Egyptian Developmental Screening Test For Infants From Birth Up To 30 Months

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Abstract

Background: Detecting developmental delays in infants is an ongoing world commitment, especially for those below three years old. It provides appropriate services to them, early inspection enhances the communal quality of resolving difficult issues of this critical period of age. Thus, our main objective lies in developing a sufficient screening test for early evaluation of mental and motor development for infants.

Methods: 54 items of motor and mental developmental milestones were adopted from the Baroda Screening Test. Then, researchers enrolled 1600 subjects based on certain inclusion and exclusion criteria. 97% pass level of developmental achievements resembles the threshold of which infants below which, infants are considered delayed.

Results: The designed Egyptian Developmental Screening Tool ("EDST") from birth up to 30 months with 50% and 97% pass level curves proves efficacy, reliability, cultural adaptability, and simplicity to use when compared with other peer screening tools. Results revealed a statistically significant difference between Egyptian and Baroda chart at 50% and 97% pass level. A z-score chart for motor and mental development follow up designed by calculating each age group.

Conclusions: Developmental screening tests from birth up to 30 months proved consistent reliability and versatility to use in Egypt for early development delay detection. The wide variation of Egyptian infants' developmental ages on both Egyptian and Baroda charts underpins the Egyptian chart to the Egyptian public. The z-score chart is a rapid and easy follow-up chart for Egyptian infants' development.

Background

Almost 200 million children worldwide suffer from different forms of disabilities; though, the majority present in low-to-middle-income countries. According to Fischer et al., living in developing countries places children susceptible to disabilities attributable to poverty-related health factors, such as malnutrition.¹

Therefore, developmental assessment of young children is considered pivotal in such countries. However, relying exclusively on clinical judgments may deliver misleading results. Screening tools are, thus, indispensable to identify children for further testing and follow-up procedures. A screening tool can be feasibly administered to parents or tested on the child. In this respect, providing parent-administered screening tools are of great value, especially in cases of children's sleepiness, irritability, and illness. Ranges from 70% to 80% of sensitivity and specificity, as Urkin et al. demonstrated, denote acceptable remarks for developmental screening tests.²

Moreover, developmental screening is ardently desired whenever an issue identified during the developmental surveillance or when concerns are raised by parents, caregivers, or by child-health professionals. What provides more accurate outcome herewith lies in conducting standardized assessments of children's developmental status rather than simple clinical impressions. In this regard, the American Academy of Pediatrics recommended the administration of standardized screening tools at the ages of 9, 11, 24, or 30 months in order to produce effective developmental surveillance. Nonetheless, performing repeated developmental screening surpasses single assessments in their accuracy and validity levels.³

One of the effectual screening tests is the Baroda Developmental Screening Test (BDST) by Phatak & Khurana. Besides its simplicity, rapidness, and cost-efficiency, the test is outsourced from normal developmental milestones in India. A total of 54 items was selected from Bayley Developmental Screening Test. Any child failed items in his/her chronological age group was screened out for further detailed study. The screening test was in effect during a field survey, as well as in clinical practices (particularly well-baby clinics). Worth mentioning is that reported sensitivity and specificity have reached 65–95%.⁴

In the current study, the Egyptian Developmental Screening Test (to be referred to in this article as "EDST") was developed in the conventional chart format of which many features from the BDST are adopted for ease of administration; it is versatile enough to fit in the Egyptian environment.

Methods

It is an across-sectional study in the Menoufia governorate in Egypt. All infants and their mothers were enrolled in the study from January 2019 to August 2019 (8 months). Then, authors contacted the study subjects personally at the governmental family health units and vaccination centers. The study adheres to the Helsinki Declaration and was approved by the ethics committee at the Menoufia Faculty of Medicine. In terms of privacy, all respondents submitted written informed consent, stating their volunteering participation in the study.

Participants

The total number of admitted subjects was 1600 infants aged from birth to 30 months. Participants were then grouped month-wise for the first 12 months, three monthly for the next three months, and six-monthly for the next 12 months according to Baroda methodology. 100 infants in a subsequent age category.

Data Collection

The study was undertaken within a span of 8 months– from January 2019 to August 2019. Involved children have met the inclusion and exclusion criteria as to be full-term, received all vaccines dues according to their corresponding age categories, prosperity, no NICU admission normal anthropometric measures (i.e., weight, stature, and head circumference). Also, authors made sure that participants have not experienced chronic infections cardiac, hematological, chest, or endocrinal problems.

Afterward, they were thoroughly examined, and their mothers were interviewed. Firstly, a questionnaire was piloted to obtain socioeconomic and demographic factors using Fahmy socioeconomic scale in Egypt.⁵ Secondly, a checklist of motor and mental milestones that contain 54 items (22 motors and 32 mental) was adopted from the Baroda test to reuse in the questionnaire. Before the item adoption, an acceptance letter has been received from the Baroda test authors to use Baroda screening test items with modifications. The researchers then translated the questionnaire items into Arabic and culturally simplified them to the parents. Inquiries regarding the test's milestones were either observed or directed the mothers to answer. 97% is determined referentially the passing percentage of developmental milestones. Hence, any infant failed to achieve above the 97% pass level criterion was considered 'delayed'.

Data Analysis

Collected data was adequately processed by SPSS software for statistical analysis (ver. 21).⁶Data was, then, described using minimum, maximum, mean, standard deviation. For that, categorical variables were described using absolute frequency and percentage attributes. Moreover, comparisons were carried out between two studied dependent normally distributed variables using the paired T-test.⁷Additionally, z-scores were calculated for age groups individually.⁸Microsoft Excel (Microsoft Office Professional) enabled us to generate polynomial trend line curves. ⁹An alpha level was set to 5% with a significance level of 95%, and a beta error was accepted for up to 20% with an 80% statistical power.

Results

(45.56%) females and (54.44%) males constituted the gender distribution of the 1600 subjects(**table1**). Also, results denote 52.72%urban and 47.28% rural dwellers in the Menoufia governorate(**table2**). Notably, high socioeconomic infants represent 55.06%, whereas the moderate-level participants represent 44.94% of the sample (**table 3**)

The Egyptian screening chart's vertical line indicates the number of items passed plotted against the chronological age on the horizontal one. The 50% pass level curve drawn intermittent, whereas the 97% pass level curve drawn continuous below which the continuous line is considered developmentally delayed (**Figure 1**).

Statistically, there was a significant difference between Egyptian developmental screening test of infants compared to Baroda developmental screening test of infants (BDSI), with null p-value ($p = 0.000$) calculated by measuring the Egyptian infants' developmental age on both charts at 50% and 97% passing indices(**table 4**).Z-score curve of Egyptian developmental screening chart of infants demonstrates relevant age placement of each item at various percentage passing levels from birth up to 30 months(**table 5**)& (**figure 2**).

Discussion

Since developing a developmental screening tool that targets the community, the tool should be perceived simple, cost-efficient, and less time consuming, and most importantly, easy to understand by community health workers and parents. As expounded by Chauhan et al., the tool ought to consider cultural differences and reflect all developmental domains.¹⁰

The suggested (EDST), per se, does meet these criteria for early detection of developmental delay of infants at that age. Items of the Indian BDST are simple, applicable and convenient to Egyptian society. On the other hand, children's performance can be detected through the plotting scores of accomplished criteria on the vertical line against their corresponding chronological ages on the horizontal line. Through the 50% and 97% age placement passing levels in which the earlier marks the upper curve, while the latter indicates the lower curve, what remains below the curves represents the vulnerable population that requires further investigation for developmental delay (3%).For instance, the 6-month-year old infants could accomplish 24 items on the 50% curve, which signpost the number of items passed by 50% of children at this age groups. 97% of the same age expounds 19 items, which, consequently, epitomize specific features characterized by 97% of children at that age group. That determines, therefore, how healthy those infants would be.

Another crucial feature in the Egyptian test lies in the Developmental Age (DA), which is defined by Phatak et al. as the age at which 50% of normal children are expected to have identical scores.⁴ Similarly, the Egyptian model could successfully generate the developmental screening chart by intersecting the horizontal level of scores with the 50% curve. Moreover, Developmental Quotient (DQ) is calculated directly from the EDST chart. The DQ summarizes how well or poor the infant performs in contrast to a large group of infants at the same age.¹¹ To exemplify, if a child from the 12th month group scores 23, he/she is shown on the curve as 'delayed.' 50% of children attained a score of 23 at the 6th months their DQ will be calculated as: $(DA / CA) \times 100$. $DQ = 6/12 \times 100$. $DQ = 50\%$ (Figure1).

Additionally, there is a significant difference between the EDST test of infants and the Baroda screening test of infants (BDSI) that were identified via measuring the DA of Egyptian infants in either chart: 50% and 97% passing percentage. Such statistical implication points to the higher versatility of the EDST compared to the BDST to be extensively deployed in Egypt.

Some researchers such as Chunsuwan et al. claimed that using instruments developed mainly for a single culture may not provide the same results in another due to the cultural influence, which is called then a deviant development.¹² Nevertheless, other studies have contended the importance of doing more efforts in development of screening tools that respect the local differences.¹³

However, Western developmental tools (e.g., Bayley scales, and the Denver II) have been primarily designed and validated in Western countries – a fact that might reveal a sort of exclusivity in nature. Even though Gladstone and his colleagues advocated that rendering translations of tests to different languages may bring about misinterpretation of results, as translation may not meet local typicality and culture specificity.¹⁴ Likewise, Junejet et al. affirmed that all Western tests have some items that are culturally inappropriate for rural Africa, such as prepares cereal, 'play board games' and other uncommon activities.¹⁵

Another testing tool that we could have adopted in our study but rejected because of its laborious structure is the Ages & Stages Questionnaire (ASQ) which is a parent report tool widely studied in the West. It is a 19-questionnaire set (30 items per questionnaire) investigating the age range of 2 to 60 months with an overall sensitivity of 75% and specificity of 86%.¹⁵

Another study established to validate the Egyptian screening tool by Ages and Stages Questionnaire (ASQ), and the study showed a good correlation of results and approved the Egyptian screening test is valid. The sensitivity is 84.38% and specificity is 98.36%. The study is under publish eshafe et al 2020.

A Z-score was developed from our chart facilitates following up infants' motor and mental developments. In this regard, a child plotted above (-2SD) curve is considered normal, while whoever recognized below -2 SD is deemed developmentally delayed and thus to follow-up his/her progress in further visits. Z-score was calculated for each age group at the following: -3,-2,-1,0,1,2,3 equally in sequence the percentiles (0.13, 2.27, 15.87, 50, 84.13, 97.72, 99.87 respectively). (Figure 2)

Conclusions

Throughout the present research, the suggested Egyptian developmental screening test (EDST) is accountable, user-friendly, and culturally convenient. It presents rapid results to employ for early development delay detection of infants from birth up to 30 months by pediatric practitioners and health workers. The significant difference of the developmental age of Egyptian infants exhibited in the Egyptian chart and Baroda curve at both 50% and 97% pass levels denote a superior strength in favor of our designed model. Subsequently, we may stress the idea that each country build up its own screening tool. Furthermore, developing a Z-score chart renders rapid and reliable charts to use at the follow-up stages of the Egyptian infants' motor and mental development.

Abbreviations

ASQ : age stage questionnaire

BDSI : barooda developmental screening test of infants

CA : chronological age

DA : developmental age

DQ : developmental quotient

EDST: Egyptian developmental screening test

NICU : neonatal intensive care unit

SD : standard deviation

Recommendation

This research work encourages a full application of the Egyptian screening test in clinical practices and field surveys across Egypt. Z-score charts of the Egyptian screening test is recommended to deploy due to their seamless functionality.

Declarations

Recommendations

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Declarations

Ethics :Ethics approval and cosent to participate : The study adheres to the Helsinki Declaration and was approved by the ethics committee at the Menoufia Faculty of Medicine. In terms of privacy, all respondents submitted written informed consent, stating their volunteering participation in the study.

Consent : Consent for publication has been obtained from parents of children participants in the study .

Availability of data: The datasets used and analysed during the current study are available from the corresponding author on reasonable request . raw data and all data generated or analysed during this study are included in this published article and its supplementary information files available from the corresponding author on reasonable request.

Contributions: SF and MB are responsible for collecting raw data . AS , ZA and WB are responsible for interpretation and analysis of data . SB is responsible for data transfer to soft copy ,statistical analysis and drawing curves.

All authors have read and approved the manuscript.

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Competing interest ; this article aims to early detection of developmental delay in infants and to make their life healthy. There is no financial benefits to authors. Authors aim to help infants growing well and early detection of any undiserable effect on them.

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Tables

		Sex		Total
		Male	Female	
1.	n	61	39	100
2.	%	61.00%	39.00%	100.00%
1.	n	62	38	100
2.	%	62.00%	38.00%	100.00%
1.	n	57	43	100
2.	%	57.00%	43.00%	100.00%
1.	n	49	51	100
2.	%	49.00%	51.00%	100.00%
1.	n	55	45	100
2.	%	55.00%	45.00%	100.00%
1.	n	51	49	100
2.	%	51.00%	49.00%	100.00%
1.	n	51	49	100
2.	%	51.00%	49.00%	100.00%
1.	n	48	52	100
2.	%	48.00%	52.00%	100.00%
1.	n	57	43	100
2.	%	57.00%	43.00%	100.00%
1.	n	53	47	100
2.	%	53.00%	47.00%	100.00%
1.	n	52	48	100
2.	%	52.00%	48.00%	100.00%
1.	n	48	52	100
2.	%	48.00%	52.00%	100.00%
1.	n	63	37	100
2.	%	63.00%	37.00%	100.00%
1.	n	61	39	100
2.	%	61.00%	39.00%	100.00%
1.	n	50	50	100

2	%	50.00%	50.00%	100.00%
	25-30			
1	n	53	47	100
2	%	53.00%	47.00%	100.00%
	Total			
1	n	871	729	1600
2	%	54.44%	45.56%	100.00%

Table 1: Sex distribution of the sample study

		Residence		Total
		Rural	Urban	
1.	1.0			
	n	39	61	100
2.	%	39.00%	61.00%	100.00%
1.	2.0			
	n	39	60	99
2.	%	39.39%	60.61%	100.00%
1.	3.0			
	n	42	58	100
2.	%	42.00%	58.00%	100.00%
1.	4.0			
	n	42	58	100
2.	%	42.00%	58.00%	100.00%
1.	5.0			
	n	29	71	100
2.	%	29.00%	71.00%	100.00%
1.	6.0			
	n	40	60	100
2.	%	40.00%	60.00%	100.00%
1.	7.0			
	n	51	49	100
2.	%	51.00%	49.00%	100.00%
1.	8.0			
	n	50	50	100
2.	%	50.00%	50.00%	100.00%
1.	9.0			
	n	48	52	100
2.	%	48.00%	52.00%	100.00%
1.	10.0			
	n	50	50	100
2.	%	50.00%	50.00%	100.00%
1.	11.0			
	n	50	50	100
2.	%	50.00%	50.00%	100.00%
1.	12.0			
	n	46	54	100
2.	%	46.00%	54.00%	100.00%
1.	13-15			
	n	63	37	100
2.	%	63.00%	37.00%	100.00%
1.	16-18			
	n	51	49	100
2.	%	51.00%	49.00%	100.00%
1.	19-24			
	n	55	45	100
2.	%	55.00%	45.00%	100.00%
1.	25-30			
	n	61	39	100
2.	%	61.00%	39.00%	100.00%

	Total			
1.	n	756	843	1599
2.	%	47.28%	52.72%	100.00%

Table 2:Demographic distribution of the sample study

		Socio-economic Status		Total
		Moderate	High	
1.	n	48	52	100
2.	%	48.00%	52.00%	100.0%
1.	n	41	59	100
2.	%	41.00%	59.00%	100.00%
1.	n	45	55	100
2.	%	45.00%	55.00%	100.00%
1.	n	45	55	100
2.	%	45.00%	55.00%	100.00%
3.				
1.	n	45	55	100
2.	%	45.00%	55.00%	100.00%
3.				
1.	n	45	55	100
2.	%	45.00%	55.00%	100.0%
1.	n	45	55	100
2.	%	45.00%	55.00%	100.00%
1.	n	42	58	100
2.	%	42.00%	58.00%	100.00%
1.	n	47	53	100
2.	%	47.00%	53.00%	100.00%
1.	n	43	57	100
2.	%	43.00%	57.0%	100.00%
1.	n	43	57	100
2.	%	43.00%	57.00%	100.00%
1.	n	44	56	100
2.	%	44.00%	56.00%	100.00%
1.	n	45	55	100
2.	%	45.00%	55.00%	100.00%
1.	n	46	54	100
2.	%	46.00%	54.00%	100.00%
1.	n	47	53	100
2.	%	47.00%	53.00%	100.00%
1.	n	41	59	100
2.	%	41.00%	59.00%	100.00%
1.	n			
2.	%			

1	n	46	54	100
2	%	46.00%	54.00%	100.00%
1	n	51	49	100
2	%	51.00%	49.00%	100.00%
1	Total	719	881	1600
2	%	44.94%	55.06%	100.00%

Table 3:Socio-economic standard of the sample study

Age Category	DA 50%		Paired t-Test	DA 97%		Paired t-Test
	EGYPTIAN	BARODA		EGYPTIAN	BARODA	
1.0	0.96±0.34	0.65±0.39	t = 12.426 p = 0.000*	1.67±0.39	1.93±0.36	t = 33.494 p = 0.000*
2.0	2.42±0.69	1.95±0.62	t = 41.985 p = 0.000*	3.36±0.79	3.72±0.87	t = 27.896 p = 0.000*
3.0	2.95±0.59	2.41±0.54	t = 60.836 p = 0.000*	3.95±0.64	4.42±0.77	t = 29.740 p = 0.000*
4.0	4.22±0.79	3.62±0.78	t = 78.155 p = 0.000*	5.38±0.91	5.91±0.87	t = 29.956 p = 0.000*
5.0	4.87±0.74	4.25±0.75	t = 85.896 p = 0.000*	6.13±0.84	6.58±0.78	t = 21.418 p = 0.000*
6.0	6.34±1.11	5.64±0.98	t = 26.631 p = 0.000*	7.79±1.23	8.14±1.22	t = 19.741 p = 0.000*
7.0	7.22±1.16	6.35±0.90	t = 19.856 p = 0.000*	8.70±1.19	9.05±1.12	t = 22.183 p = 0.000*
8.0	8.33±1.00	7.29±0.84	t = 23.213 p = 0.000*	9.96±1.11	10.17±0.99	t = 11.007 p = 0.000*
9.0	9.09±1.19	8.00±1.08	t = 30.133 p = 0.000*	10.87±1.40	10.99±1.25	t = 6.305 p = 0.000*
10.0	10.49±1.13	9.27±0.96	t = 52.407 p = 0.000*	12.55±1.29	12.51±1.17	t = 2.523 p = 0.000*
11.0	11.82±1.30	10.39±1.07	t = 62.293 p = 0.000*	14.09±1.50	13.91±1.36	t = 8.551 p = 0.000*
12.0	12.46±1.33	10.92±1.12	t = 71.270 p = 0.000*	14.82±1.56	14.57±1.39	t = 10.262 p = 0.000*
13-15	14.51±1.79	12.77±1.67	t = 106.534 p = 0.000*	17.35±2.16	16.96±2.27	t = 5.946 p = 0.000*
16-18	17.70±1.57	15.89±1.53	t = 190.161 p = 0.000*	21.16±1.81	21.83±2.84	t = 6.151 p = 0.000*
19-24	20.62±3.13	18.31±2.52	t = 31.996 p = 0.000*	22.43±2.21	23.78±3.42	t = 8.753 p = 0.000*
25-30	24.57±1.29	21.24±0.83	t = 69.788 p = 0.000*	24.64±0.97	22.68±2.07	t = 9.097 p = 0.000*

Table 4: Comparison of developmental age (DA)at 50% and 97% pass level of Egyptian infants on Baroda chart and Egyptian chart.

Age	"-3" Z	"-2" Z	"-1" Z	"0" Z	"1" Z	"2" Z	"3" Z
0	0	0	0	0	0	0	0
1	2.0	2.0	3.0	5.0	6.0	7.0	8.0
2	5.0	6.0	8.0	10.0	13.0	17.0	18.0
3	9.0	9.0	10.0	12.0	15.0	17.0	17.0
4	11.0	12.0	14.0	17.0	19.0	23.0	24.0
5	15.0	15.0	16.0	19.0	22.0	24.0	25.0
6	18.0	19.0	20.0	24.0	27.0	30.0	31.0
7	18.0	21.0	22.0	26.5	29.0	31.0	33.0
8	21.0	24.0	27.0	29.0	32.0	35.0	37.0
9	24.0	26.0	28.0	32.0	35.0	37.0	37.0
10	29.0	30.0	32.0	36.0	38.0	41.0	42.0
11	32.0	33.0	36.0	39.0	42.0	45.0	45.0
12	35.0	36.0	37.0	40.0	43.0	45.0	46.0
13	35.0	35.0	39.0	42.0	46.0	48.0	48.0
14	35.0	35.0	42.0	45.0	47.0	50.0	50.0
15	41.0	41.0	43.0	46.0	49.0	50.0	50.0
16	46.0	46.0	46.0	49.0	51.0	52.0	52.0
17	45.0	45.0	47.0	50.0	51.0	53.0	53.0
18	46.0	47.0	47.0	50.0	51.0	53.0	54.0
19	47.0	47.0	50.0	51.0	52.0	53.0	53.0
20	47.0	47.0	48.0	52.0	54.0	54.0	54.0
21	46.0	46.0	48.0	52.0	54.0	54.0	54.0
22	49.0	49.0	50.0	52.0	54.0	54.0	54.0
23	48.0	48.0	48.0	53.0	54.0	54.0	54.0
24	46.0	46.0	49.0	53.0	54.0	54.0	54.0
25	52.0	52.0	53.0	54.0	54.0	54.0	54.0
26	51.0	51.0	51.0	54.0	54.0	54.0	54.0
27	53.0	53.0	54.0	54.0	54.0	54.0	54.0
28	54.0	54.0	54.0	54.0	54.0	54.0	54.0
29	52.0	52.0	52.0	54.0	54.0	54.0	54.0
30	53.0	53.0	54.0	54.0	54.0	54.0	54.0

Table 5: Values of Z-score chart showing the age placement of each item at various percentage pass levels

Figures

Figure 1: The Egyptian developmental screening chart and calculation of developmental age (DA) and Quotient (DQ)

Figure 1

The Egyptian developmental screening chart and calculation of developmental age (DA) and Quotient (DQ)

Figure 2: Z-score curve of Egyptian developmental screening chart of infants showing the age placement of each item at various percentage pass levels up to 18 months

Figure 2

Z-score curve of Egyptian developmental screening chart of infants showing the age placement of each item at various percentage pass levels up to 18 months

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [checklist.docx](#)
- [STROBEchecklistcrosssectional.docx](#)