very low verbal + Very low nonverbal
b. Similar to (a) above but nonverbal scores much higher (better) than verbal scores
c. Below average functioning with similar verbal and nonverbal scores and
d. Average range of scores with similar verbal and nonverbal scores

It appears that (a) above represents significantly low functioning children, (c) represents below average functioning children and (d) the children in the normal range of functioning while (b) represents the low performing children who appear relatively intelligent because of better non-verbal scores.

An epidemiological study of preschool children by Chakrabarti and Fombonne[8] found 31% of children with autism and 94% with other autism spectrum disorders (ASD's) (Asperger's and pervasive developmental disorder) demonstrated IQ scores above the mental retardation range. This suggests that the higher functioning forms of autism might be a more common form. Also, children with autism are known to have a verbal-performance discrepancy in favor of performance while children with Asperger's syndrome may not show this discrepancy.[2,9] This may be because verbal and performance skills may both be proportionally better, though variably below that of the population norms.

Mottron[10] in a meta-analysis of 133 studies to understand matching strategies in cognitive research, found that a majority of research in autism focused on older, higher functioning individuals with autism due to difficulties with matching for IQ. Apart from this she says that several of the instruments used to assess intelligence in autism rely on the peaks in their performance. She argues that due to the autistic individuals enhanced perceptual abilities, their performance on tests that rely on these skills is better.

One study[11] assessed a broad sample of 38 autistic children on Raven's Progressive Matrices. Their scores were, on average, 30 percentile points, and in some cases more than 70 percentile points, higher than their corresponding scores on the Wechsler scales of intelligence. Typically developing control children showed no such discrepancy, and a similar contrast was observed when a sample of autistic adults was compared with a sample of nonautistic adults. They concluded that the intelligence has been underestimated in autistics.

A report on the structure of intelligence in children and adults with high functioning autism was carried out by conducting a confirmatory factor analysis of the traditional 11 subtests of the Wechsler child and adult intelligence scales.[12] The objective was determining whether HFA groups produced similar best fitting models to those found in the normative samples. They found that while the factorial structure of the Wechsler scales in autism is similar to the structures found in the general population, cognitive abilities are less strongly associated among each other in autism than is the case for typically developing individuals. The intellectual functioning of individuals with autism was then opined to be modular, based on this finding. The performance in one subtest does not necessarily predict performance in another for an individual with autism unlike in the normal population.

Individuals with autism are often considered to be "un-testable" due to various reasons including lack of comprehension of instructions and compliance.[13]

The difficulties associated with autism can confound the cognitive assessment of the individual and make it difficult to arrive at a true measure when testing for intelligence.[14] They have stated that matching IQ to controls in children with a neuro-developmental disorder creates unrepresentative groups. Either the neuro-developmental disorder group will have higher IQs than the population with that disorder or the control group will have IQ scores below normative expectations.

While attempting to match for IQ in autism research it is important to understand the factors that affect measuring of IQ among individuals with autism, the feasibility of accurate assessment and the SD of the IQ scores obtained in a group of individuals with autism.

The current paper explores the feasibility of using IQ as a fulcral measure in case-control studies of ASDs in our context. Research into autism in India is limited, and we need to explore such issues in the Indian context. Moreover, there is an urgent need to understand if the children with autism that we see in Indian clinical settings show IQ discrepancies as reported from other countries. Reports such as this will take us a step closer to this understanding.

MATERIALS AND METHODS

The sample consisted of 28 children in a clinical sample, in the age range of 5-12 who were attending special schools. A perusal of their medical records confirmed that they had been seen by psychiatrists or neurologists and had been diagnosed as having ASD. They scored between 12 and 29 on the Social Communication

Questionnaire (SCQ).[15] The average score on the SCQ was 19. Inclusion criteria were children rated as high functioning based on their teacher reports. Teachers were asked to look at the Coloured Progressive Matrices (CPM)[16] manual and decide whether their wards were capable of participating in the study. All had at least some verbal skills in terms of being able to identify some pictures/objects and indicate some of their basic needs. In another study from our center,[17] teacher estimate of mental age did correlate with children's Wechsler Intelligence Scale and when only nonverbal measures could be assayed to derive IQ, it still showed a significant relationship with adaptive behavior. These observations encouraged us to identify High Functioning Autism based on teacher report. Children with documented mental retardation and other prominent co-morbid diagnoses and those who were nonverbal were excluded from the study.

The selected children were administered the CPM[16] in the presence of at least one familiar adult. There were 4 girls and 16 boys in this sample. Scores were compared with scores of 21 typically developing children. The typically developing children were selected from the pediatric OPD at St. John's College Hospital and were of similar economic background as the children with autism. There were 6 girls and 15 boys in this sample.

The CPM is a standardized test of nonverbal intelligence developed by Raven and is considered to be a measure of fluid intelligence. During administration of the test, several modifications were required. Each child had to be given instructions in vocabulary that they were familiar with, for example, "match pictures" or "look for same."

RESULTS

Of the 28 children identified as high functioning by teachers, only 20 children could complete the CPM. Of the eight children who could not complete the CPM, four were unable to follow the instructions given by the examiner even when several demonstrations were carried out. Two were highly distracted and wanted to read the numbers on the pages and comment on the colors. Two refused to do the test.

The range of percentile scores on the CPM along with the SDs for the two groups is given in Table 1.

The percentile scores on the CPM for children with autism ranged from 5 to 95, with many falling in the 10th to 25th percentile [Figure 1], which was considerably below the norms for children in India[16] [Figure 2].

DISCUSSIONS

We have demonstrated the discrepancy between presumed higher functioning in children and their actual lowered performance on a standardized measure which avoids dependence on verbal skills to a good extent. It appears that even those children with autism who are presumed to be high-functioning have difficulty in performing on standardized intelligence tests. The CPM is considered relatively easy to administer to children with autism but it still may fail to estimate the child's true mental age as the teachers here clearly believed that these children were much closer to their age levels than shown by the CPM findings. It is possible that only those children clearly in the lowered percentiles

Table 1: Range of CPM percentile scores for the two groups (ASD and typical population)

Group	Number	Range	Mean and SD
ASD	20	5-95	22.25±26.679
Typical population	21	50-100	83.10±18.673

SD - Standard deviation, CPM - Coloured progressive matrices, ASD - Autism spectrum disorders

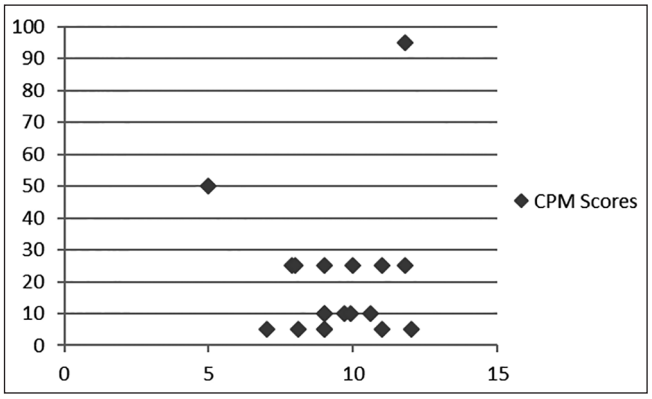

Figure 1: Scatter of Coloured progressive matrices scores of the subjects with Autism

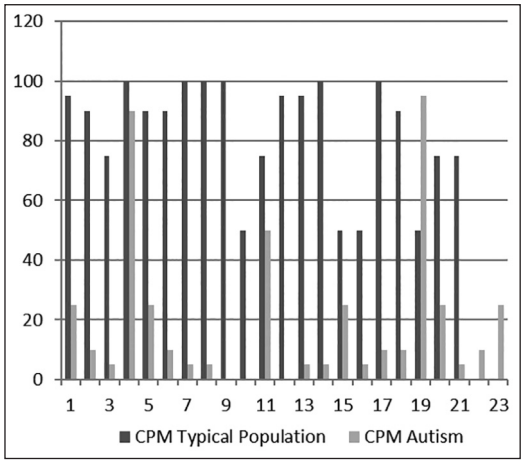

Figure 2: Comparison of colored progressive matrices scores of children with autism with those from typical population

of functioning seek admission in special schools. The teachers in such schools may grade children within their experience as high and low functioning. Thus, the children selected for this study may be a biased sample. Our own growing experience suggests that the 'truly high functioning' children may well be subsumed within regular school settings. This would bring in yet another challenge to case-control studies in our context. At the least, our findings cautions against the loose use of the term high-functioning autism in clinical and special school contexts in India.

Children with autism often find it difficult to focus on the instructions given for carrying out the test despite having adequate verbal comprehension. They tend to focus on minute details leading to wrong responses or incomplete tests and thereby lower scores. Moreover, their motivation levels can fluctuate during the process more than appears to occur with neurotypically developing children.

On a different note, CPM is reported to exaggerate mental age in typical developing children. Matching by equating performance on carefully designed control tasks[18] or using the parent reported adaptive behaviors as alternative global developmental indices[17] have been suggested by other researchers.

Assessment procedures for children with autism need to be designed bearing in mind unique cognitive profiles, tendency to get caught up in details and inadequate comprehension of verbal instructions, besides co-morbidities such as overactivity. Use of pro-rated IQ's as done in some studies[6] may not be ideal too as it has been shown that there is a low degree of correlation between subtests for children with autism.[12]

Case-control studies in this area may remain challenging. Using statistical methods to control for IQ, however artificial, may be one solution. This will be useful only with an accepted standard measure of IQ. Another alternative would be to devise tests that are more suited to the pattern of intelligence found among the children with autism and match their performance with that of controls on the same measure.

Intelligence quotient tests have traditionally been constructed to measure intelligence in the typical population. Maybe we should look beyond this and design tests more suited to the "cases" rather than the controls. Then matching for IQ might make more sense since we will be matching for IQ that reflects the IQ of the cases. Devising measures that are suitable to individuals with autism might provide us with a more accurate level of their global cognition. Another option would be if we had separate norms for children with autism just as the separate norms published for the Vineland Adaptive Behavior Composite.[19]

Matching on adaptive behavior scores and using nontimed tasks in those with reading or writing ability may help reduce the challenges when incorporating high-functioning subjects. This needs to be systematically explored in our context. It is possible that newer imaging markers of global intelligence using resting functional magnetic resonance imaging protocols may help better identify ideal control groups in order to evaluate role of specific cognitive aspects in autism.

CONCLUSIONS

Intelligence quotient despite controversies has remained an index of global cognitive ability though some researchers have matched for chronological age[20,21] or verbal, mental age.[22] As shown by our report here, nonverbal IQ measures may not do away with the challenges of IQ assessment in children with autism. There is a need to explore alternative methods of measuring the intelligence or global indices of cognitive functioning of children with autism. Case–control studies need to be clear about the meaning of the matching parameters and the theoretical basis for using global cognitive measures in specific studies.

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