Establishment of Egyptian developmental screening chart for infants from birth up to 30 months

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Abstract

Background: Detecting developmental delay in infants is an ongoing world commitment, especially for those below three years old. Early detection prevents the adverse outcomes in this critical period of age. To accurately assess the development of children; a culturally appropriate screening tool must be used. Egypt lacks such tool and multiple studies have shown that western tools are not suitable in other cultures.

Objectives: To establish sufficient easy, rapid, culturally appropriate and applicable screening chart for early detection of developmental delay among Egyptian infants from birth up to 30 months.

Methods: A cross sectional study was carried out on 1503 Egyptian infants of both genders aged from birth up to 30 months assumed to have normal development according to the inclusion and exclusion criteria. They were selected from vaccination centers and well-baby clinics. Developmental milestones from Baroda development screening test (BDST) were applied on them. Egyptian infants' developmental milestones scores were analyzed and carefully prepared in tables and charts. 97% pass levels of developmental achievements of infants represent the threshold below which infants are considered delayed. A z-score chart for motor and mental development follow up was designed by calculating each age group achievement.

Results: The designed Egyptian Developmental Screening Chart (EDSC) is represented in a chart format with two curves 50% and 97% pass level. Infants considered delayed when infant's score below 97% pass level. Results revealed a statistically significant difference between Egyptian and Baroda chart at 50% and 97%pass levels.

Conclusions: Extensive revision of the BDST was needed in order to create a more culturally appropriate Egyptian screening chart. This is the first study to create an Egyptian-specific screening tool, to be rapid and easy to use in Egypt for early detection of developmental delay and enabling early intervention practices. A z-score curve is reliable for follow up motor and mental development by calculating each age group achievement.

Introduction

Almost 200 million children worldwide suffer from different forms of disability, the majority of them present in developing countries. Living in developing countries makes children more susceptible to disability due to poverty related health factors, such as malnutrition.¹

Developmental assessment of young children is a challenging task. Relying exclusively on clinical judgment alone may be misleading. Thus, screening tools are important to identify children for further testing and follow-up. A screening tool may be feasibly administered to the parents or tested on the child.

Parent-administered screening tools are of great value, especially in cases of children's sleepiness, irritability and illness. The range of sensitivity and specificity of 70% to 80% have been considered suitable for developmental screening tools.²⁻³

Developmental screening is indicated whenever a problem is noticed during developmental surveillance or when doubts are raised by parents, caregivers or child health practitioners. It is more accurate outcome when applying standardized assessments of children's developmental status rather than simple clinical impressions. American academy of pediatrics recommended administration of standardized screening tools at the ages (9, 11, 24, or 30 months) in order to produce effective developmental surveillance. It also recommends that performing repeated developmental screening is more accurate and reliable than single assessment.⁴⁻⁵

One of the effective screening tests is the Baroda development screening test (BDST) by *Phatak* and *Khurana*. It is a simple, rapid, and cost-effective tool. This test is outsourced from normal developmental milestones in India. A total number 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 effective during a field survey, as well as in clinical practices. Its sensitivity and specificity have reached 65–95%.⁶

This study aim to establish a sufficient easy, rapid, culturally appropriate and applicable screening chart for early detection of developmental delay among Egyptian infants from birth up to 30 months.

Materials & Methods

A cross sectional study was implemented on 1503 normal Egyptian infants aged from birth up to 30 months at vaccination centers and well-baby clinics. The study was carried out in a time frame from January 2019 till January 2020 in Egypt. A minimal sample size is calculated based on a previous study aimed to develop a screening test for the assessment of the motor-mental development of infants by selecting items from the Bayley Scales of Infant Development (BSID),⁷ concluded that a routine use of our test is recommended for following the development of normal infants as well as for screening from the community infants with possibility of development delay. The latter must be referred for detailed testing on the full scales. Based on this study, a sample size of 1500 infants is the enough required sample to conduct the trial (50 infant per each month of age) assuming a significance level of 95% ($\alpha = 0.05$), and statistical power ($1 - \beta$) of 80%.⁸⁻⁹

The sample size was calculated according to *Charan and Biswas (2013)*.¹⁰ Online Open Source Epidemiologic Statistics for Public Health was also used to confirm the calculation.¹¹

A total number of 1600 infants were enrolled on our study; exclusion criteria were applied to 97 children leaving 1503 children as a final total sample to be included in the study. The selected infants were divided into 30 groups based on their chronological age. The sample per month ranges between 44 to 58

infants. Workshop training was provided to field work team to explain the items of the checklist and how to interview with the parents/or guardians. A pilot study of 150 infants was designed (five infants per month) to test all items of the developmental checklist on Egyptian infants and also to test and standardize the capabilities of the involved team before proceeding to the main data collection. A consent was obtained from parents/or guardians who were informed about the objective of the study, its benefits and the absence of any risk associated with the participation of their infants. Egyptian Developmental Screening Chart (EDSC) was developed in a chart format as BDST for ease of administration enough to fit the Egyptian culture.

Inclusion and Exclusion criteria: Inclusion criteria included; full term infants, age from birth up to 30 months, anthropometric measurements (weight, length and head circumference) within normal for age according to WHO growth charts. Exclusion criteria included; history of prematurity, hospital admission including neonatal intensive care unit (NICU), malnourished baby according to WHO (≤ -2 standard deviation of weight to height), known chronic diseases (cardiac, hematological, chest or endocrinal diseases) and known developmental or physical disability.

Data collection

Socioeconomic and demographic factors were collected using Fahmy schedule for estimating socioeconomic standard in Egypt.¹² Infants were examined for any developmental or physical disability. Weight and length were assessed by identical measuring equipment. Weight was measured by a digital balanced scale (Beurer model G 11, Germany) and length was assessed by a recumbent baby length scale. This is followed by an interview to their parents/or guardians to complete the developmental checklist. The checklist items are 54 items (22 motors and 32 mental), translated to Arabic and simplified to the parents/or guardians with their local expressions. The scores of checklist items passed by infants were analyzed and tabulated. 97% pass level of developmental score of infants was taken as a reference. Any infant's score lies below 97% pass level considered delayed. Developmental age (DA) can be calculated from EDSC by intersection of the horizontal level of the score with the 50% pass level curve. Moreover, Developmental Quotient (DQ) was calculated directly from the EDSC. The DQ summarizes how well or poor the infant performs in contrast to a large group of infants at the same age. It was calculated as: $(DA / CA) \times 100$.¹³ A z-score chart for motor and mental development follows up was designed by calculating each age group achievement.

Data Analysis

Collected data were adequately processed by statistical package SPSS, version 21 for windows (SPSS Inc., Chicago, Illinois, USA). Data were described using minimum, maximum, mean and 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. Additionally, z-scores were calculated for age groups individually. Microsoft Excel (Microsoft Office Professional) enabled us to generate polynomial trend line curves. An alpha level was set to 5% with a significance level of 95%, and a beta error was accepted for up to 20% with 80% statistical power. A Z-score was calculated for each age group at the following: -3, -2, -1, 0, 1, 2, 3 equally in sequence the percentiles (0.2nd, 2.3rd, 16th, 50th, 84th, 97.7th, 99.8th respectively).¹⁴

Results

The study enrolled a total of 1503 infants, of which 785 (52.2%) were male and 718 (47.8%) females. The socioeconomic standard of participants was high in 1076 (71.6%) and moderate in 427 (28.4%) infants.

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. Any infant achieves below the continuous line is considered developmentally delayed. (*Figure 1*) Statistically, there was a significant difference between EDSC of infants compared with BDST, with p-value ≤ 0.001 , calculated by measuring the Egyptian infants' developmental age on both charts at 50% and 97% passing levels. (*Table 1*) A z-score curve of EDSC of infants demonstrated relevant age placement of each item at various percentage passing levels. (*Figure 2*)

Discussion

A developmental screening tool for community should be simple, cost-efficient, less time consuming and easy to understand by community health workers and parents. The tool should consider cultural differences and reflect all developmental domains.¹⁵⁻¹⁶

BDST have been used in Egypt for infants motor and mental development assessment, as a rapid, easy and valid test according to many studies.¹⁻¹⁷ So we found suitable to develop an Egyptian developmental chart according to Egyptian norms. EDSC for infants from birth up to 30 months established to meet these criteria for early detection of developmental delay at this age category. Items of the Indian BDST are simple, applicable and convenient to Egyptian society. If the child performance lies below the 97% pass level, it represents the vulnerable population that requires further investigation for developmental delay (3%). There was a significant difference between the EDSC of infants and BDST. This was identified by measuring the DA of infants in either chart: 50% and 97% passing level in EDSC verses BDST.

Chunsuwan and *Hansakunachai* 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 a deviant development. Also; other studies have contended the importance of doing more efforts in development of screening tools that respect the local differences.¹⁸

Western developmental tools (e.g. Bayley scales, and the Denver II), which have been designed and validated in Western countries may be used in non-Western or low- and middle-income (LAMI) countries, and often translation to another language is the only action to be done. However, translations of tests to different languages may bring out misinterpretation of results, as translation may not meet local typicality and culture specificity. For example, all domains of Western tests have some items that are culturally inappropriate for rural Africa, such as 'prepare cereal', 'play board games' and other uncommon activities.^{19–20} Another testing tool (the Ages & Stages Questionnaire (ASQ)) was not used in our study because of its laborious structure and time consuming.²¹

A Z-score chart was developed to facilitate the follow up of infants' motor and mental development. A child performance plotted above $-2SD$ curve was considered normal, while who recognized below $-2SD$ was deemed developmentally delayed and need follow-up for child progress in future visits.

Conclusions

EDSC is an easy, rapid, applicable, and culturally appropriate tool. It presents a rapid result to detect early developmental delay of infants by pediatric practitioners and health workers. Subsequently, we may stress the idea that each country build up its own screening tool. Furthermore, developing a z-score chart renders a rapid and reliable chart to use at the follow-up stages of the Egyptian infants' motor and mental development. Ongoing study for validation to EDSC is recommended.

Declarations

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Author Contributions Statement:

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Ethics approval: Institutional Review Boards (IRB) of the Menoufia faculty of medicine had approved the study (ID: 180112Ped). Research work had been performed in accordance with the [Declaration of Helsinki](#). consents were taken from parents or guardians after explain the objective of the study, absence of any risk in participation. All procedures performed in the study were approved and were in accordance with the ethical standards of Menoufia University institutional research committee. Ethical approval from the author of BDST has been taken to standardize a screening developmental chart for infants in Egypt using BDST.

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Availability of data: The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Table 1

Table (1): comparison between developmental age of Egyptian and baroda charts at 50 and 97 pass levels.

Age Category	DA 50%		P value	DA 97%		P value
	BARODA	EGYPTIAN		BARODA	EGYPTIAN	
1.0	0.48±0.405	0.86±0.284	$p = 0.000^*$	1.80±0.319	1.53±0.339	$p = 0.000^*$
2.0	2.23±0.697	2.73±0.751	$p = 0.000^*$	4.12±0.955	3.71±848	$p = 0.000^*$
3.0	2.45±0.540	3.00±0.571	$p = 0.000^*$	4.48±0.744	4.00±0.631	$p = 0.000^*$
4.0	3.87±0.896	4.48±0.895	$p = 0.000^*$	6.18±0.999	5.67±1.027	$p = 0.000^*$
5.0	4.26±0.779	4.89±0.768	$p = 0.000^*$	6.64±0.795	6.15±0.873	$p = 0.000^*$
6.0	6.25±0.812	7.00±1.018	$p = 0.000^*$	8.89±0.986	8.55±1.055	$p = 0.000^*$
7.0	6.30±0.974	7.13±1.222	$p = 0.000^*$	8.95±1.206	8.64±1.287	$p = 0.000^*$
8.0	7.29±0.844	8.40±1.012	$p = 0.000^*$	10.17±1.015	9.97±1.124	$p = 0.000^*$
9.0	8.10±1.077	9.16±1.198	$p = 0.000^*$	11.11±1.250	11.00±1.390	$p = 0.000^*$
10.0	9.55±0.835	10.81±1.016	$p = 0.000^*$	12.85±1.045	12.92±1.143	$p = 0.000^*$
11.0	10.66±1.077	12.16±1.288	$p = 0.000^*$	14.27±1.350	14.47±1.518	$p = 0.000^*$
12.0	11.30±1.144	12.92±1.332	$p = 0.000^*$	15.06±1.379	15.35±1.581	$p = 0.000^*$
13.0	11.49±1.408	12.54±1.625	$p = 0.000^*$	15.06±1.705	15.42±1.809	$p = 0.000^*$
14.0	12.34±1.403	13.24±1.637	$p = 0.000^*$	15.84±1.809	16.33±1.862	$p = 0.000^*$
15.0	13.13±1.396	14.28±1.733	$p = 0.000^*$	17.03±2.161	17.49±1.975	$p = 0.000^*$
16.0	14.13±1.555	15.15±1.924	$p = 0.000^*$	18.42±2.580	18.78±2.096	$p = 0.000^*$
17.0	15.31±1.656	16.64±1.771	$p = 0.000^*$	20.28±2.871	20.40±2.002	$p = 0.387 NS$
18.0	15.88±1.606	17.44±1.893	$p = 0.000^*$	21.18±2.525	20.99±1.726	$p = 0.215$
19.0	17.07±1.544	18.24±1.712	$p = 0.000^*$	22.93±2.267	22.51±1.827	$p = 0.006^*$
20.0	17.89±1.946	19.20±2.423	$p = 0.000^*$	23.78±2.770	23.14±2.249	$p = 0.001^*$
21.0	17.94±1.705	19.20±2.155	$p = 0.000^*$	24.04±2.102	23.59±2.092	$p = 0.001^*$
22.0	18.08±1.687	19.40±2.188	$p = 0.000^*$	24.25±2.262	23.55±2.031	$p = 0.000^*$
23.0	18.43±1.932	19.92±2.700	$p = 0.000^*$	24.08±2.358	23.74±2.326	$p = 0.001^*$

24.0	19.19±1.671	21.02±2.692	$p = 0.000^*$	25.18±2.484	24.61±2.198	$p = 0.000^*$
25.0	19.40±1.525	21.02±2.379	$p = 0.000^*$	25.31±1.969	25.25±2.104	$p = 0.218 \text{ NS}$
26.0	19.42±1.496	21.13±2.477	$p = 0.000^*$	25.33±1.674	25.33±2.168	$p = 0.226 \text{ NS}$
27.0	20.20±1.145	22.43±2.296	$p = 0.000^*$	25.78±1.954	26.37±1.764	$p = 0.482 \text{ NS}$
28.0	20.19±1.331	22.38±2.407	$p = 0.000^*$	25.96±1.846	26.53±1.930	$p = 0.001^*$
29.0	20.45±1.306	23.10±2.337	$p = 0.000^*$	26.76±1.732	27.12±1.914	$p = 0.001^*$
30.0	21.03±0.969	24.37±1.549	$p = 0.000^*$	24.94±3.203	27.35±1.857	$p = 0.411 \text{ NS}$

Figures

Figure 1

Shows 50 and 97pass levels where chronological age plotted horizontally and number of items passed plotted vertically up to 24 months.

Z- score curve of Egyptian developmental screening chart of infants

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 24 months.

Supplementary Files

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