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# *Readiness and Adjustments to School for Children With Intrauterine Growth Restriction (IUGR): An Extreme Test Case Paradigm*

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**ABSTRACT:** *This long-term, prospective study evaluated repeatedly school readiness and adjustment at kindergarten and first grade of children with extreme intrauterine growth restriction (IUGR;* n *= 20) in relation to controls (*n *= 19). Methods included individual testing of cognitive competence, self-perception, motivation, loneliness and academic achievements; parental anxiety and family-functioning; and teacher ratings of cognitive, emotional, and social adjustment. Children with IUGR had lower cognitive and achievement scores and frequent impulsivity. However, they experienced no socioemotional difficulties. Children in this group, particularly boys, who had mild cognitive difficulties, rule breaking tendencies, and social adjustment issues experienced academic adjustment difficulties during the first school year. Findings underscore a susceptibility of children born with extreme IUGR to develop learning difficulties, and highlight their initial socioemotional resilience.*

Children with specific biological and developmental risk factors, such as those born with intrauterine growth restriction (IUGR), are likely to experience adjustment difficulties. To date few research studies have been able to determine mechanisms affecting school adjustment in these populations. Basic questions regarding school adjustment of children with developmental disabili-

ties are not yet fully understood. These questions pertain to major issues such as what are the relationships between specific biological risk factors and specific domains of academic adjustment difficulties? Does risk for learning disabilities increase the risk for adjustment difficulties? What is the degree of dependence between cognitive and socioemotional adjustment? One of the more interesting models to study these questions is IUGR.

IUGR presents the child with an extreme adjustment challenge. IUGR is a prenatal condition characterized by unexpected low birth weight for the estimated gestational age (EGA) of the newborn infant. It is a biological process related typically to placental insufficiency, and is often detected from midpregnancy through birth via routine ultrasound imaging. IUGR occurs in 3% to 10% of all pregnancies (Leeson & Aziz, 1997; Pryor, 1997) and is thus fairly common. The most frequent inclusion criterion is birth weight < 10th percentile for EGA (Leitner et al., 2000; Pryor).

School adjustment for this particular group is at risk, from both emotional and cognitive perspectives. The development of these children is already compromised in the womb. These infants are characterized (and are essentially labeled) as extremely deviant from the norm, even prior to any social encounter. This is a significant emotional burden that has its own long-term consequences (Elgen, Sommerfelt, & Markestad, 2002; Geva, Eshel, Leitner, Fattal-Valevski, & Harel, 2005).

With regard to cognitive and academic achievements of children born with IUGR, this is currently under debate. On the one hand, some propose that IUGR-related deficits are not severe enough to cause secondary deficits: It has been reported that infants born small for gestational age displayed a reduced cognitive capacity in young adulthood, compared with controls. However, this lower capacity is not considered sufficiently severe to affect educational level or social adjustment (Viggedal, Lundalv, Carlsson, & Kjellmer, 2004).

Conversely, initial school years may witness difficulties: There are reports of increased susceptibility to learning problems and assignment to special education classes, indicating that developmental difficulties may become increasingly evident for these children in the early school years (Smedler, Faxelius, Bremme, & Langerstrom, 1992). This aspect of the debate relies on studies showing that children born with IUGR are reported to be significantly different from controls regarding measures of physical growth (Yanney & Marlow, 2004); neurodevelopmental skills (Leitner et al., 2000); and cognition (Geva, Eshel, Leitner, Fattal-Valevski, & Harel, 2006a). More specifically, IUGR is often associated with specific dysfunctions in the areas of fine motor and graphomotor ability (Leitner et al.); visuospatial functioning (Sommerfelt et al., 2002); language (Frisk, Amsel, & Whyte, 2002); executive functions; and attention and problem solving (Geva, Eshel, Leitner, Fattal-Valevski, & Harel, 2006b). These deficits have been interpreted as contributing particularly to cognitive performance and academic achievements. However, research has not focused directly on academic adjustment of children born with IUGR, or on emotional–social competence of children born with IUGR, except for a single report on social difficulties and low self-esteem among children with IUGR studied in northern Europe (Elgen, Sommerfelt, & Ellertsen, 2003).

This issue is also of particular interest in light of the broader question regarding long-term effects of IUGR on adjustment in general. Indeed, studies of individuals with full-term IUGR in adulthood are indicative of typical social functioning despite lower cognitive and occupational achievements (Strauss, 2000; Viggedal et al., 2004). These reports support the hypothesis that children born with IUGR may experience adjustment difficulties in school due to cognitive and learning deficiencies; however, their emotional–social adjustment may be sufficient to withstand this challenge. Thus, the study of academic and socioemotional adjustment of children with IUGR in kindergarten and in first grade should yield both theoretical and pedagogic implications.

## ADJUSTMENT TO SCHOOL

Adjustment difficulties may arise due to cognitive deficiencies (Entwisle & Alexander, 1989), specific learning disabilities, or lack of socioemotional resources to flexibly adjust to the novel educational setting (Foelling-Albers, 1980). For

many children, the effects of maladjustment persist (Hamre & Pianta, 2001; Mayfield, 1983). The most common behaviors associated with maladjustment are school phobia, inability to communicate effectively with peers and/or teachers, low achievements, and behavioral problems (Wertlieb, Weigel, & Feldstein, 1989). These symptoms bear grave consequences to the child, classmates, teachers, and family.

Parents and caregivers are often concerned about the ability of developmentally at-risk children to adjust to formal educational settings. Unlike in the United States, where kindergarten has become very much like first grade, in Israel, the transition from kindergarten (5–6 years of age) to first grade of school is more similar to the transition to kindergarten in the United States. This developmental milestone typically occurs in Israel at 6 years of age. It is a significant marker for several reasons, some being specific to the school system in Israel and others being more universal. In terms of Israel, this change marks a major school transition. At kindergarten, as in previous preschool years, children engage in loosely structured exploration and joint experiences in a flowing schedule. In first grade, they are confronted for the first time with direct instruction in a classroom, with all the academic, social, and emotional demands that accompany this change. Children must acclimate to an unfamiliar environment, including a new building, classrooms, classmates, and teachers. They are required to learn additional and different rules, and adjust to higher academic expectations (Donelan-McCall & Dunn, 1997). Furthermore, the transition requires rapid learning of specific symbol codes of written language and arithmetic procedural conventions.

The adjustment challenge is increased for developmentally at-risk children. From many perspectives this transition also marks an intervention change for them, from a focus on medical and paramedical treatments aimed at advancing sensorimotor and language development to an educational focus on academic achievements and socialization.

There are three dimensions of adjustment: (a) a learning dimension that includes adjustment to novel learning strategies and creativity; (b) a social dimension, associated with the child's interactions with other children and adults; and (c) an emotional dimension, reflecting the child's emotional coping with the novel environment and its demands (Smilansky & Shfatyah, 2001).

## PURPOSE OF THE PRESENT STUDY

In light of the distinctive range of impairments associated with IUGR, the aim of the current study was to examine, in supportive familial environments, the learning, social, and emotional adjustment of IUGR children in kindergarten and first grade, as evaluated by the children themselves, their parents, and teachers. The study was designed to deepen our understanding of three specific questions, each of which has ramifications that span beyond the current investigation:

1. *In view of the aforementioned indications of a unique cognitive and emotional profile, how does a unique subgroup of developmentally at-risk children, diagnosed at birth with extreme IUGR, adjust to kindergarten and to first grade?* This question entails the need to ascertain the degree of preparedness established at kindergarten of children with IUGR and controls, prior to entry in first grade. Several variables contribute to a child's preparedness for elementary school: cognitive abilities, educational exposure, socioeconomic status (SES), as well as other nonintellectual variables such as social and emotional readiness for transition (Kauffman & Kauffman, 1996; La Paro & Pianta, 2000). Social readiness for school refers to a child's social abilities, such as those of sharing and cooperating with peers (Derlak, 1983; Dunn, Cutting, & Fisher, 2002; Hartup, 1996; Parker & Asher, 1987; Rubin, Daniels-Beirness, & Bream, 1984; Welsh, Parke, Widaman, & O'Neil, 2001; Wentzel, 1993). Emotional readiness denotes a child's self-perception, motivation, and ability to stay calm and pay attention when necessary (Ladd, Kochenderfer, & Coleman, 1996). Thus, these domains of functioning (i.e., cognitive, social, and emotional dimensions) in kindergarten are predicted to contribute to adjustment to first grade. We hypothesize that children with IUGR will be less prepared cognitively for

school activities. This relative difficulty should be apparent already in kindergarten and maintained or even augmented during first grade. We expect that the cognitive domain will be significantly more affected than the socioemotional domains at these ages.

2. *What is the relationship between risk for learning deficits and adjustment difficulties to kindergarten and first grade?* It is hypothesized that children who have cognitive deficits and difficulty complying with rules will have greater adjustment difficulties in first grade. Consequently, children with IUGR are expected to have more significant adjustment difficulties.
3. *What is the association between cognitive and socioemotional adjustment to kindergarten and at first grade?* In light of the aforementioned literature, IUGR may have an impact on cognitive development at 6 years of age, but its effect may not be as pronounced on social–emotional adjustment to school. Thus (a) children with IUGR are expected to have lower cognitive competence than controls and exhibit more frequent impulsive behavior; (b) this difference may impede academic readiness, adjustment, and achievements. At the same time, in view of reports on adults who were born at term with IUGR, social–emotional adjustment, self-perception, motivation, and confidence within the social environment are not expected to be influenced by an IUGR factor at kindergarten and first grade. Nevertheless, it is hypothesized that the IUGR factor as well as learning and socioemotional adjustment scores attained at kindergarten would significantly predict academic adjustment to first grade.

## PARTICIPANTS AND METHODS

### *Sample*

Thirty-nine children from 30 kindergarten classes in the central urban area of Israel participated in this study. The study group comprised 20 children born with extreme IUGR (birth weight < 5th percentile), who were a subsample of a long-term follow-up study of factors related to IUGR (Geva et al., 2006a; Leitner et al., 2000). They were selected from the research registry according to their age (6 years) during their last 3 months of kindergarten. The control group comprised 19 children, matched for gender, SES, age, and maternal education as suggested specifically for IUGR studies (Morrison, Rimm-Kauffman, & Pianta, 2003).

The experimental group comprised participants with extreme IUGR measures, such that the neonatal birth weight of 12 infants was smaller than the 1st percentile for their gestational age and the birth weight of the remaining infants was smaller than the 5th percentile for their gestational age. Table 1 shows the distribution of participants according to gender and maternal education. Chi square analyses (Table 1) revealed no statistically significant differences between the groups regarding the demographic variables of gender, level of maternal education, familial structure, birth order, and family size.

Special care was invested in securing that both groups were characterized by comparable family relationships (i.e., familial adaptability and intrafamilial cohesion). To ensure that the expected differences in the children's performances would not be accounted for by these variables, we used a structured questionnaire designed for this purpose (Olson, Portner, & Lavee, 1983; Teichman & Navon, 1990).

A medical checklist, to ensure no occurrence of previous major medical complications or injuries during childhood, was administered to ensure performance was not related to any other relevant medical condition. Children's mothers were requested to complete medical questionnaires regarding their medical conditions; all participating mothers were healthy, with the exception of one in the control group. Two children were excluded from the study because their birth weight bordered on the 10th percentile (Leiberman, Fraser, Weitzman, & Glezerman, 1993).

Maturational factors are summarized in Table 2. As expected, there were differences in birth weight between the groups, such that mean birth weight of the IUGR group was in the 2nd percentile that is indicative of extreme IUGR, whereas that of the control group was at the ex-

**TABLE 1**

*Demographic Characteristics of the Intrauterine Growth Restriction (IUGR) and Control Groups*

| | *IUGR* | *Controls* | | |
|---|---|---|---|---|
| *Demographic Variable* | *%* | *%* | $\chi^2$ | p < |
| Gender | | | | |
| Female | 33.3 | 36.8 | | |
| Male | 66.7 | 63.2 | 0.050 | 0.50 |
| Maternal education | | | | |
| High school | 55.6 | 52.6 | | |
| College | 44.4 | 47.4 | 0.030 | 0.46 |
| Parental status | | | | |
| Single | 16.7 | 15.8 | | |
| Couple | 83.3 | 84.2 | 0.005 | 0.64 |
| First born | 50 | 52.6 | 0.026 | 0.77 |
| Number of siblings | | | | |
| 0 | 11.1 | 10.5 | | |
| 1 | 38.9 | 47.4 | | |
| 2 | 50 | 42.1 | 0.28 | 0.77 |

pected average level. All children were low-risk preterm and term children. Most children in both groups were born at term. Average gestational age was 36.6 and 38.7 weeks for the experimental and control groups, respectively. Despite significant differences between gestational ages of the groups, none of the participants was born before the 34th gestational week. Ages (in months) of the participants prior to school entry and at the end of first grade were comparable at both testing ages. Table 2 presents mean and standard deviations of infants' demographic variables and a summary of *t* tests conducted on these variables. All participants were born and resided in communities that were rated as middle SES according to the governmental statistical registry for communities (IUGR standardized SES score = 0.6636 ± 0.3683, and control standardized SES score = 0.8267 ± 0.3383, $t = -1.302$, $p = .203$). All subjects attended regular classes in a public school in their corresponding residential area. All public schools in Israel employ eclectic reading acquisition programs, through which children are expected to acquire phonological reading–decoding by spring vacation of first grade. Testing was conducted shortly after this period. Of the participating cohort, only one participant from the IUGR group was receiving individual occupational therapy.

**TABLE 2**

*Maturational Variables of Intrauterine Growth Restriction (IUGR) and Control Groups*

| | *IUGR* | | *Controls* | | | |
|---|---|---|---|---|---|---|
| *Variable* | M | SD | M | SD | t | p < |
| Gestational age (weeks) | 36.66 | 2.32 | 38.73 | 1.93 | 2.95 | .006 |
| Birth weight (percentile) | 2.47 | 2.53 | 51.61 | 25.27 | 9.36 | .001 |
| Postconception age (months) | | | | | | |
| Kindergarten | 74.88 | 3.04 | 74.21 | 2.76 | 0.71 | .91 |
| First grade | 84.00 | 3.61 | 82.67 | 2.87 | 1.15 | .36 |

*MEASURES*

Procedures used were carefully selected to reflect children's competences and perceptions, parental perceptions, as well as educational perspectives. Therefore, a full battery of tests was administered. This included the following:

1. Wechsler Preschool and Primary Scale of Intelligence (WPPSI; Wechsler, 1979 [Hebrew version]). The full battery of tests was administered to the experimental group by a trained developmental psychologist at kindergarten. The four-test short form, comprising a block design, (original Israeli sample $\alpha = 0.82$), vocabulary (original Israeli version $\alpha = 0.41$), comprehension (original Israeli version $\alpha = 0.36$), and arithmetic tests (original Israeli version $\alpha = 0.76$) was used to estimate IQ in the control group (Tsushima, 1994).
2. Academic Achievement Scale of the Kauffman Assessment Battery for Children (K-ABC; Kauffman & Kauffman, 1996 [Hebrew version]). This scale is designed to evaluate reading–decoding, reading–understanding, arithmetic, and verbal abilities using independent tests for each domain. Reliability scores for various scale tests for the original Israeli version were $\alpha = 0.95$ at 6 years of age and $\alpha = 0.97$ at 7 years of age.
3. Tower of London test for the neuropsychological evaluation for children (NEPSY), a developmental neuropsychological assessment (Korkman, Kirk, & Kemp, 1998). This is a problem-solving test that relies on prospective planning of multistep problems. It has been reported also to have high validity in that it has been shown to be highly sensitive and highly specific in children with attention deficit hyperactivity disorder (ADHD; Culbertson & Zillmer, 1998). Reliability of originally reported coefficient is $\alpha = 0.90$ at 6 years of age (Korkman et al.). Performance is timed. Scores were coded using standardized scores. In addition, error types were coded for rule-breaking attempts (i.e., when the child grabbed two balls simultaneously, placed a ball on the table, or attempted to stack balls on a too-short stem).
4. Socioemotional composite was composed from three measures: The first measure was the loneliness and peer relations questionnaire for young children (Cassidy & Asher, 1992), a closed interview (comprising 23 items) for children. Children were asked to rate their degree of agreement with the various items. In order to improve response validity, three cups with three different levels of colored fluid were used as aids for the children to code their responses ("no fluid" represented no; "half-full" represented sometimes, and "full cup" represented yes). Reliability coefficient in the present cohort was higher than the original Israeli reports ($\alpha = 0.79$ in the original Israeli reports vs. $\alpha = 0.90$ in this study). The second measure was the Picture Motivation Scale for children (Haywood, 1971). We used a subset of this test comprising 12 pairs of pictures that depict internal motivation and external orientation of motivation (Tzuriel & Klein, 1983). Cronbach's reliability coefficient in the present sample was $\alpha = 0.79$ after three items were removed because they did not correlate with overall test score. The third measure was a "He is . . . I am . . ." test (Hebrew version and picture adaptation by Bennett-Yovel, 2001), which is a picture questionnaire test designed to assess self-image regarding physical, emotional, academic, and social performance for young children. Reliability coefficient in the present cohort was Cronbach $\alpha = 0.70$.
5. Adjustment scale of children to kindergarten and school for teachers (Smilansky & Shfatyah, 2001). This rating scale was administered by a trained researcher to both the kindergarten and first-grade teachers of each participant. Each teacher rated the child's academic, social, and emotional adjustment domain. In the current study reliability coefficients for each domain were $\alpha = 0.81$, $\alpha = 0.71$, and $\alpha = 0.76$, respectively.
6. Parenting Stress Index (PSI; Abidin, 1995) is an extensively used index based on a parental questionnaire comprising 120 items and is designed to estimate stress related to the child, stress in the parental arena, and stress

due to daily life events. Parents were asked to complete the questionnaire during the home visit. Originally reported reliability for the total scores was $\alpha = 0.90$.

7. Family Adaptability and Cohesion Evaluation Scales, 3rd edition, (Olson et al., 1983; Teichman & Navon, 1990 [Hebrew version]). This is a 20-item scale administered via a structured interview by a trained researcher evaluating parental perception regarding familial functions. Items are rated by the parents on a five-level scale. Composite scores of familial cohesion and adaptability to change are computed. Composite scores range from 0 to 50. Previous Israeli samples were Cronbach $\alpha = 0.72$ for the adaptability score and $\alpha = 0.76$ for cohesion score (Peleg-Popko & Dar, 2003). Analysis showed that the present study groups were characterized by good interpersonal relationships, IUGR group mean, 42.29 ± 3.65; control group mean, 42.55 ± 4.05; $F_{(1, 34)} = 0.03$, $p = .515$; and high adaptability to change of both groups, IUGR and controls, mean 29.24 ± 6.95 and 31.66 ± 5.59, respectively, $F_{(1, 34)} = 0.13$, $p = .716$. Multivariate analysis of variance (MANOVA) showed that there were no prior differences between the groups on either measure, $F_{(2, 33)} = 0.65$, $p = .707$.

### *Procedure*

The experimental group was recruited at birth by neonatologists as part of a comprehensive study on the effects of IUGR. This group was followed up prospectively from birth to 7 years of age. Follow-up program entailed a yearly check-up evaluation by a pediatric neurologist and a psychologist. Intervention recommendations were made whenever clinically appropriate. All participants were enrolled in typical Israeli preschool programs. The control group was recruited at 6 years of age from 13 kindergarten classes located in the same geographical areas as the experimental group. They were randomly selected using school registries to match maternal education and residential areas. Children in both groups were evaluated at their homes twice, prior to school entry and at the end of first grade, by a research assistant who was a highly experienced special education teacher. The first evaluation of the children included individual psychoeducational assessment of school readiness, cognitive abilities (verbal and visual–constructive), problem solving, self-perception, intrinsic motivation, loneliness, and academic achievements. The second psychoeducational evaluation of the children included self-perception, intrinsic motivation, loneliness, and academic achievements. In addition, all mothers completed anxiety and family function questionnaires when the participant entered kindergarten, and first-grade teachers graded each child's learning adjustment. Social and emotional adjustments were evaluated in kindergarten and in first grade. All participating children, parents, and teachers completed the full protocol.

### *Analysis*

The first hypothesis that children with IUGR are lacking in the degree of readiness prior to transition to school was tested by examining levels of cognitive development, problem solving, rule-breaking tendencies, and reading readiness at kindergarten. Differences between the IUGR and control groups on the outcome measures of cognitive abilities (estimated IQ), impulsivity (number of Tower of London impulsive rule breakings), problem solving (standard scores of Tower of London), reading readiness (standard scores of K-ABC reading–decoding test) at kindergarten were first analyzed by *t*-test comparisons for independent samples. Analysis of variance of group mean differences was then performed on academic achievement domains (achievement scaled scores of the K-ABC battery) and adjustment to academic environment at first grade as a function of preparedness components at kindergarten. To test for the second hypothesis, significant differences were then evaluated by multivariate analysis of covariance (MANCOVA) to adjust differences for the effects of baseline cognitive competence on performance. To test the effect of transition to school on the two groups, repeated measures were used to evaluate differences in performances between kindergarten and first grade. The hypothesis tested was that children with IUGR would be affected by the transition to a greater degree than the controls.

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The third hypothesis pertained to the differential effect of IUGR on cognitive abilities relative to the socioemotional domains. To test this hypothesis, emotional and social variables (e.g., self-perception, intrinsic motivation, loneliness, and adjustment) were first analyzed for group differences at kindergarten and at first grade. In view of the study's hypothesis, these domains were expected to be less affected by IUGR relative to the cognitive domains. The socioemotional factors pertaining to the child were then analyzed by MANOVA, with group and gender as a between-subject factor. Finally, MANOVA with repeated measures was performed to compare performances at kindergarten and first grade as a function of the transition. Hierarchical regression models were used to examine the predictive power of IUGR and adjustment capacities at kindergarten on academic adjustment and reading achievements at first grade.

## RESULTS

### *Cognitive Abilities*

The primary hypothesis of the study was that IUGR may have an impact on cognitive development at kindergarten and at first grade, but its effect may not be as pronounced on social–emotional adjustment at first grade. On average, IQ performance was within normal limits for all participants (score range = 75–132, *SD* = 13.429). There was a significant difference in IQs between the groups, such that children from the IUGR group scored significantly lower than those of the control group (IUGR mean 105.11 ± 13.852, control group mean 115.32 ± 13.852; $t = -2.468$, $p < .019$). In order to find IUGR-related differences in cognitive abilities prior to first grade entry, MANOVA was conducted, $F_{(1, 38)} = 3.338$, $p < .013$, partial Eta squared = 0.409. The analysis revealed a significant difference between the two groups in cognitive abilities as a function of IUGR status, $F_{(2, 34)} = 6.51$; $p < .01$, partial Eta squared = 0.20. Univariate analysis of variance (ANOVA) on each cognitive variable suggested that mean estimation scores of IQ, $F_{(1, 35)} = 11.78$, $p < .05$, partial Eta squared = 0.20, and problem solving on the Tower of London scores of the IUGR group were lower than those of the control group, $F_{(1, 35)} = 6.89$; $p < .005$, partial Eta squared = 0.199. On average, problem solving of Tower of London was lower than the level expected for IQ in the IUGR group, and at a normal level for the controls (means for IUGR and controls = 7.72 ± 2.164 and 9.95 ± 2.916, respectively). Univariate ANOVA showed that the interaction between grouping, gender, and IQ was significantly affecting Tower of London standard scores, so much so that boys in the IUGR group had greater difficulties in problem solving the Tower of London test particularly when their IQ scores were lower, $F_{(1, 29)} = 4.368$, $p < .006$, partial Eta squared = 0.353. These data provided support for the preliminary part of the first hypothesis.

### *Impulsivity in Kindergarten*

To test the hypothesis that children with IUGR are expected to exhibit more frequent impulsive behavior, we conducted an analysis of impulsive rule-breaking rate during performance on the Tower of London test. Children's performance was coded for impulsivity whenever impetuous performance did not comply with the rules of the test (e.g., two balls were taken simultaneously, a ball was put at a specific spot other than at the pegs, and a ball was put on top of an overly short peg). The mean number of rule-breaking errors of the IUGR group ($M = 3.47$, $SD = 1.62$) was on average double that of the controls ($M = 1.94$, $SD = 1.39$). One-way MANOVA demonstrated a significant difference in breaking the rules between the two groups, $F_{(1, 34)} = 9.17$, $p < .01$, partial Eta squared for group effect = 0.21. The analysis of covariance (ANCOVA) for the dependent measure of impulsive rule breaking was conducted with the standard score of the Tower of London test. This score was entered as a covariate to ensure rule-breaking differences were not accounted for by the

intercorrelation between the standard score of the Tower of London test and the impulsive rule-breaking score. This analysis also demonstrated a significant difference between the two groups, $F_{(1, 33)} = 6.48$, $p < .05$, partial Eta squared for group effect = 0.16. Hence, the analysis of error type was efficient in showing hypothesized group differences (i.e., the IUGR group was more impulsive than the control group prior to the transition to school). These data support the second hypothesis.

### *Transition From Kindergarten to First Grade*

*Academic Achievements—Reading.* Reading achievements were measured twice—at kindergarten and at first grade. Comparison of reading achievements prior to school entry showed that there were group differences in reading readiness, $F_{(1, 28)} = 4.24$, $p < .05$, partial Eta squared for group effect = .11. Reading–decoding achievements of the IUGR group were significantly lower than those of the control group (mean standardized scores were 84.5 ± 12.08 and 92.44 ± 11.03, respectively). This difference is both statistically and clinically significant (Figure 1).

An ANCOVA was conducted to examine whether differences prior to school entry were augmented or rather alleviated during the first year of school, with kindergarten reading achievements entered into the analysis as a covariate to control for initial baseline differences. This analysis allowed examination of differences in change of reading skills over time, while controlling for baseline differences between the groups at kindergarten. This analysis did not reveal significant differences over time. Initial disadvantage of the IUGR children prior to entry to school was preserved throughout the first year of school, $F_{(1, 27)} = 0.17$, $p = 0.66$, partial Eta squared for group effects < .1.

Differences in the degree of progress in reading during the first grade of both groups were evaluated by ANOVA 2 × 2 (time × group) with repeated measures. This analysis showed significant differences over time; both groups had improved age-dependent standard reading–decoding scores at the end of the first grade, but the disparity between the groups was maintained, $F_{(1, 28)} = 95.28$, $p < .001$, partial Eta squared for group effect = 0.77, indicating a strong effect; the interaction factor of group by time was not significant.

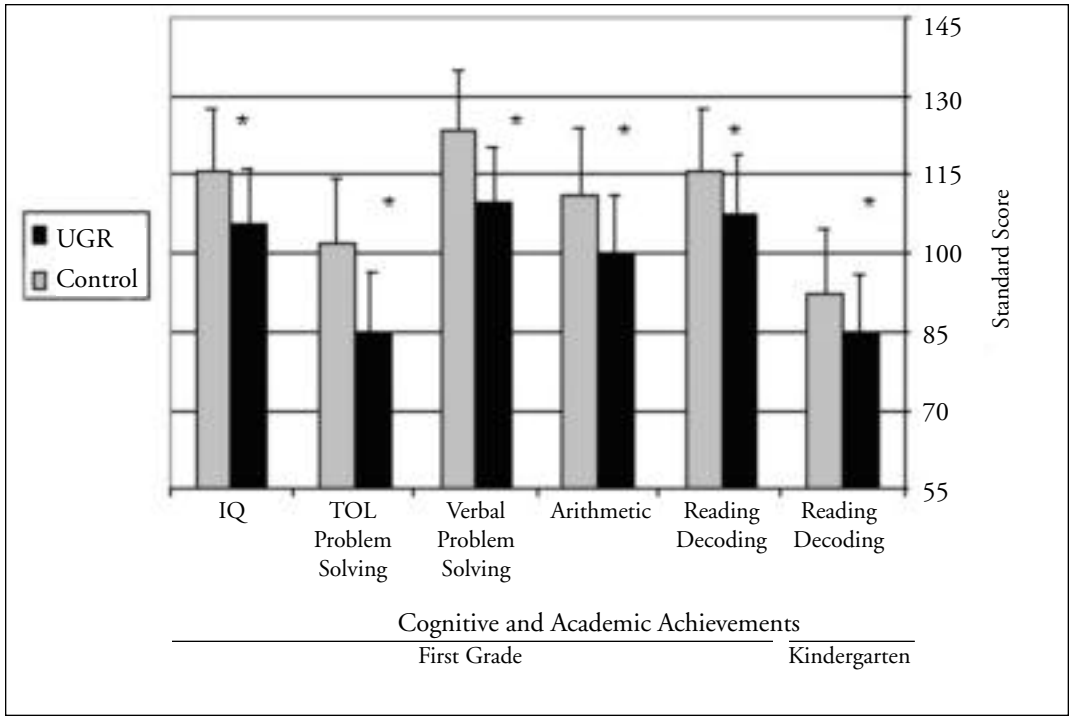
*Academic Milestones Achieved by the End of First Grade.* Academic achievements scale in first grade included general information, verbal analogies, persons and places, riddles, reading–decoding, reading–comprehension, verbal opposites, and arithmetic subtests of the K-ABC (Kauffman & Kauffman, 1996 [Hebrew version]). The full achievement scaled score of the K-ABC was analyzed as a function of IUGR grouping. The ANOVA revealed significant differences between the groups, $F_{(1, 29)} = 8.21$, $p < .01$, partial Eta squared for group effect = 0.22 (Figure 1). Mean achievement scale scores in the IUGR group were within the normal range at the end of first grade (103.15 ± 16.23), but they were significantly lower than in the control group (116.77 ± 10.25). On average the difference between the two groups aggregated to one standard deviation from the mean. Nevertheless, ANCOVA of academic achievements at the end of first grade with IQ as a covariate revealed that variances in academic achievement were due to the cognitive discrepancy between the groups rather than to the transition stage itself (Table 3), $F_{(1, 28)} = 0.05$, $p = .816$.

*Socioemotional Abilities.* To test the hypothesis that IUGR would not affect socioemotional factors during the transition to first grade, an array of socioemotional abilities at kindergarten and at the end of first grade were analyzed. Emotional abilities were evaluated by five independent measures: self-perception, intrinsic motivation, loneliness, social–emotional, and learning adjustments to kindergarten and first grade. First, ANOVA was conducted to test an a priori difference between the groups at kindergarten on these measures. Scores on these measures were in the normal expected range. One-way MANOVA did not yield significant differences between groups on any of the emotional dependent measures prior to entry to school, $F_{(6, 30)} = 1.52$, $p$s > .05, partial Eta squared for group effects < .001. This finding supports the latter part of the first hypothesis regarding absence of a priori difference between groups prior to school entry in this domain.

In order to test for differences in socioemotional adjustment as a function of the transition to first grade, we conducted MANOVA 2 × 2 (time × groups) with repeated measures over

**FIGURE 1**

*Cognitive and Academic Achievements at Kindergarten and First Grade as a Function of Group*




*Note.* TOL = Tower of London test. * = $p < .05$.

time. This analysis demonstrated the absence of a significant interaction between time and group, indicating that both groups adjusted emotionally to first grade in a similar fashion, $F_{(6, 24)} = 0.15$, $p = .67$, partial Eta squared for group effects < .001. In order to examine if adjustment differs as a function of time, providing the scores are adjusted for differences in baseline (kindergarten) scores, MANCOVA with kindergarten respective scores was conducted. The analysis revealed no significant differences between the first and second time points in emotional adjustment (self-perception, intrinsic motivation, loneliness, and adjustment) between the two groups. Albeit, the MANOVA did show significant differences between these measures as a function of time, $F_{(6, 24)} = 3.18$, $p < 0.05$, partial Eta squared for group effects = .018, < .001, < .001, and .003 respectively, indicating weak effects sizes. Thus, both groups demonstrated similar moderate improvements in their emotional abilities of adjustment to first grade during the first year of school, $F_{(1, 30)} = 7.095$, $p < .012$, partial Eta squared = 0.191, and in their academic adjustment, $F_{(1, 30)} = 4.139$, $p < .051$, partial Eta squared = 0.121.

### *Academic Adjustment to First Grade*

In order to test the second hypothesis, MANCOVA for academic adjustment at the end of first grade was highly significant and accounted for 63.5 of the variance explained (Table 3). This model included IQ scores, rule-breaking tendencies on the Tower of London test, social adjustment scores at kindergarten, and the group-by-gender interaction term. Each term had relatively high power and added significantly to the variance explained.

Hierarchical regression analysis to predict academic achievements in first grade was also statistically highly significant as predicted (Table 4). Furthermore, using kindergarten adjustment scores to predict academic adjustment at first grade proved to be highly fruitful. Hierarchical regression analysis (Table 5) with social adjustment scores at kindergarten entered into the analysis in addition to cognitive competence, impulsivity in-

**TABLE 3**

*Hierarchical Regression Analysis Predicting Academic Adjustment of Children Born With Intrauterine Growth Restriction (IUGR)*

| | | | | | Change Statistics | | | | |
|---|---|---|---|---|---|---|---|---|---|
| *Model* | R | $R^2$ | *Adjusted* $R^2$ | *Standard Error of the Estimate* | $R^2$ | F | $df^1$ | $df^2$ | *Sig.* F |
| 1 | 0.794[a] | 0.630 | 0.576 | 0.49909 | 0.630 | 11.510 | 4 | 27 | 0.000 |
| 2 | 0.793[b] | 0.630 | 0.590 | 0.49060 | –0.001 | 0.055 | 1 | 27 | 0.816 |

*Note.* Sig. = significance.

[a]Predictors: (Constant), experimental group, learning adjustment at kindergarten, emotional adjustment at kindergarten, intelligence quotient. [b]Predictors: (Constant), learning adjustment at kindergarten, emotional adjustment at kindergarten, intelligence quotient.

dicated by rule-breaking behavior on the Tower of London test, and the interaction term between group and gender was highly statistically significant. Each term has significant moderate to high power in accounting for the variance in academic adjustment. The model accounts for 63.5% of the variance explained in academic adjustment in first grade.

## DISCUSSION

Parents and educational professionals are often concerned regarding potential difficulties that children born with a developmental risk may experience during the transition to school. In general, research on school adjustment of children diagnosed with IUGR has not yet been studied. This study is a response to recent calls to investigate school adjustment of children with IUGR in light of growing interest in the IUGR process (Mikkola et al., 2005). There are four main contributions that the present study addressed: (a) better understanding of the IUGR pathogenic process; (b) investigation of the relationships among risks for learning deficits, socioemotional profile, and adjustment difficulties; (c) addition to the theoretical debate regarding the dependency between cognitive and socioemotional processes, by use of unique procedural controls; and (d) study of the question at hand in specific cultural and educational settings. Each of these issues

**TABLE 4**

*Multivariate Analysis of Covariance (MANCOVA) for Reading Achievements of Children Born With Intrauterine Growth Restriction (IUGR) at the End of First Grade*

| *Source* | *Type III Sum of Squares* | df | MS | F | *Sig.* | *Partial Eta Squared* | *Observed Power* ($\alpha < .05$) |
|---|---|---|---|---|---|---|---|
| Corrected model | 4612.185 | 5 | 922.437 | 8.966 | 0.000 | 0.651 | 0.999 |
| Intercept | 136.252 | 1 | 136.252 | 1.324 | 0.261 | 0.052 | 0.197 |
| Group × gender | 1675.846 | 3 | 558.615 | 5.429 | 0.005 | 0.404 | 0.892 |
| Rule-breaking (Tower of London error rate) | 738.103 | 1 | 738.103 | 7.174 | 0.013 | 0.230 | 0.729 |
| IQ | 1704.431 | 1 | 1704.431 | 16.566 | 0.000 | 0.408 | 0.974 |
| Error | 2469.282 | 24 | 102.887 | | | | |
| Total | 384298.000 | 30 | | | | | |
| Corrected total | 7081.467 | 29 | | | | | |

*Note.* Adjusted $R^2$ of the full model = 0.579. Sig. = significance.

**TABLE 5**

*Multivariate Analysis of Covariance (MANCOVA) for Academic Adjustment at the End of First Grade of Children Born With Intrauterine Growth Restriction (IUGR)*

| *Effect* | *Wilks's* Λ *Value* | F *exact Statistic* | *Hypothesis* df | *Error* df | *Sig.* | *Partial Eta Squared* | *Observed Power* ($\alpha < .05$) |
|---|---|---|---|---|---|---|---|
| Intercept | 0.866 | 1.706 | 2 | 22 | 0.205 | 0.134 | 0.319 |
| Group x Gender | 0.538 | 2.668 | 6 | 44 | 0.027 | 0.267 | 0.810 |
| Social adjustment | 0.723 | 4.216 | 2 | 22 | 0.028 | 0.277 | 0.678 |
| Rule breaking (Tower of London) | 0.767 | 3.338 | 2 | 22 | 0.054 | 0.233 | 0.570 |
| IQ | 0.464 | 12.724 | 2 | 22 | 0.000 | 0.536 | 0.992 |

*Note.* Adjusted $R^2$ of the full model = 0.635. Sig. = significance.

will be addressed taking into consideration the currently available literature.

### *Focus on School Performance of Children Diagnosed at Birth as Having Extreme IUGR*

The first hypothesis of the study concentrated on IUGR effects on cognitive and socioemotional capacities. The study focused on children whose growth was extremely restricted during pregnancy. The prenatal growth of the majority of these children was at or below the 1st birth weight percentile for their determined EGA. A direct study of the effects of extreme IUGR on development and adjustment was possible due to several important characteristics of this experimental project: (a) risk level was determined prospectively by a known physiological process, and not by outcome, without confounding effects of selective educational concern or clinically based referrals; (b) the sample population was characterized by good prenatal care which is freely available to all infants, good nutritional status, lack of teenage pregnancies, and typically good parental care; and (c) all the study participants were characterized by good intrafamilial relationships. Thus, it was possible to study the effects of IUGR.

School adjustment for this particular IUGR group is an important developmental junction, from both emotional and cognitive perspectives. In the emotional domain there are indications, on the one hand, of significant emotional stress (Elgen et al., 2002; Geva et al., 2005), and conversely, some indications for emotional resilience in adulthood (Viggedal et al., 2004). This dilemma was directly tested in the current study at a time that poses stress for all children, the "going to school for the first time" milestone. This transition may be particularly stressful to children diagnosed with IUGR, as they are known to have specific neurocognitive deficits from the beginning. Our study demonstrated that children, particularly boys, diagnosed with IUGR, who have some mild cognitive difficulties, rule-breaking tendencies, and social adjustment issues are at risk for academic adjustment difficulties during the first school year and thus supported the second hypothesis. Effect sizes indicate that the risk is mild but statistically significant. The implications of the above findings are briefly discussed below.

### *Cognitive Abilities*

The first hypothesis postulated lower cognitive competence of children born with IUGR relative to controls. Indeed, results demonstrated that the IUGR group had significantly lower cognitive abilities than those of the control group. These current findings from Israel are consistent with previous studies conducted by other research groups in the United States (Frisk et al., 2002) and Spain (Puga, Longas, Romero, Mayayo, & Labarta, 2004). The results also complement reports on adults born with IUGR in Sweden who have lower cognitive competence (Lundgren, Cnattingius, Jonsson, & Tuvemo, 2003; Viggedal et al., 2004). These data may imply that IUGR impedes cognitive development by mildly reduc-

ing the probable expression of the child's full genetic potential.

### *Impulsivity and Rule-Breaking Tendencies*

As hypothesized, IUGR children exhibited significantly more impulsive behavior prior to entering first grade compared to controls. Children with IUGR tended to break the rules twice as often as the controls. A certain difficulty in problem solving and planning, evident in the Tower of London test, has been described in children with ADHD (Culbertson & Zillmer, 1998); it was recently reported in children born prematurely (Deforge et al., 2006) and in children diagnosed with IUGR in the third and fourth grades (Geva et al., 2006a, 2006b). In the current study we found that this difference appears already at 6 years of age. Furthermore, we found that the difference between the groups was significant even when scores were adjusted for overall difficulty differences to solve the presented problems, using the standard score as a covariate in the analysis. Comparable results were recently shown to indicate a susceptibility to be diagnosed with learning disabilities (Sikora, Haley, Edwards, & Butler, 2002; van der Schoot, Licht, Horsley, & Sergeant, 2000).

A rule-breaking deficit detected in the current study also highlights the factor of impulsivity in children with IUGR. Impulsivity affected their performance above and beyond their greater cognitive difficulty in trying to solve complex problems. It also contributed to the variance explained in academic achievements and in academic adjustments rated by the teachers. Indeed, impulsivity may account for reports on regulation difficulties and behavioral problems at school of children born with IUGR (Elgen et al., 2002). Because impulsivity may also prevent efficient problem solving, hamper cooperation with peers, and reduce adjustment to school in later years (Lauth & Mackowiak, 2004), this difficulty may be in educational settings.

Nevertheless, it has been noted that the rule-breaking deficit detected via individual testing was not correlated in the teacher's socioemotional ratings at this age. Such lack of interdependence between individual evaluation with the Tower of London and other measures of executive control was also found in a cohort diagnosed with ADHD. This finding has been interpreted as resulting from the unique character of the Tower of London task that taps different aspects of behavior (Riccio, Wolfe, Romine, Davis, & Sullivan, 2004).

### *Socioemotional Abilities: Self-Perception, Intrinsic Motivation, Loneliness, and Adjustment to Kindergarten and First Grade*

The latter part of the first hypothesis was concerned with the IUGR effect on socioemotional capacities. The current findings showed that despite the children being physically small, having some mild cognitive difficulties, greater impulsivity tendencies, and lower achievements in reading (decoding and comprehension) and in arithmetic, both in kindergarten and in first grade, their other domains of adjustment functions such as self-esteem, motivation, and emotional and social adjustment are hitherto preserved. Thus, findings may imply that children who are at some risk for learning disabilities are not necessarily at greater risk for generalized adjustment difficulty at an early stage, but rather are more susceptible to an isolated deficit initially that is directly expected from their neurocognitive deficit on entry to school. These findings complement findings on adults born with IUGR in Israel (Paz et al., 1995) and in Great Britain (Strauss, 2000) during the second and third decade of life. Moreover, social adjustment at kindergarten contributed to the variance explained in academic achievements and in academic adjustments. This discovery underscores the importance of social competence as a mediator of scholastic performance.

In the present study, both the IUGR and control groups demonstrated high self-esteem at 6 and 7 years of age. Such high self-perception qualities were also reported by Glanz (1981) with other cohorts at this age. The scores were well-correlated with very positive social relationships reported by the children. This is an important finding. Both groups of children experienced the challenging phase of transition from kindergarten to first grade similarly, as a positive transition.

The stability of self-perception qualities found in the present study from kindergarten to first grade is impressive, particularly as some of the children experienced difficulties. Children in the IUGR group, particularly boys, experienced cognitive and learning difficulties as well as difficulty in complying with rules. However, their self-perception regarding self-efficacy and self-competency, as well as social networking, were typical for their age. Self-perception and social confidence were evidently resilient to the effects of IUGR and mediated efficient transition at this age.

### *Interdependence Between Cognitive and Socioemotional Competences*

The results of the current study strongly allude to an interdependence between cognitive and self-regulation difficulties and socioemotional competence. The third hypothesis of the study pertained to a certain degree of interdependence between cognitive and socioemotional domains. A recent data-driven hypothesis postulated some dependence between cognitive and socioemotional domains in children with learning deficits (Lackaye & Margalit, 2006). Our study highlights some degree of independence, which is not often reported (Murray & Greenberg, 2001). These findings may reconcile the debate regarding the dependence between cognitive and socioemotional competences. Data demonstrate a mismatch between IUGR-related cognitive and self-regulatory capacities, which are somewhat low on the one hand, and at the same time a notable socioemotional resiliency that seems to prevent "slippage" of both cognitive and socioemotional functioning during the transition from kindergarten to first grade. This discrepancy between cognitive and socioemotional adjustment found for children born with IUGR has intervention implications, as it may imply that social–emotional skills may be harnessed to intervene with academic performance (Greenberg et al., 2003; Lackaye & Margalit).

This finding of a relative independence of the socioemotional dimension, supported by multiple measures, is highly important for several reasons: First, theoretical implications may be considered regarding the unique contribution of each of these domains, socioemotional and cognitive, to the child's adjustment, and their interdependence, particularly in boys. In the present study we invested a great deal of effort (via individual interviews with the parents) to carefully select the two experimental groups, which are characterized by good familial cohesion and appropriate readiness to accommodate change. The compatibility between the groups on parental, familial, and social characteristics made it possible to show independence between the neurologically based learning and self-regulation deficits affecting academic achievements and academic adjustment in children with IUGR. Thus, the salient socioemotional cognitive discrepancy found in the current study has methodological implications for studies with at-risk groups in that it reaffirms the importance of controlling confounding factors that accompany the primary independent factor (Geva et al., 2005).

*Moreover, social adjustment at kindergarten contributed to the variance explained in academic achievements and in academic adjustments.*

From an educational point of view, parents of both groups provided an equally good supportive environment to facilitate their children's adjustment. These qualities may have served as a solid protective base that permitted direct examination of the independent variables of the study (i.e., the effect of IUGR). The current results elaborate the understanding of the importance of emotional support in the first-grade classroom, alluded to by Hamre and Pianta (2005), by highlighting the vital familial contribution to this domain for children who are at risk of school failure.

Finally, the socioemotional resilience may be a unique feature of the life-span consequences of IUGR, in that it complements phenomena perceived in adults born with very low birth weight—so much so that they tend to have lower occupational placements, lower educational achievements, and have specific health problems; however, they are not less happily married and/or socially satisfied (Hack, 2006). In this sense, the findings of the current study complement the

current literature with regard to outcome of very low birth weight individuals.

### *Academic Achievements*

Achievements in reading (decoding) prior to beginning first grade were significantly lower, though still within the normal range, in the IUGR versus control groups. Lowered academic achievements evident in both reading and arithmetic at first grade, some due to an a priori deficit detected in kindergarten, were found in boys diagnosed with IUGR who have a priori cognitive deficits and social adjustment difficulties. The magnitude of the deficit is maintained at a constant level throughout first grade. Nevertheless, overall, IUGR children were able to gain knowledge and realize their cognitive abilities during first grade.

These results complement recent reports of the academic achievements of very preterm born children in whom deficits were noted only in reading skills (Kirkegaard, Obel, Hedegaard, & Henriksen, 2006). It is plausible that infant programming processes related to unsatisfactory preterm growth affect specific brain maturation processes that compromise the ability to manage acquisition of reading and basic arithmetic concepts.

Is this neurocognitive deficit augmented by mere transition to school? It appears not. In contrast to our hypothesis that academic adjustment of children with IUGR would be more affected by the transition to first grade than controls, the results showed no difference between the groups on academic adjustment variables. Our hypothesis is that good emotional and social abilities, as well as family support, reduced the IUGR risk factor effect (Walker, Chang, Powell, & Grantham-McGregor, 2004) and enabled the children to steer their energy toward learning and academic adjustment at this age.

Moreover, it is highly plausible that as academic demands increase in upper grades, achievements of the children born with extreme IUGR would have greater challenges in view of cognitive susceptibility. Furthermore, although academic achievements of first-grade children with IUGR were within the normal range, the findings of impulsivity and difficulties in problem solving could augment learning difficulties at later ages, as was recently reported in children with IUGR at ages 9 to 10 (Geva et al., 2006a; Hollo et al., 2002) and at 14 years of age (O'Keeffe, O'Callaghan, Williams, Najman, & Bor, 2003). As the IUGR children mature, we recommend continual monitoring of their academic achievements and adjustments to changing school requirements, and to initiate preventative intervention as early as required.

### *An Ecological Note: Focus on School Adjustment in Israel*

The setting in Israel offers two unique windows to study school adjustment of children with IUGR. First, social and cultural characteristics of parents of Israeli-born children with IUGR are different from cohorts located in other countries, in that they are characterized by relatively low-risk factors, such as nutritional intake deficits, extremely low parental education levels, low maternal age at birth, insufficient prenatal care, and unsatisfactory neonatal and pediatric care. Thus, the direct effects of IUGR may be studied with significantly low risk for major confounds. Second, the school system in Israel is different from what is fairly prevalent in the United States in that kindergarten is not an integral part of school but rather is a continuation of prekindergarten. It is possible that children who are at a certain developmental risk also benefit from going through this significant school transition at 6 years of age, rather than, as in the United States, at 5 years of age. This hypothesis merits further research.

*As the IUGR children mature, we recommend continual monitoring of their academic achievements and adjustments to changing school requirements, and to initiate preventative intervention as early as required.*

It would be interesting to study school adjustment of children with IUGR in other parts of the world. Sporadic studies, conducted to date, are indicative of interesting differences: Academic failures were reported in Finland (Hollo et al.,

2002) and Germany (Weindrich, Jennen-Steinmetz, Laucht, & Schmidt, 2003); ADHD symptoms were reported in Northern Europe in Finland (Hollo et al., 2002) and in Norway (Elgen et al., 2002), as well as in Israel (Geva et al., 2006a). Self-regulation deficits have been reported in the western world (Hille et al., 2001). Underachievements were reported in Germany (Weindrich et al.) and in Israel (Geva et al., 2006a); and social dysfunctions, low self-esteem, and passivity have been reported in Northern Europe (Elgen et al., 2002; Hollo et al.). These differences elucidate in part cultural and educational differences that may be of great value for understanding the settings and intervention effects on school adjustment outcome of children with IUGR.

## LIMITATIONS

The main limitation of the study was its limited sample size. We took significant a priori steps to alleviate the concern with regard to the sample size. These steps included using an extreme case paradigm and careful selection of controls. Further measures to preclude effects of confounds included conservative selection criteria with regard to possible neonatal confounds, such as selection of healthy, mostly term neonates with IUGR; use of a long-term prospective paradigm; rigorous evaluation of parental variables, such as parental age and education, parental stress; control over familial variables, such as family structure and interpersonal relationships among family members to preclude familial confounds; a strict age at testing to limit maturational components; and no attrition. Nevertheless, the concern with regard to an increased risk for a Type I error warrants replication of the study with other cohorts using comparable prospective paradigms.

## IMPLICATIONS FOR THE FIELD AND FUTURE DIRECTIONS

The main results of the current prospective study showed that children with IUGR typically perform within normal limits, cognitively and academically, both at kindergarten and first grade; however, their cognitive and academic achievements are lower than those of carefully matched controls. Israeli-born children with IUGR, particularly boys, tend to have significantly more academic adjustment difficulties, evident both at kindergarten and at first grade. They are less cognitively equipped on entry to school and tend to have lower cognitive abilities than controls. Their cognitive level affects learning and academic achievements both prior to school entry and throughout first grade. Furthermore, higher levels of impulsive behaviors characterize the IUGR group compared to controls. Children with IUGR have deficits in problem solving and a two-fold increase in the tendency to break rules impulsively.

There are four important implications to the current study:

1. Educationally, children with IUGR are at some risk for lower academic reading and arithmetic achievements and a greater tendency for impulsive behavior already at kindergarten and first grade. These findings imply that gathering information about prenatal course of development, and IUGR in particular, may direct educators' attention to a potential need for special educational care and attention. Furthermore, socioemotional competences of children with IUGR are at this age not affected and may even serve as a resource to support learning and mediate better achievements. Thus, to facilitate the children's difficulties in acquiring new academic skills, we advise that it is important to get them involved in interactive learning groups rather than focus on individual tutoring.
2. Pedagogically, academic differences may seem to be minor but they are already in place early at kindergarten and at first grade. Even though overall performance was on average within normal limits, lower achievements and a two-fold increase in impulsive behavior may indicate that these "small effect sizes" may be nipped in the bud before a full-blown learning disability diagnosis evolves.
3. Despite the above it was noted that children in both groups succeeded in adjusting emotionally and socially to first grade. This may be in part attributed to good intrafamilial

support from birth through transition to school.

4. Empirically, the analysis highlights cognitive and behavioral differences that are associated with a process that is detectable prenatally. Results indicate that the IUGR process is related to long-term cognitive and adjustment issues that are expressed in the classroom.

According to Greenberg's (2004) view, "future directions are driven by three significant research-to-service challenges faced by practitioners and researchers. These involve systems integration across developmental stages, levels of care, and institutional structures" (p. 1). Our paradigm followed this challenge: integration across three developmental stages—neonatal, kindergarten, and first grade; in a well-controlled level of care—extreme-case cohort; and in unique institutional structural settings—kindergarten and first grade in Israel. We encourage parallel projects in more extended developmental stages, in well-controlled level of care cohorts, focusing on diverse risk factors in other institutional settings, to deepen the understanding of the mechanisms involved in adaptive adjustment to school-based challenges.

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