Normative data on mental and motor development in Nigerian children

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Summary

Background: **In Nigeria and sub-Saharan Africa at large, there has been heavy reliance on the "Caucasian data" in the developmental assessment of children. Hence, this study set out to establish normative data for psychomotor development on Nigerian children.**

Study design: **One hundred and twenty eight children distributed equally to eight different integrative age groups between 8 weeks and 30 months were included in the cross-sectional study. The subjects were assessed for the five fields of development using Developmental Screening Inventory (DSI) and Bayley Scales of Infant Development (BSID): a screening and performance instruments respectively. A trained research assistant administered the DSI on each of the subjects, and the scores made blind to the researchers until after the subject's assessment with the BSID within maximum of 24 hours interval.**

Results: **The subjects scored above the normal values in the five fields of development for each of the instruments. Furthermore, from the normative data derived, there were high scores in the motor and personal –social fields, especially among subjects in the lower age groups of 8, 16,and 32 weeks when compared to data from the western world.**

Conclusion: **It is concluded that this normative data will be of much clinical value to practitioners in Nigeria, especially the pediatricians, psychiatrists, clinical psychologists, etc.**

Key-words: ***Normative data, Psychomotor development, Nigerian children, DSI, BSID.***

Résumé

L'arriére: Au Nigéria et dans le sous-région Sahara Africain en general, il y avait été
Une grosse confiánce sur 'la donnée Caucacíenne's aux evaluation développemental des enfants. Ainsi, cette etude se mettre en route d'établir une donnée normative pour le developpement psychomotor sur les enfants Nigérians.

Le Projet d'étude: Cent vingt-huit enfants également distribué en huit groupe different d'âge integrative entre huit semaines et trente moîs y étaient compris dans l'étude en section. Les sujets ét ait évalués pour cinq domains de development utilisant L'Écran Developpmental Inventaire (EDI) et les Balances Barley de Developpment Nourrisson (BBDN): un instrument d'inspection et performance respectivement L'EDI était régi sur chaque sujet par un assistance de recherché bien fait, et les chiffres aveuglé le rechercheur jusqu à l'évaluation de sujet avec BBDN à l'intérieur d'intervalle de vingt-quatre heures.

Les resultats: Les sujets ont marques en haut valeur normale sur les domains developpemental pour chaque instrument. En outré, à partir de donnée normative derive, il y était un haut chiffrees dans le psychomotor et des domains personelle-sociales, surtout parmi les sujets aux groupe d'âge base de huit, siéze et trente-deux semaines quand l'on compare à la donnée du monde occidental.

La Conclusion: On a conclut que cette étude donnée normative sera le plus valeur clinique aux practiciéns Nigérians, surtout les paediatres, les psychiatres, les clinique psychologue etc.

Introduction

The monitoring of psychomotor development, especially in the first few years of life is one of the most important aspects of child health-care services; and generally, developmental studies are aimed at two important goals. First, is to describe the general sequence of the various developmental stages, otherwise known as developmental milestones, and norms are the average ages at which the various developmental skills or milestones appear in children[1]. Hence, using the cross-sectional or longitudinal method in childhood developmental studies, "normative data" can be obtained for a population of children[1,2]. Secondly, developmental studies also aimed at describing the variations among children at attaining the different developmental milestones as a result of environmental factors of culture, race, geographical location etc[2,3]. Thus, using the mean developmental scores, normative data have been obtained for childhood psychomotor development among children in various countries, most especially in the western world[2]. Examples include the norms by Pasamanick on the American Negro children using the Gesell Developmental Schedule[4] and on the Israeli children by Kohen–Raz using the BSID[5]. Furthermore, Nancy Bayley studied 1,262 American children of different races, culture and geographical location to obtain the normative values with her instrument, the BSID[6].

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In Africa, most of the childhood developmental studies in the past have focused mainly on the influence of socio-cultural practices on the achievement of different milestones[7,8]. One of the fallouts of such comparative studies was the finding by most of the authors that African children were more advanced in development compared to Caucasian children especially in the first year of life. They therefore constructed this as a form of "precocity"[9,10]. To the best knowledge of the present researchers, no comprehensive normative data have been established for African children. Geber and Dean (1957) attempted to do this on some Ugandan children using Gesell Developmental Schedules. However, the authors studied only three different age groups, with rather too wide age ranges of 1 – 6 months, 7 – 12 months and 18 months respectively[11]. The present study as part of a larger research work was therefore conducted to provide normative data on the psychomotor development of healthy Nigerian children in the different eight integrative ages between 8 weeks to 30 months. The outcome of the validation study in Nigeria of one of the instruments used on the subjects, the Developmental Screening Inventory (DSI) by the authors has been reported earlier[12]. In the study, DSI (a screening instrument) was validated against the performance type of instrument, BSID. There were significant correlations between the standardized ("Z") scores of subjects for both instruments. For instance, the adaptive and personal-social fields "Z" scores of DSI had correlation values of 0.39 and 0.37 respectively to the mental scale "Z" scores of BSID, and significant at $P<0.01$. Similarly, the gross motor and fine motor "Z" scores of DSI were of correlation values 0.36 and 0.32 to the psycho-motor scale "Z" scores of BSID and significant at $P<0.01$. Also, the reliability value using Cronbach's alpha was +0.64 at $P<0.01$[12]

Materials and methods

(a) Study location

The study was carried out at Ile-Ife, an ancient town in the South Western part of Nigeria.

During the fieldwork that lasted eleven months, the subjects were studied in various locations viz day-care centers, nursery/primary schools, well baby clinics and religious centers (church and mosques), and few of them were assessed at home. A serene atmosphere in each of these study locations devoid of environmental distraction was chosen to carry out the assessment.

(b) Research instruments.

(i) Socio-demographic questionnaire: this was constructed to obtain the necessary demographic data of the subjects and their parents/care givers.

(ii) Developmental Screening Inventory (DSI): A pen-and-paper type of test produced from extensive revision of Gesell Developmental Schedules by Knobloch and Pasamanick[13]. It is made up of age-appropriate questions in each of the five fields of development: adaptive, gross-motor, fine-motor, language and personal-social. To administer the instrument, the mother or care giver who is familiar with the subject's developmental trend responds to the developmental questions in each of the five developmental fields appropriate for the age of the subject.

For a subject who performs either below or above the age-appropriate questions, the researcher can go up or down the scale until the age at which the maximal score is obtained, this is the raw score. A standard score, known as the developmental quotient (DQ) is computed thus:-

$$DQ = \frac{\text{Maturity age}}{\text{Chronological Age}} \times 100$$

These scores are obtained in each of the five fields of development.

(iii) Bayley Scales of Infant Development (BSID): This is a performance developmental test designed by Nancy Bayley[14]. It is made up of the following three complementary tools:

- A 163 – item mental scale
- An 81 – item motor scale
- Infant Behaviour Recording (IBR): is meant to document the behaviour of a subject while being tested with the mental and motor scales.

The BSID test contents include manipulative play items such as toys, bell, mirror, cubes etc that are well packaged into a test box including a 180-page test manual. Two components of the motor scale, a three-step twin staircase and a walking board are constructed locally in accordance with the author's specifications in the test manual. The mental and motor scales are administered to each subject following the instructional guide in the test manual. A raw score was obtained for each scale on each of the subjects. This was converted to a standardized score using the appropriate conversion tables in the test manual. The standardized scores are Mental Developmental Index (MDI) derived from the mental raw score and Psychomotor Developmental Index (PDI) derived from the motor raw score.

(c) Subjects

One hundred and twenty eight (128) apparently healthy subjects were studied. These were distributed equally, that is sixteen (16) subjects to each of the eight age groups of 8,16 and 32 weeks; 10, 12, 18, 24 and 30 months. According to Gesell, these age groups are some of the integrative periods in childhood development[13]. The subjects were randomly sampled from the children populations in the various study locations. The normal health status of the subjects was determined by taking a history from the mothers/care givers. In addition, physical examination was carried out on each of the subjects by one of the researchers (O.F.A).

(d) Study design/ test administration

The first author (OFA) was trained in the use of both instruments (DSI and BSID) by the second author (O.M). Two year four medical students were subsequently

trained as research assistants to administer the DSI, but only one of them (DF) eventually served as the research assistant in the study. The research and ethical committee of OAUTHC granted the ethical approval to carry out the study. Additionally, while on the research fields consent was obtained from mothers or care givers to include their wards in the study.

A pilot study was carried out on twenty-four subjects (3 in each age group). This was aimed at getting well accustomed to the use of the instruments. Secondly, it was also to find out the likely problems that could be encountered during the data collection, and devise means to overcome them.

During the field work, the co-operation of each subject and the mother or caregiver was secured before the child was assessed. The subjects were usually tested in the morning between 09:00 to 12:00 hours, and while being alert. Two to three subjects were tested each day. The research assistant administered the socio-demographic questionnaire and the DSI on each subject. The scores obtained from the assessment with the DSI were made blind to the researcher (O.FA). Shortly thereafter (maximum of 24 hours), the BSID was administered same day by the researcher to obtain the appropriate scores on the mental and psychomotor scales.

Results

Socio-demographic characteristics

Sixteen subjects were tested in each of the eight age groups of 8, 16 and 32 weeks; 10, 12, 18, 24 and 30 months, giving a total of one hundred and twenty eight (128) subjects in all. The subjects included sixty-seven males (52%) and sixty-one females (48%).

About 37% of the subjects' mothers had up to secondary school education; and 15.6% with post secondary qualification obtained either from the polytechnic or college of education. Close to 8% of them were university graduates. Also about 11% had primary education only; and lastly, 5.5% of them had no formal education.

Normative developmental scores with DSI (Table I)

For this instrument (DSI), the adaptive DQ is the general developmental quotient, and according to the

Table 1 Mean scores with DSI for the different age groups

Milestone variables	Age groups and scores							
	8 Weeks	16 Weeks	32 Weeks	10 Months	12 Months	18Months	24Months	30Months
Adaptive DQ								
Median	125.0	100.0	109.4	111.6	101.9	116.7	114.6	100.0
Mean	126.6	111.7	106.7	104.3	109.5	108.2	110.8	102.3
SD	35.9	32.1	10.8	11.9	24.8	26.9	34.5	13.4
SE Mean	8.9	8.0	2.7	3.0	6.2	6.7	8.6	3.4
Gross Motor DQ								
Median	150.0	100.0	106.3	111.6	112.2	125.0	116.7	113.3
Mean	150.0	99.7	107.1	110.9	123.0	120.5	121.9	111.8
SD	51.6	30.6	7.8	22.0	24.7	17.8	13.5	10.4
SE Mean	12.9	7.6	2.0	5.5	6.2	4.4	3.4	2.6
Fine Motor DQ								
Median	175.0	100.0	100.0	93.0	108.0	100.0	125.0	100.0
Mean	165.6	102.3	100.0	104.2	112.5	114.6	116.4	100.0
SD	23.9	19.5	7.2	25.9	18.1	28.9	13.5	0.00
SE Mean	5.9	4.9	1.8	6.5	4.5	7.2	3.4	0.00
Language DQ								
Median	150.0	131.3	100.0	88.4	103.9	122.3	116.7	106.7
Mean	156.3	136.7	100.8	94.2	112.0	114.6	119.0	103.2
SD	72.7	18.0	9.4	18.0	22.4	27.5	17.0	9.9
SE Mean	18.2	4.5	2.3	4.5	5.6	6.9	4.3	2.5
Personal-Social DQ								
Median	162.5	131.3	112.5	102.0	107.7	126.4	133.3	113.3
Mean	148.4	125.0	110.2	106.8	112.6	127.1	130.9	111.3
SD	48.7	29.9	5.0	19.4	23.5	12.9	15.8	10.5
SE Mean	12.2	7.5	1.3	4.9	5.9	3.2	4.0	2.6

Note: DQ = Developmental Quotient.
SD = Standard Deviation.
SE Mean = Standard Error of Mean.

Table 2 BSID mean scores for the different age groups

Milestone Variables	Age groups and scores							
	8 Weeks	16 Weeks	32 Weeks	10 Months	12 Months	18 Months	24 Months	30 Months
MDI								
Median	105.0	116.0	111.0	102.0	96.09	98.0	91.0	90.5
Mean	104.4	112.6	111.4	101.9	95.2	93.6	93.9	91.6
SD	5.5	13.7	9.4	10.5	11.9	13.2	16.7	18.6
SE Mean	1.4	3.4	2.36	2.6	3.0	3.3	4.2	4.7
PDI								
Median	124.0	117	102.0	93.5	101.5	103.5	114.0	94.0
Mean	121.6	119.9	106.8	94.9	97.6	107.4	113.6	100.3
SD	15.8	15.0	10.0	16.8	14.6	23.7	20.8	18.5
SE Mean	4.0	3.7	2.5	4.2	3.7	5.9	5.2	4.6

Note: MDI = Mental Developmental Index
PDI = Psychomotor Developmental Index
SD = Standard Deviation
SE Mean = Standard Error of Mean

test authors, the minimum normal score is 75[13]. All the different age groups had mean scores of their adaptive DQ above the normal minimum value. The highest mean score of 126.6±35.9 was by the age group 8 weeks, followed by the 16 weeks age group with the mean score of 111.7±32.1. The lowest mean score of 102.3±13.4 was by the age group 30 months.

All the different age groups had impressive mean scores in both gross motor and fine motor fields. The high mean motor DQ score values were especially in the 8 weeks; 12, 18 and 24 months age groups. The highest mean values of 150±51.6 for gross motor DQ and 165.6±23.9 for fine motor DQ was by the 8 weeks age group.

Furthermore, there were high mean scores for the personal-social DQ across all the age groups. The highest values of 148.4±48.7 and 130.9±15.8 were for the age groups 8 weeks and 24 months respectively.
From the table, the subjects also fared very well in their mean language DQ scores across all ages.

Normative scores with BSID (Table 2)

With BSID assessment, the minimum normal developmental index (DI) score as specified by the test author is 50[14].

For the Mental Developmental Index (MDI), the mean scores are far above the minimum normal value across all age groups. The highest mean MDI of 112.6±13.7 was by the 16 weeks age group, closely followed by 111.4±9.4 of the 32 weeks group. The lowest mean MDI score was by the 30 months age group, i.e 91.6± 18.6.

Generally, all the groups performed better in the psychomotor scale than the mental scale except the 32 weeks and 10 months age groups that fared better on the mental scale. The highest PDI mean score of 121.6±15.8 was by the 8 weeks age group, closely followed by 16 weeks age group with mean value of 119.9±14.9. On the other hand, the 10 months age group had the lowest PDI mean value of 94.9± 16.8.

Discussion

Variations in the rate at which children of different race, geographical location and cultural backgrounds achieve developmental milestones have necessitated the establishment of norms for children in these different groups. Mean scores derived from the norms of the western standardization groups are not universally applicable; but at best can only be used for the basis of comparison[2]. As previously mentioned, no known comprehensive norms have been established for children of different age groups in Africa.

Our study has shown high mean scores among the subjects in the lower age groups of 8 and 16 weeks, but to a lesser extent in 32 weeks age group. The high mean scores are especially with the Developmental Screening Inventory (DSI) than the Bayley Scales of Infant Development (BSID). As shown in Table I for the DSI scores, the high mean scores are mostly in the gross and fine motor as well as the personal-social milestones. Being a screening instrument, with its local validation against the performance instrument of BSID reported earlier[12], the apparently high scores by the subjects with the DSI could partly be explained by possible exaggeration of the subjects' abilities by their mothers/ caregivers. However, despite the critique of inconclusiveness on an earlier study on Nigerian children by Poole using the Griffiths developmental scale, the subjects were also noted to be somewhat advanced on most of the developmental milestones[7]. Furthermore, the high mean scores in the gross and fine motor milestones in our study are quite understandable as many studies in the past have shown the "motor precocity" of African children when compared to their caucasean counter parts[2,3,10,11].

Furthermore, the high mean scores in the personal-social milestone in these early age groups, though not specifically highlighted in the previous African studies are not surprising findings. This may be explained by the extended family system in Africa, which allows contact between the child and the other members of the extended family. Furthermore, the child could also be offered to neighbours and visitors to cuddle or carry, hence allowing personal-social interaction not only with family members but visitors inclusive[2,15,16].

With the BSID, the mean developmental indices (MDI and PDI) were also higher for the subjects in the lower age groups of 8, 16 and 32 weeks when compared to the other age groups. When compared to the mean MDI and PDI values of the standardization sample used by the test author, our subjects scored higher for these three age groups. For instance, for our subjects in 8 weeks (2 months) group, the mean MDI was 104.4, but 100.0 for the test author's standardization sample, PDI was 121.6 but 100.0 also for the standardization sample. For 4 months age group, mean MDI and PDI scores for our subjects were 112.6 and 119.9 but 99.8 and 99.9 respectively for the test authors' standardization samples. Despite the limitations of using very wide age ranges of 1-6, 7-12 and 18 months respectively, and, the very limited number of age groups assessed; past studies in Africa on Kikuyu and Kipsigi children of Kenya and Uganda using the BSID instrument also showed high mean MDI and PDI scores especially in the lower age groups[10,17,18]. In conclusion, when compared to the previously attempted normative research works, our study could be of wider clinical applications in Africa considering it's peculiar advantages of evaluating more different integrative age groups. Secondly, in Nigeria with poor socio-economic indices, the use of DSI, one of the two instruments utilized in the study, being a "pen-and-paper" type of test that is simple to administer even by primary health care workers, can be cheaply reproduced and made available to most health care facilities in the country.

Study limitations

- Inadequate funding limited the number of subjects in this study; hence there is need to evaluate larger sample in subsequent studies.
- There is a need to collect data from pathological groups peculiar to African setting such as malnourished children, and those with chronic pathologies such as the sickle cell disease (SCD).

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