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THE DENVER DEVELOPMENTAL SCREENING TEST: NORMATIVE DATA FOR ANKARA CHILDREN*

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Key words: Denver Developmental Screening Test (DDST), Turkish children

In recent years, with the encouragement and support of international organizations such as WHO and UNICEF, Turkey has begun health programs emphasizing prevention and early treatment of medical conditions[1]. Within this framework, some attention has been given to early identification of intellectual delays and mental retardation[2]. The reasoning is that pediatricians are in a position to detect social and intellectual delays in children at an early age[3,4]. Early identification of such developmental delays, however, can be done effectively only with the systematic use of an appropriate developmental screening test.

There are several developmental screening tests available[5-9], one of which is the Denver Developmental Screening Test (DDST) [10,11]. The DDST was devised specifically for pediatricians, providing them with a standard and reliable but speedy measure of development. Currently, it is widely used in the medical field[5]. There are several technical factors that have led to its success and hence to its wide usage. In the first place, it samples a variety of functions, including social-personal, fine motor-adaptive, language and gross motor behaviors; this means that it is sensitive to a wide range of developmental delays. A second factor concerns the selection of individual items. The items were selected from several psychological tests that have been in use for many years. Only such items as had been found to be reliable, valid and easy to administer were included in the test. Consequently, from a technical point, the DDST is a relatively well-designed screening test[12].

Nevertheless, however technically good a screening test may be its effectiveness depends on the availability of well-defined and appropriate normative data[5]. For developmental screening tests, it is essential that norms take into account the normal developmental differences related to culture and environment. Consequently, screening programs for developmental delays can be effective only when norms are available which are appropriate for the population being evaluated.

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Since the emphasis on preventive medicine is on the increase, it seemed timely to standardize a developmental screening test to be used with Turkish children. The DDST was the one selected because technically it is efficient and has, moreover, been successfully applied in several countries[13-16]. This provides some evidence that it can be readily adapted to other cultures.

The goal of our study was to provide normative data for the DDST in Turkey. As our target population, we selected healthy urban children, the reason being that programs for early intervention would have their first application within urban areas. For practical reasons, the city of Ankara was selected to represent the Turkish urban population.

Material and Methods

The test manual and form were translated from the original manual[10,11]. All 105 items in the original form were used in the data collection phase of the study. Only the vocabulary list in the Language Section was altered. Using the Turkish adaptation[17] of the Peabody Picture Vocabulary Test, as a reference source, the following changes were made: SEA for LAKE; APPLE for BANANA; LADDER for HEDGE. The test materials were the same as in the original.

Procedures for testing, selecting the sample and analyzing the data were adopted from those used in the original Denver normative study[18]. Consultation on procedures was continued throughout the project by personal contact with the authors of the original test and subsequently included a visit of one of the project co-directors (K. Yalaz) to the John F. Kennedy Child Development Center, University of Colorado Health Sciences Center at Denver, Colorado.

Sample

All the children used in this study were residents of metropolitan Ankara. They were located in 8 well-baby clinics, 5 nurseries, 5 kindergartens, and 5 private offices selected from several districts of Ankara. These institutions and offices were used for sampling because reliable data on health histories and birthdates could be obtained from records. To reduce sampling bias as much as possible, districts were selected which were geographically distant from each other and which were different on such variables as type of-housing (predominantly squatters' housing versus apartment buildings) and the income level of the residents. As in the original normative study, the initial criteria for selection were: healthy at time of testing, mother present during testing and only one child per family. Excluded were: premature births, multiple, breech and cesarean births, children who had been hospitalized for an illness, children with congenital or other physical abnormalities or with neurological disorders. Adopted children also were excluded.

At a second stage, criteria for selection included age, sex, and social class factor. Following the procedure used in the original Denver normative study, children from 16 days to 6 years 4 months were tested. Age levels were divided into 75 subgroups for sampling and analysis to insure an even distribution of children throughout the age range. An effort was also made to have an equal number of boys and girls at each age level.

As a marker of social class, the education of the mothers and fathers was used. These criteria, and particularly the mother's education, have consistently been found to be strongly related to a child's rate of growth and cognitive development[19,20]. Initially, a decision had to be made about how representative our sample should be. Of the adults aged between 15 and 49 in 1978, in metropolitan Ankara, an estimated 78% of the women and 69% of the men had not received more than a primary school education, and sometimes not even that[21]. With these figures, an attempt at proportional representation would mean a small number of children from the more educated families where we would expect more optimal development to occur. Therefore, it was decided to sample more or less equally from the various educational groups so that all educational groups would be represented. An effort was made to keep the distribution of children according to parents' education approximately the same at all age levels and to keep the sex distribution approximately the same across the educational levels.

Procedure

Four pediatric residents at Hacettepe University Children's Hospital served as testers. They were trained during a one-week workshop where the test was discussed and testers were given an opportunity to practice administration under observation. Professor J. Dodds, a co-author of the test, was in Ankara at this time and provided advice on administration during the training period and in the early stages of data collection.

Tester reliability was measured early and midway during data collection. The percentage of agreement between the testers in the early stages ranged from 84% to 100% with a mean agreement of 96% (n = 20 children; ages 1 year to 5 years). Midway through the testing, the agreement between the testers ranged between 80% and 100% with a mean agreement of 95% (n = 6 children; ages 1 year to 6 years). Test-retest agreement over a one-week interval, and with different testers at each testing, ranged from 87% to 94% with a mean agreement of 89% (n = 7 children; ages 3 months to 3 years).

Computation of Norms

The BIOMEDICAL Computer Program for PROBIT analysis was used to obtain smoothed developmental curves for each item[22]. Input for the analysis consisted of

the number of children at each age passing the item. The first age taken for each item was that at which the first pass was recorded. The last age was that at which all or all but one of the children had passed. The results of the analysis were estimates of ages at which 25%, 50%, 75% and 90% of the children passed each item. These percentages were the ones considered in the original Denver study.

TABLE I

Age Distribution of the Normative Sample

Age Group (in months)	Age Range (in days)	No.
1	16-45	60
2	46-75	39
3	76-105	47
4	106-135	42
5	136-165	49
6	166-195	45
7	196-225	46
8	226-255	59
9	256-285	47
10	286-315	42
11	316-346	48
12	347-375	42
13	376-405	36
14	406-435	41
15	436-495	39
18	496-585	70
21	586-675	56
24	676-810	52
30	811-990	60
36	991-1170	41
42	1171-1350	42
48	1351-1530	40
54	1531-1710	42
60	1711-1980	52
72	1981-2340	39
Total		**1176**

Results

Normative Sample

A total of 1176 children, 596 boys and 580 girls, were tested. Table I shows the age distribution and Table II the distribution of parents' educational levels.

TABLE II

Educational Level of the Parents

Educational Level	Mother		Father	
	No.	%	No.	%
No formal education	135	12	23	2
Primary school	471	40	314	27
Middle school	154	13	161	14
Lycée or equivalent	260	22	289	24
University or equivalent	156	13	389	33
Total	**1176**		**1176**	

TABLE III

Items with Significant Differences between Computed Curves and Original Data

Items	X^2	df	P
Smiles responsively	9.8	3	< .05
Smiles spontaneously	20.8	9	< .05
Resists toy pull	88.1	43	< .01
Indicates wants (not crying)	46.8	22	< .01
Sits, takes 2 cubes	20.8	11	< .05
Laughs	21.3	10	< .05
Squeals	20.8	8	< .01
Prone, lifts head 45°	25.3	7	< .001
Pulls to sit, no head lag	31.8	15	< .01
Balances on 1 foot 1 second	23.1	12	< .05

Evaluation of items

The results of the data analysis were used initially to evaluate the Turkish version of the items. Two criteria were used: 1) A goodness-of-fit test between the ages predicted from the PROBIT regression line and the original data; and 2) The age span between the point where 25% of the children passed to the point where 90% of the children passed. On the basis of these criteria, inadequate items were identified and eliminated from the Turkish version of the test.

Goodness-of-fit

X^2 tests were computed for each item for goodness-of-fit betweeen the ages predicted from the PROBIT regression line and the original data. The fit for 95 items was good, that is, the X^2 tests were not significant. Significant differences were found between computed values and original data for only 10 of the items. These items with the X^2 values are shown in Table III. Inspection of the data showed that the major differences between the computed values and original data for these items were at the extreme ends of the curves and not at those points which were to be used in construction of the form. Therefore, this did not seem a sufficient reason for eliminating the items from the test.

Age Span

Six items had an unusually wide range between the age at which children began passing the item and the age at which most passed. Table IV shows these items with the computed ages for the 25% and 90% points. Most of these items were from the Personal-Social section. Technically, such items have a limited value in screening tests; therefore, it was decided to drop them from the Turkish version of the DDST, with the exception of "Initially shy with strangers". This was retained somewhat arbitrarily, so as not to reduce too drastically the number of items in the Personal-Social section.

TABLE IV

Items with Wide Span between Age at which 25% of the Children Passed and Age at which 90% Passed

Items	Ages at which given percent passed	
	25%	90%
Pulls self to stand	9.0 mo.	14.0 mo.
Resists toy pull	1.7 mo.	15.6 mo.
Plays peek-a-boo	5.0 mo.	Not more than 80% passed
Initially shy with strangers	4.7 mo.	23.8 mo.
Separates easily from mother	12.4 mo.	6.5 years
Grasps rattle	0.8 mo.	10.2 mo.

Normative data

Table V gives the estimates at which 25%, 50%, 75% and 90% of the Turkish children passed each of the 100 remaining items of the DDST. These estimates were computed from the PROBIT regression line and were used for constructing the test form shown in Figure 1.

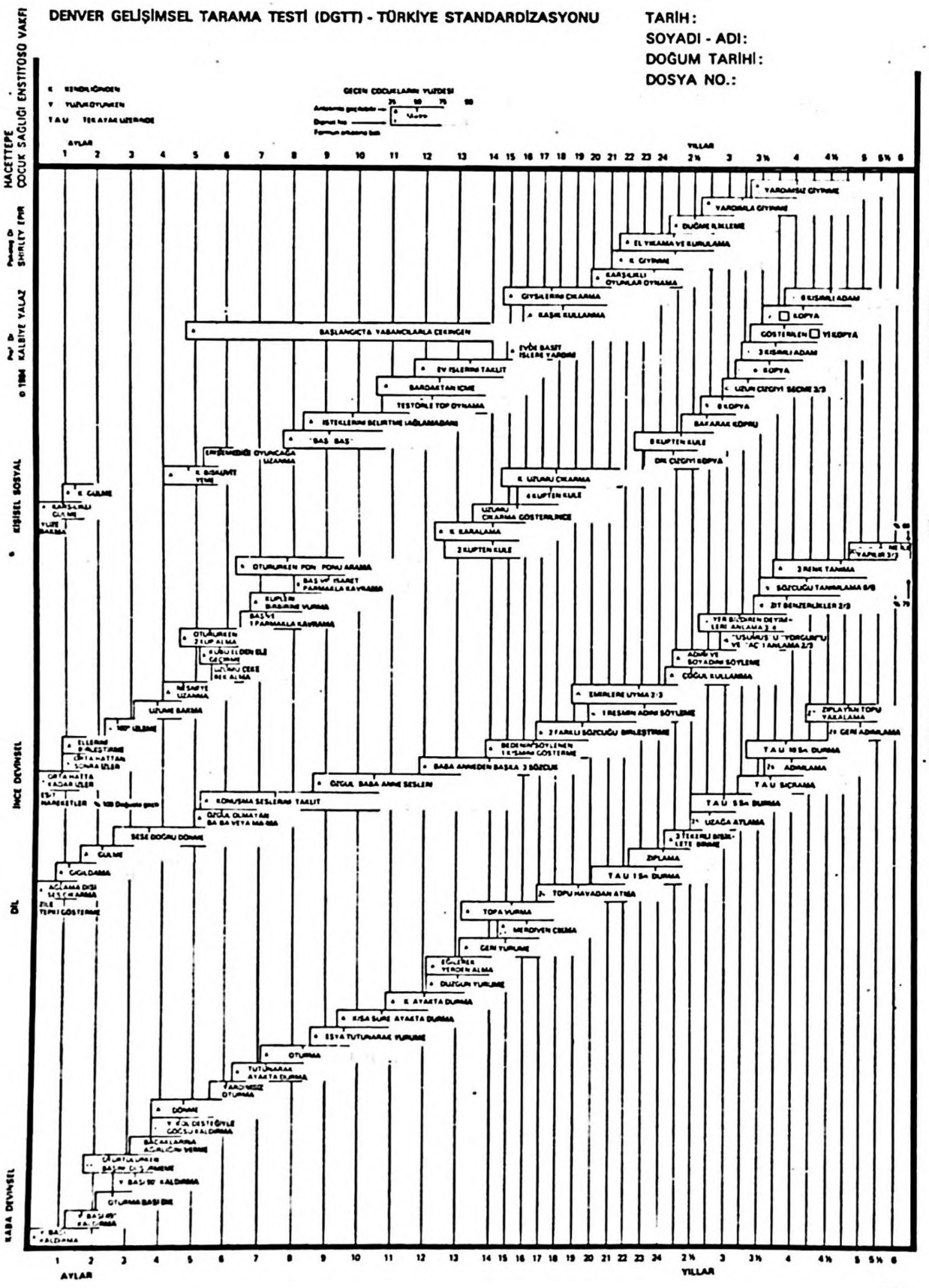
TABLE V

Total Sample Norms, Age at which Given Percent of Population Pass Items

Item	25%	50%	75%	90%
Personal-Social				
Regards face	—	—	—	0.8 mo.
Smiles responsively	—	0.9 mo.	1.5 mo.	2.2
Smiles spontaneously	0.9 mo.	1.3	1.9	2.7
Feeds self cracker	4.0	4.8	5.7	6.8
Resists toy pull	5.2	5.7	6.2	6.8
Plays pat-a-cake (bas, bas)	7.7	9.1	10.8	12.7
Indicates wants (not crying)	8.3	9.8	11.5	13.5
Plays ball with examiner	10.7	12.2	13.9	15.7
Drinks from cup	10.5	12.4	14.7	16.9
Imitates housework	11.7	13.4	15.3	17.3
Helps in housework - simple tasks	14.8	16.2	17.7	19.3
Initially shy with strangers	4.7	8.2	14.0	23.8
Uses spoon, spilling little	15.8	18.2	20.9	23.8
Removes garment	14.6	17.5	21.0	2.1 yrs.
Plays interactive games	19.9	23.6	2.3 yrs.	2.7
Puts on clothing	21.0	2.2 yrs.	2.8	3.5
Washes and dries hands	21.5	2.2	2.8	3.5
Buttons up	2.1 yrs.	2.5	3.1	3.7
Dresses with supervision	2.6	3.2	4.0	4.8
Dresses without supervision	3.3	4.0	4.8	5.7
Fine Motor-adaptive				
Symmetrical movements	100% passed			
Follows to midline	—	0.9 mo.	1.4 mo.	2.0 mo.
Follows past midline	0.9 mo.	1.4	2.1	3.1
Hands together	—	0.9	1.7	3.4
Follows 180 degrees	2.2	2.6	3.2	3.8
Regards raisin	3.1	3.8	4.6	5.5
Reaches for object	4.0	4.6	5.4	6.2
Rakes raisins, attains	5.5	6.0	6.5	7.0
Transfers cube from hand to hand	5.1	5.7	6.4	7.2
Sits, takes 2 cubes	4.5	5.4	6.3	7.4
Thumb-finger grasp	6.4	7.2	8.3	9.3
Bangs 2 cubes	6.7	7.7	8.9	10.2

Item	25%	50%	75%	90%
Fine Motor-adaptive (continued)				
Neat pincer grasp of raisin	8.0	9.1	10.3	11.6
Sits, looks for yarn	6.3	7.8	9.6	11.8
Tower of 2 cubes	12.6	14.1	15.8	17.6
Scribbles spontaneously	12.3	14.1	16.1	18.3
Tower of 4 cubes	15.7	17.5	19.4	21.5
Dumps raisin as demonstrated	13.4	15.6	18.1	21.0
Dumps raisin spontaneously	14.6	17.9	21.8	2.2 yrs.
Imitates vertical line within 30 degrees	23.1	2.2 yrs.	2.6 yrs.	2.9
Tower of 8 cubes	22.5	2.3	2.8	3.4
Imitates bridge	2.3 yrs.	2.7	3.1	3.6
Copies circle	2.6	2.9	3.4	3.9
Picks longer line, 3 of 3	2.9	3.3	3.9	4.5
Copies +	3.1	3.6	4.1	4.6
Draws man, 3 parts	3.2	3.7	4.3	5.0
Imitates square, demonstrated	3.3	3.8	4.4	5.1
Copies square	3.5	4.1	4.8	5.5
Draws man, 6 parts	3.8	4.5	5.3	6.2
Language				
Responds to bell	—	—	—	0.6 mo.
Vocalizes, not crying	—	0.9 mo.	1.4 mo.	2.1
Squeals	0.7 mo.	1.2	2.0	3.2
Laughs	1.5	2.2	3.2	4.6
Turns to voice	2.5	3.6	5.4	7.7
'Ba-ba', 'ma-ma' nonspecific	5.0	5.9	7.0	8.3
Imitates speech sounds	5.2	7.5	10.7	15.1
'Ba-ba' 'ma-ma' specific	8.6	10.5	13.2	15.6
3 words other than mama, baba	11.9	14.0	16.5	19.4
Points to 1 named body part	13.9	16.7	19.9	22.6
Combines 2 different words	16.8	19.5	22.7	2.2 yrs.
Names 1 picture	19.9	23.2	2.3 yrs.	2.6
Follows 2 of 3 directions	18.9	22.9	2.3	2.7
Uses plurals	2.1 yrs.	2.5 yrs.	3.1	3.8
Gives first and last names	2.2	2.7	3.2	3.8
Comprehends 'cold', 'tired', 'hungry'	2.9	3.4	3.9	4.4
Comprehends 3 prepositions	2.6	3.2	3.9	4.9
Opposite analogies 2 of 3	3.4	3.9	4.7	5.5
Defines 6 words	3.5	4.2	5.2	6.3

Item	25%	50%	75%	90%
Language (continued)				
Recognizes 3 colors	3.7	4.7	6.1	6.3 (79%)
Composition of materials	4.8	5.6	6.3 (66%)	
Gross Motor				
Prone, lifts head	—	—	0.5 mo.	1.1 mo.
Prone, head up 45 degrees	1.2 mo.	1.7 mo.	2.3	3.3
Sits, head steady	2.1	2.7	3.4	4.4
Prone, head up 90 degrees	2.7	3.4	4.3	5.3
Pulls to sit, no head lag	1.7	2.5	3.9	5.8
Bears some weight on legs	3.1	3.8	4.8	5.9
Prone chest up arm support	3.8	4.7	5.8	7.1
Rolls over	3.8	4.8	6.0	7.4
Sits without support	5.6	6.1	6.8	7.4
Stands holding on	6.3	7.3	8.4	9.7
Gets to sitting	7.1	8.4	9.8	11.5
Walks holding on furniture	8.6	9.7	11.0	12.4
Stands momentarily	9.4	10.8	12.2	13.9
Stands alone well	10.9	12.1	13.4	14.8
Walks well	12.1	13.1	14.3	15.5
Stoops and recovers	12.1	13.2	14.4	15.6
Walks backwards	13.1	15.0	17.2	19.5
Walks up steps	14.5	16.3	18.2	20.4
Kicks ball forward	13.2	15.4	18.0	20.8
Throws ball over hand	16.9	19.4	22.2	2.1 yrs.
Balances on 1 foot 1 second	20.1	23.9	2.4 yrs.	2.8
Jumps in place	22.3	2.1 yrs.	2.5	2.9
Pedals trike	2.1 yrs.	2.4	2.7	3.1
Broad jump	2.5	2.8	3.2	3.7
Balances on 1 foot 5 seconds	2.5	3.0	3.4	4.0
Hops on 1 foot	3.2	3.7	4.2	4.8
Heel-to-toe walk	3.6	4.0	4.6	5.1
Balances on 1 foot 10 seconds	3.3	3.9	4.5	5.3
Backward heel-to-toe walk	4.5	5.0	5.6	6.2
Catches bounced ball	4.2	4.8	5.5	6.3


DENVER GELİŞİMSEL TARAMA TESTİ (DGTT) - TÜRKİYE STANDARDİZASYONU
TARİH:
SOYADI - ADI:
DOĞUM TARİHİ:
DOSYA NO.:
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KABA DEVİNSEL
İNCE DEVİNSEL
DİL
KİŞİSEL SOSYAL
AYLAR
YILLAR

Figure 1.

Discussion

In a normative study such as the one presented here, there is always a question regarding the appropriateness of the reference group. Rural-urban differences and social class differences in growth and development occur in any society[23-25]. These differences may be greater in countries where nutritional deficiencies of some groups add to the already existing differences related to subcultural factors such as child rearing practices and the amount of stimulation in the environment[19]. Screening test norms should be sensitive to subcultural differences in a society but should also reflect some optimal rate of development. It was for this latter reason that only healthy children were included in this sample. It was also for this reason that we attempted to have a somewhat equal distribution of children from the least advantaged families and children from the more advantaged families. In this manner, subcultural differences would be represented without undue weight to the least advantaged as a more proportional representation sampling procedure would have done.

An alternative method would have been to have taken two normative samples, one for the more educated families and one for the less educated families. This procedure was not economically feasible. As it is, the data that have been collected are sufficient for comparison between the two groups. Such an analysis has been done and provides some information on the extent of the differences between these two urban groups in Turkey[26-28].

The current norms are based on the Ankara population. The question is how appropriate would these norms be for other areas of Turkey. We would not recommend these data for routine screening of village children as urban-rural differences are often great, particularly at preschool ages[29,30]. These data should be reasonably adequate for other areas of Turkey since there is no reason to expect great differences simply on the basis of geography.

An important aim of this normative study was to encourage the medical profession in the early identification of developmental handicaps when remedial efforts can be most effective. Early detection requires not only a technically good screening test, such as the DDST, but norms that are appropriate for the population being evaluated. Hence, this present study.

A word of caution. The DDST is not a diagnostic test and should never be used as a substitute for intelligence or other diagnostic tests. Its value lies in the efficient selection of children who are most in need of further medical or psychological evaluation.

While the emphasis in this paper has been placed on identifying children at risk for mental, motor and social delays, the DDST has potential as a research instrument as well. Namely, it can be used for noting cross-cultural or geographical differences in child development[14,31].

Finally, this test has been recommended for monitoring the development of normal children in much the same way as growth measures are used[32]. As such, it can be used routinely by pediatricians in general practice. To encourage such routine practice, a shorter version of this test has been devised which can be administered in a few minutes[33,34]. The same normative data are applicable to this shorter version.

Summary

Normative data were collected from a total of 1176 normal children, 596 boys and 580 girls living in Metropolitan Ankara, for a Turkish standardization of the Denver Developmental Screening Test. Data were summarized in tables and final test forms.

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