Screening 5 and 6 year-old children starting primary school for development and language

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Beginning school is an important milestone for children. Children's readiness for school involves cognitive, physical, and emotional development. Certain school programs allow children to start first grade after 66 months of age, together with 72 month-old children.

In order to estimate school readiness, we screened children before starting first grade and compared their school performance according to their age and socio-demographic characteristics. Marmara School Readiness, Denver II developmental screening, and language assessment tests were applied. Language delays were more frequent and school readiness test scores were lower in the younger group compared to older children. However, school achievement did not differ between the two age groups. Preschool education, parental income and education affected performance in most tests.

Preschool screening seems effective in detecting children with lower than average developmental skills, and the school system may provide a practical opportunity for providing support to those children.

Key words: developmental status, language development, school readiness.

Beginning school is an important and often challenging milestone for children and families. Children's readiness for school involves cognitive, physical, and emotional development, and affects the first experience at school, whose impact may extend well into later years[1].

In Turkey, children who complete 66 months before September of each year are allowed to be enrolled in first grade within the same class with 72 month-olds. The rationale and the success of this practice are being debated. In order to evaluate the school readiness of children starting at routine (72-78 months) and younger (66-72 months) ages, we applied preschool screening before starting first grade and compared the developmental status and school achievement of 5 year-old and 6 year-old children from different sociocultural backgrounds. We evaluated the predictive value of different tests, all in relation with school readiness and achievement during first year at school.

Material and Methods

This study was part of the general health and developmental screening examinations conducted in 6 schools in Ankara between September 2012 and November 2013 according to the rules outlined in the Declaration of Helsinki and with the permission granted by the Ankara Department of National Education. The study was conducted in 6 schools from various districts of Ankara.

Subjects

Children (n=239) starting primary school in September 2012 were included. The younger group (2007-born) consisted of 43 boys (58.1%) and 31 girls (41.9%) aged 67.9±2.8 (66.0 -72.0) months. The older group (2006-born) consisted of 75 boys (45.5%) and 90 girls (54.5%), aged 76.8±2.3 (72.0-78.0) months (Table I).

Methods

Demographic data were collected by a standard questionnaire including the items below: child's gender; birth date; preschool (kindergarten) attendance in the previous year (preschool education "present" or "absent"); name of the current primary school, number-coded from 1-3 representing lower middle, middle and higher middle class, respectively, as determined according to data from each municipality's data; family's income (low, lower middle, middle, upper middle and high); family type (nuclear family, extended family, single parent); mother's and father's age stratified as: ≤25, 26-35, and ≥ 36 years old; mother's and father's education: primary school, secondary school, university/post-graduate; mother's occupation: homemaker, manual worker, office job; father's occupation: unemployed, manual worker, office job; physical and neurological examinations including: head circumference, height and body weight, and ophthalmological examinations were performed by a team consisting of a pediatrician, ophthalmologist, optometrist nurse, and pediatric neurologist.

Developmental screening with Denver II: The latest standardization of Denver II for Turkey was applied to all children by child development specialists and pediatric neurologists[2,3]. The test contains 134 developmental items in 4 domains: personal-social, fine motor, language, and gross motor. Denver II test results were recorded as normal, suspect, and abnormal.

Children's drawings, addition and subtraction skills were assessed by subtests of "Marmara School Readiness Scale". This test was designed in Turkey for 5-6 year old children[4]. It includes 5 subtests in Mathematics (47 items on figure recognition, addition-subtraction, color sets, shapes, ranking), problem solving (14 items), phonetics (8 items on alliterations, rhymes), drawing (3 items involving connecting dots, avoiding crossings and maze). Each correct answer is recorded as 1 score and total score/100 is recorded as the test result.

Language skills were evaluated using the Preschool Language Scale (PLS-4) adapted to Turkish[5]. It consists of 127 items of expressive communication and auditory comprehension skills for age up to 82 months. Results were stated as developmental age.

School performance was evaluated by teachers' questionnaire which is the standard criterion accepted by the Turkish Ministry of Education in first grade. A questionnaire of five items including classroom performance, behavioral adjustment, attention time, teamwork, and taking responsibility was given to the teacher during the second half of the year. Results were classified as low average, average, and high average.

Statistical analysis

The difference between groups 2006 and 2007 in terms of gender, demographics, preschool education, developmental and language parameters was analyzed by Chi-Square test. Correlation between demographics of children, previous education, mother and father's features and developmental and language assessment parameters was analyzed by Spearman's correlation rho efficient test. Correlation between developmental and language assessment parameters was analyzed by Spearman's correlation rho efficient test.

The effects of independent variables [age in months, sex, birth year (2006, 2007), primary schools, kindergarten/preschool education, paternal and maternal age, education and occupation, family type, income, math skills, drawing skills, Denver result, receptive and expressive language scores, sociocultural status, physical examinations] on each of the dependent variables (Denver II results, receptive and expressive language development scores) was analyzed by Linear regression Analysis (Backward); and on each of the dependent variables (addition, subtraction and drawing skills) was analyzed by Logistic Regression Analysis (Backward Linear Regression) (First) where all items were compared with the first code of that item. For instance, the effect of primary schools on "subtraction skills", was examined by comparing primary school 2 (code 2) with primary school 1 (code 1), other primary schools (code 3) with primary school 1 (code 1). SPSS 16.0 (SPSS Inc., Chicago, 2007) was used for the analyses, and $p < 0.05$ was considered as statistically significant.

Results

Demographic and other characteristics of children and parents are shown in Table I.

Table I. Demographics of Children and Parents

		Group 1 (2007-born) n=74		Group 2 (2006-born) n=165		p
		n	%	n	%	
Gender	Male	43	58.1	75	45.5	0.070
	Female	31	41.9	90	54.5	
Kindergarten/Preschool education	Absent	32	45.7	32	19.8	0.000
	Present	38	54.3	130	80.2	
Primary Schools	Lower middle	25	34.7	75	45.2	0.165
	Middle	17	23.6	42	25.3	
	Higher middle	30	41.7	49	29.5	
Father's education	Primary school	19	27.2	55	35.9	0.291
	Secondary school	30	42.9	54	35.3	
	University/postgraduate	21	30.0	44	28.8	
Mother's education	Primary school	22	31.4	76	48.4	0.046
	Secondary school	24	34.3	49	31.2	
	University/postgraduate	24	34.3	32	20.4	
Family type	Nuclear family	51	91.1	106	92.2	0.965
	Extended family	3	5.4	5	4.3	
	Divorced parents	2	3.6	3	2.6	
Mother's occupation	Homemaker	40	65.6	121	75.2	0.175
	Manual worker	2	3.3	3	1.9	
	Office job	19	31.1	37	23.0	
Father's occupation	Unemployed	1	1.6	2	1.3	0.302
	Manual worker	36	59.0	81	51.6	
	Office job	24	39.3	74	47.1	
Mother's age	≤25 years	4	5.7	6	3.8	0.170
	26-35 years	39	55.7	90	57.3	
	≥ 36 years	25	35.7	61	38.9	
Father's age	≤25 years	2	2.9	0	0.0	0.984
	26-35 years	20	29.0	53	34.6	
	≥ 36 years	47	68.1	65.4	66.2	
Monthly income	500-1,000 TRY	22	33.3	55	40.7	0.275
	1,000-2,000 TRY	19	28.8	46	34.1	
	2,000-3,000 TRY	10	15.2	17	12.6	
	>3,000 TRY	15	22.7	16	11.9	
Sociocultural level	Lower middle	24	40.7	79	48.5	0.224
	Middle	14	23.7	45	27.6	
	Higher middle	21	35.6	39	23.9	
Physical examination	Normal	65	89.0	140	84.8	0.352
	Eye	4	5.5	12	7.3	
	Neurology	0	0.0	1	0.6	
	Cardiology	2	2.7	0	0.0	
	Weight < 5 percentile	0	0	2	1.2	
	Weight >95 percentile	2	2.7	10	6.1	

SD: standard deviation

The family type was nuclear in both groups. Most of the mothers were homemakers and most fathers, manual workers. There was no significant difference between groups in terms of family type, income, parents' occupation and age. There were more mothers with higher education in the 2007-born group (p=0.046). In the 2007-born group, 54.3% and in 2006-born group, 80.2% had kindergarten or any preschool education (p<0.05). The medical examinations of the children revealed similar results and no serious medical conditions in either group.

Denver II Developmental Screening Test

The rate of normal results of 2006-born children were significantly higher than those of 2007-born group (92.7% vs 78.1%, p = 0.001) (Table II).

School Readiness Test

Addition, subtraction and drawing skills were significantly higher in the 2006-born group than those of 2007-borns (Table II). In the 2006-born group, addition (84.0% correct) and subtraction (68.3% correct) were significantly higher than 2007-borns (63.5% and 52.7% correct answers, respectively) (p<0.05). Likewise, 2006-borns had higher drawing skills than 2007-borns: 97. vs. 77.8% had at least one correct drawing (p<0.05) (Table II).

Table II. Developmental and Marmara School Readiness Test Results

			Group 1 (2007 born) n=74		Group 2 (2006 born) n=165		P
			n	%	n	%	
Denver II Test		Normal	57	77.0	153	92.7	0.001
		Suspect	14	18.9	11	6.7	
		Abnormal	3	4.1	1	0.6	
School Readiness Test	Addition	Incorrect	27	36.5	26	16.0	0.000
		Correct	47	63.5	137	84.0	
	Subtraction	Incorrect	35	47.3	52	31.7	0.021
		Correct	39	52.7	112	68.3	
	Drawing	Suboptimal	15	20.8	5	3.0	0.001
		Satisfactory	56	77.8	160	97.0	

Table III. Correlation Between Developmental and Language Assessment Tests*

			Denver II result	School Readiness Test			Language Test	
				Addition	Subtraction	Drawing	Receptive	Expressive
Denver II result		r		-0.156	-0.136	-0.453	-0.186	-0.167
		p		0.016	0.036	0.000	0.005	0.011
School Readiness Test	Addition	r	0.156		0.392	0.168	0.322	0.211
		p	0.016		0.000	0.010	0.000	0.001
	Subtraction	r	0.136	0.392		0.156	0.231	0.212
		p	0.036	0.000		0.016	0.000	0.001
	Drawing	r	0.453	0.168	0.156		0.094	0.183
		p	0.000	0.010	0.016		0.157	0.005
Language Test	Receptive	r	0.186	0.322	0.231	0.094		0.510
		p	0.005	0.000	0.000	0.157		0.000
	Expressive	r	0.167	0.211	0.212	0.183	0.510	
		p	0.011	0.001	0.001	0.005	0.000	

* Spearman's correlation Rho efficient test

Language Development

In the comprehension domain, 9.2% of 2006-born children and 17.4% of the 2007-borns scored below their chronological age. These figures were 7.4% and 5.5% in expressive language (p>0.05).

Teacher's assessment

There was no difference in the scores of 2006-born and 2007-born children in general achievement, attention and classroom behavior.

High scores on one test was associated with high scores on others and with a higher rate of normal Denver II results (p <0.05) (Tables III and IV). The only non-significant, although positive, correlation was between drawing skills and language comprehension (p = 0.157, r = 0.094) (Table III). Denver II results were concordant with teacher's assessment: children with abnormal Denver II result obtained low or average scores, and children with normal Denver II had more average or higher scores. Of children with normal Denver II (n=205), 26(12.6%), 21 (10.2%) and 20 (9.7%) had general success, behavior and attention lower than class average, respectively (Fig. 1) (Chi-Square test, p<0.05). Children failing at the Marmara School Readiness Test were more likely to receive lower scores on teacher's assessment, although not significantly.

Table IV. Relationship Between Teacher's Scores and Developmental Tests

		Teacher's Assessment: General achievement						P (Chi-Square test)
		Lower than average		Average		Higher than average		
		n	%	n	%	n	%	
School ReadinessTest	Successful	16	12.0	87	65.4	30	22.5	0.189
	Unsuccesful	2	28.5	4	57.1	1	14.2	
Denver II	Abnormal	2	50.0	2	50.0	0	0,0	0.002
	Suspect	6	25.0	17	70.8	1	4.1	
	Normal	26	12.7	131	64.2	47	23.1	
		Teacher's Assessment: Classroom behavior						
		Lower than average		Average		Higher than average		
		n	%	n	%	n	%	
School ReadinessTest	Successful	12	9.0	97	72.9	24	18.0	0.215
	Unsuccesful	3	42.8	3	42.8	1	14.2	
Denver II	Abnormal	3	75.0	1	25.0	0	0.0	0.000
	Suspect	7	29.1	16	66.6	1	4.1	
	Normal	21	10.2	140	68.6	43	21.1	
		Teacher's Assessment: Attention						
		Lower than average		Average		Higher than average		
		n	%	n	%	n	%	
School ReadinessTest	Successful	11	39.3	94	59.5	28	58.3	0.266
	Unsuccesful	2	7.1	4	2.5	1	2.1	
Denver II	Abnormal	2	50.0	2	50.0	0	0.0	0.002
	Suspect	6	25.0	17	70.8	1	4.1	
	Normal	20	9.8	138	67.6	46	22.5	

Gender, preschool education and family factors (Table V)

Gender and family type were not associated with any significant difference in development and language parameters. Attendance to preschool education made a significant difference in both groups in all developmental parameters: Denver II, school readiness and language development (receptive and expressive) ($p < 0.05$), and classroom behavior, but not in general school achievement according to Teacher's Assessment. Language comprehension scores tended to increase with parent's age; significantly with father's age ($p = 0.011$, $r = 0.172$). Language scores and mathematic skills were higher in children whose parents had higher levels of education and higher income. Language skills were also higher in children whose parents worked in office jobs. According to teacher's assessment, 20% of children from low sociocultural status, 8.5% from middle and 5% from high sociocultural status scored lower than average ($p=0001$, $\chi^2=19.578$) while there was no difference in average or higher scores.

Table V. Correlation Between Demographic Parameters and Educational and Developmental Results*

		Denver II result	School ReadinessTest			LanguageTest	
			Addition	Subtraction	Drawing	Receptive	Expressive
Age (months)	r	0.272	0.253	0.169	0.233	0.172	0.187
	p	0.000	0.000	0.009	0.000	0.009	0.004
Gender	r	-0.039	0.062	0.021	-0.098	0.026	-0.009
	p	0.549	0.343	0.743	0.130	0.694	0.895
Birth year	r	0.216	0.212	0.157	0.270	0.168	0.173
	p	0.001	0.001	0.015	0.000	0.010	0.008
Kindergarten/ preschool	r	0.215	0.247	0.191	0.156	0.231	0.157
	p	0.001	0.000	0.003	0.017	0.000	0.019
Father's age	r	-0.019	0.042	0.020	-0.015	0.172	0.057
	p	0.782	0.532	0.762	0.826	0.011	0.409
Mother's age	r	0.093	0.008	0.065	0.023	0.120	0.097
	p	0.162	0.904	0.331	0.734	0.075	0.151
Father's education	r	0.074	0.166	0.036	0.036	0.294	0.209
	p	0.269	0.013	0.595	0.591	0.000	0.002
Mother's education	r	-0.007	0.138	0.050	-0.028	0.269	0.170
	p	0.915	0.038	0.454	0.675	0.000	0.012
Family type	r	0.112	0.091	-0.035	0.151	0.012	0.085
	p	0.145	0.236	0.653	0.051	0.877	0.273
Monthly income	r	0.107	0.222	0.201	0.064	0.196	0.202
	p	0.130	0.002	0.004	0.370	0.006	0.005
Mother's occupation	r	0.011	0.056	-0.048	0.022	0.209	0.142
	p	0.870	0.407	0.476	0.745	0.002	0.037
Father's occupation	r	0.030	0.140	0.000	0.047	0.171	0.159
	p	0.659	0.039	0.995	0.490	0.012	0.020
Sociocultural status	r	0.059	0.209	0.122	0.066	0.297	0.233
	p	0.385	0.002	0.070	0.326	0.000	0.001
Physical examination findings	r	0.068	-0.004	0.165	-0.012	-0.004	0.008
	p	0.292	0.947	0.010	0.849	0.957	0.905

* Spearman's correlation Rho efficient test

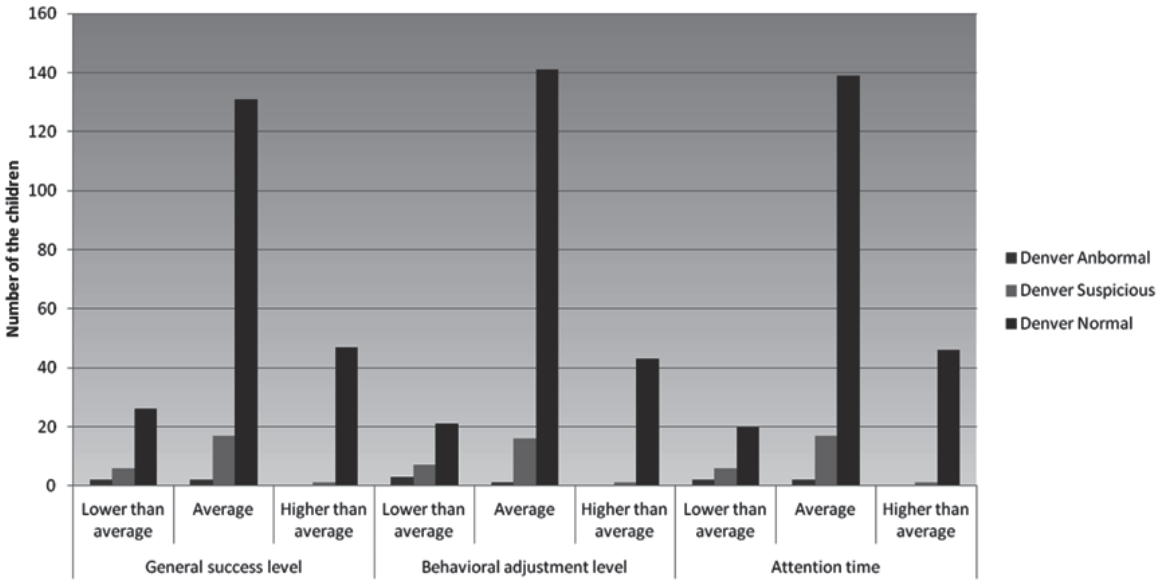

Fig. 1. Teacher's assessment of school performance and Denver II results

By linear regression analysis (backward), the effects of independent variables (age, sex, birth year, preschool education, primary schools, paternal and maternal age, education and occupation, family type, income, Denver II result, addition, subtraction and drawing skills, receptive and expressive language scores, sociocultural status, and physical examination) on each of dependent variables (Denver scores, receptive and expressive language development scores) were analyzed, and the most effective confounding factors were detected.

- The rate of normal Denver II results was significantly higher in children with higher age (months), better drawing skills and expressive language scores ($p < 0.05$).

- Expressive language scores were higher in children with higher drawing skills, language comprehension, normal Denver II, and parents who hold office jobs ($p < 0.05$).

By logistic regression analysis (backward LR), the effects of independent variables (age, sex, birth year as 2006 or 2007, preschool education, primary schools, paternal and maternal age, education and occupation, family type, income, Denver II result; addition, subtraction and drawing skills, receptive and expressive language scores, sociocultural status and physical examination) on each of dependent variables (addition, subtraction and drawing skills) was analyzed, and the most affecting confounding factors were detected.

Subtraction skills were 5.9-fold higher in children who attended preschool ($p=0.007$), children attending primary schools 2 and 3 compared to primary school 1, and in children from higher income compared to middle income (3.08-fold) and low-income (9.39 fold). Subtraction skills were lower in children whose mother's occupation is an "office job" compared to "homemakers" ($p=0.005$, Wald=7,967). Children with lower addition skills (fewer correct answers) had lower subtraction skills ($p=0.046$, Wald=3,977). There were no confounding factors for addition skills.

Discussion

School readiness has multiple dimensions including readiness for learning experiences, adjustment to a relatively structured environment, following directions, interacting with peers and adults, and self-care. This study examined 5 and 6 year-olds enrolled in the same grade for readiness and outcome in their first school year. Because no ideal screening method exists to assess school readiness, we evaluated several tests and school achievement.

Developmental screening with Denver II at the beginning of the school year showed that more children in the 2007-born group (18.9%) had "suspect" results according to their own age's standards. Because Denver II's normative

data have been obtained in a representative population in Turkey, this finding, rather than being a real delay, might be due to younger children's likelihood to be affected by testing conditions, e.g., a new environment without parent's company. The same factor might also affect school adjustment at the beginning of primary school, as suggested by behavioral scores from teachers, and implies the 5 year-old group may need more emotional support initially.

According to our results, Denver II appeared as an adequate predictor of development and school performance, and can be used for the detection of children at risk, as shown in our earlier study[6]. Children with normal Denver II were more likely to obtain higher scores on other developmental tests and to succeed at school: 87.3% of children with normal Denver II had average or high average school scores. While the Marmara School Readiness Test correlated with Denver II in general (Table III), it was not a good predictor of school performance (Table IV). As a considerable rate of language delays was found in 5 and 6 year olds (17% and 9% respectively for receptive language), additional assessment of language within preschool screening appears justified. Delays in language comprehension were more common than expression. Studies on large numbers of children reveal variable results: among parents of 4,983 children aged 4-5 years, 25.2% had concerns about their child's speech and 9.5% had concerns about their child's understanding of language. The same childrens' teachers considered 22.3% of children had some incompetence in expressive language and 16.9%, in receptive language. Researchers identified communication problems in 24%[7,8].

Our study, in a much smaller group, revealed similar rates of language delays. Language scores below chronological age were more frequent among the younger group: this suggests a maturational language delay that resolves as the child gets older. In a study using functional brain imaging during mathematical tasks, Rosenberg-Lee et al.[9] observed even one year's difference in age was associated considerable maturational difference in brain response and connectivity. On the other hand, teachers' assessment of school achievement did not differ between the two age groups except behavioral adjustment: this indicates teachers tend to evaluate 5 year-olds within their age level, or that the educational program has been successfully adapted to include the younger beginners.

Our previous findings suggest the gap between the two age groups may be wider in socioculturally disadvantaged districts; children with "suspect" Denver II results may score "normal" after one year at school[6]. A positive effect from preschool education on test results is expected, since many skills included in test items are practiced at kindergarten or preschool. In this study, parental education, employment status and sociocultural factors had significant effects on developmental test results, school readiness and performance: higher income and higher parental education affected language and mathematic skills, and lower sociocultural status could be associated with low school achievement. Language and math skills were most associated with parental education and employment, as shown in previous studies[10,11]. Although the study population was from urban Ankara and not exactly resource-poor, lower income and lower parental education appear as significant negative factors in this city. This finding may have implications for the planning of services: children from such districts should be targeted for preschool education. Follow-up studies of children at risk, such as those born prematurely, show low socioeconomic status as the most powerful factor determining school readiness[12]. On the other hand, school appears to even out the differences in exposure to pro-educational attitude and material between different sociocultural environments; formal child care can ameliorate the school readiness, receptive language, reading and math scores of 6 and 7 year-old children of mothers with low levels of education[13].

The main limitation of this study is the lack of more detailed developmental tests including behavioral assessment. The reason is feasibility; the current tests already taking one hour, extending the assessment period without forcing the child's cooperation and absence from class was not possible. Although behavioral characteristics were not tested thoroughly in this study; math, reading, and attention skills, in order of importance, are stronger predictors of later achievement and were included in our

assessment[1].

In conclusion, school readiness and adjustment appear moderately but considerably lower in the 5 year-old group who start school together with 6 year-olds in Turkey. Parental and family factors also affect school readiness, calling for additional support to 5 year-old children from lower economical status, who also are likely to benefit most from early schooling. The Denver II test's correlation with school performance in the first year supports its usefulness in identifying such children and represents a possible tool for policy makers.

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