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Use of the Griffiths Mental Development Scales in an Agro-Industrial Province in the Philippines

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Abstract

Background—There is a need to assess neurobehavioral performance of children in developing countries using standardized developmental tools.

Methods—The Griffith's Mental Developmental Scales was evaluated in the Philippines by comparing the performance of 742 Filipino children longitudinally at 6, 12 and 24 months old to those of their British counterparts.

Results—The mean general and subquotient scores of Filipino children were all within average for age. Comparison with British children showed that except for performance subscales, Filipino children had significantly higher developmental subquotients at 6 months old. As the Filipino infants grew older, their developmental subquotients in all subscales were significantly lower, except for personal and social skills at 24 months old. The genetic predisposition as evidenced by modest maternal scores on the Wechsler Intelligence Scales and lack of familiarity with test materials are factors that may influence the developmental patterns of Filipino children.

Conclusion—Although the performance of the Filipino children in the Griffiths test were within average with age, their performance on developmental subquotients at later ages of 12 and 24 months were significantly lower than British children and may have been influenced by differences in ethnicity, cultural traditions and limited environmental resources.

Keywords

behaviour; child development; developing countries; developmental delay; pediatrics

Introduction

Developmental, behavior and psychosocial problems in children constitute the "new morbidity" in pediatrics and in the United States, the prevalence ranges from 12 to 16% of children with only 20 to 30% detected before school admission (Haggerty, RJ et al. 2003; Boyle, CA et al. 1994; AAP. 2001). In the Philippines, referrals for developmental delays

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from 2004 to 2008 showed an increasing trend for developmental delay and in a surveillance study of Filipino pediatricians, more than half estimated that up to 5 % of their patients presented with at least one developmental or behavioral concern such as speech delay (Reyes, A. et al. 2009; Pacifico, R et al. unpubl. observ.). Thus, assessment of developmental problems in children is important to allow for early intervention. However, to develop an assessment tool for the Philippines will be expensive and time consuming. It is more practical for developing countries to adopt internationally standardized tests that have been proven to measure a construct of child development applicable through time and across cultural diversity (Amod Z. et al. 2007). A number of neurobehavioral tests, developed in other countries and standardized in a different population, have been used in the Philippines such as the Griffith's Mental Developmental Scales (Griffiths test) which was developed in the United Kingdom (Griffiths R. 1976; Luiz, D et al. 2001). The scales assess the developmental levels of children from birth to 8 years and have been shown to be applicable to children of different cultural groups in a variety of populations (Mc Lean M. et al. 1991). While the Griffiths test can adequately assess neurobehavioral development in Filipino children, it lacks validation and standardization in the local setting. Thus, there is a need to validate the Griffiths test across cultures, particularly those with different ethnicity, traditions and limited environmental resources to enable appropriate evaluation and interpretation of neurobehavioral performances of children at various ages within each population. The aim of this study was to determine developmental patterns and trajectories on the Griffiths test of Filipino children at 6, 12 and 24 months of age and to compare these findings to those obtained from normative British samples (Huntley, M. 1996).

Method

Sample population

The subjects were part of a research study in the Philippines, entitled, "Fetal exposure to environmental toxins and infant outcomes" funded by the United States National Institute of Child and Human Development. The research was conducted in Bulacan, an agro-industrial and fishing province, immediately north of Manila and the study design required enlistment of pregnant women mothers while in midgestation, follow them up until they delivered and then follow up their infants up to the age of 2 years. Thus, the recruitment of pregnant women for the study was done at the prenatal clinic of the Bulacan Provincial Hospital which serve the health needs of a major segment of the population. However, the Bulacan and general Philippine census show than more women deliver at home compared to the hospital (67.3% versus 28.1%). Thus, the cohort of women (and their infants) in this study represent a group with higher socioeconomic status, [e.g., house material of concrete/brick/stone/wood (71.7% versus 17.3%), flush toilet at home (87.7% versus 65.7%)] and educational status [up to high school education (69.4% versus 43.3%)] than the general population. For enrollment into the study, the pregnant women were approached for participation in the study at the prenatal clinic and those who consented were included in the study. Subjects were recruited from June 2002 to April 2004. This study was approved by the Human Investigation Committee at Wayne State University, the University of the Philippines and the Bulacan Provincial Hospital. Informed consent was obtained from the mothers for themselves and their infants. Exclusion criteria for infants included lethal malformations, severe asphyxia (defined as Apgar <3 at 5 min), meconium collection not feasible (imperforate anus, gastroschisis or in need of immediate abdominal surgical intervention). A total of 793 mother/infant dyads were enrolled at birth and followed at 6 months (N=784), 12 months (N=761) and 24 months (N=754). By 2 years of age, follow up rate was 95.1%. There were no significant differences in demographic characteristics between the 754 dyads remaining at 2 years compared to those who dropped out, except for

a lower rate of married women (43.6% vs 73.6%, $p<0.03$) and lower parity (0.3 vs 0.7, $p<0.03$) in the latter.

Instruments

The Griffiths Scales of Mental Development from birth to 2 yrs and for older children, were used. The former consist of five subscales (Huntley, M. 1996; Griffiths, R. 1984): locomotor, personal and social, hearing and language/speech, eye and hand coordination and performance. The scales for older children included a Practical Reasoning Scale that evaluates number concept and realization of simplest practical problems in young children. Scoring in the Griffiths Scale for 0 to 2 yrs old is done by reference standards that indicate a functional age based on the accumulated score for a particular subscale and a general quotient (GQ) which is obtained by averaging scores in the 5 subscales. In the scales for older children, functional age in each subscale is obtained through ascribed computations. Developmental subquotients are determined for each subscale by dividing the functional age of the child with his chronologic age at the time of testing. The general quotient is likewise obtained through averaging.

Griffiths test

Neurobehavioral development of the children was assessed by the Griffiths Mental Developmental Scale (Griffiths test) by two Griffiths certified developmental pediatrician at 6 and 12 months and by three Griffiths certified developmental pediatricians at 24 months. The inter-rater agreement for the 2 and 3 Griffiths testers were 0.9855 ($p<0.0001$) and 0.8525 ($p<0.0001$) respectively. The Griffiths scales were administered and scored according to standardized procedure. Demographic, anthropometric and socioeconomic measures were also taken. Descriptive statistics were calculated and comparisons of sample means and frequencies were analyzed by Student t-test and Pearson's chi square and correlations by Pearson's correlation coefficient. Due to multiple t-tests performed, a Bonferroni correction was used for the comparison between development quotients between Filipino and British children and $p<0.003$) was set as the level of statistical significance.

Results

The characteristics of the 754 mother/infant dyads at birth were:

Maternal

Mean (S.D.) maternal age (25.7 ± 5.9 yrs), gravidity (2.4 ± 1.6), parity (1.2 ± 1.5), married (72.1%), maternal intelligence by WAIS-III performance subscale (75.4± 11.0). Use of cocaine, opiates, marijuana and alcohol (<1%), methamphetamine (4.5%), active smoking (2.5%) and passive smoking (77.4%).

Infant

Mean gestation (38.6 ± 1.3 wks), male (54.2%), weight (2.88 ± 0.44 kg), length (48.6 ± 2.6 cm) and head circumference (33.1 ± 1.5 cm). Apgar was 7.7 ± 1.0 and 8.9 ± 0.7 at 1 and 5 min respectively. The mean weight of the infants at 6 months was 7.39 ± 0.94 kg, at 12 months, 9.01 ± 1.25 kg and at 24 months, 11.31 ± 1.76 kg.

Home and environment

A survey of the family, home and child's environment was conducted for each subject. Results showed that 69.4% of mothers and 69.2% of fathers obtained at least a high school diploma. The father's mean age was 28.4 yrs and 74.1% were non-skilled laborers. 76.9% of mothers were homemakers. Average monthly household income was P5,324 pesos

(approximately $US113). The average number of people and families per household was 5.3 and 1.6, respectively. The mean number of children under the family's support was 1.1 (range of 0–11). Families reported other dependents (children or other relatives) receiving family support (mean number 0.3, range 0–10) and an age range of 0.3 to 78 years. The predominant religion was Catholic (89.3%). About 57.2% of mothers lived in their own homes, although 7.3% were squatters in makeshift homes. The socioeconomic status (SES) was assessed using the Roberto Scale (Roberto, N. 2002) which is based on the appearance, materials used and structure of the home. The Roberto scale was devised due to the difficulty in obtaining accurate information on income per household in the Philippines. The scale ranges from A (highest) to E (lowest). Few households were classified as A or B in the study and were combined into AB. About 4.5% were in Class AB, 34% in Class C, 50.1% in Class D and 11.4% in Class E. A lead recycling plant was located near 7% of the homes. The cleanliness of the home and surroundings were rated as fair (71%). The toilet was predominantly water seal (81%), water source was either piped in (51%) or from a well (42%), waste disposal was predominantly via sewer (26.%) or canal (62%) and 60% had organized garbage collection. A modified version of the HOME (Home Observation for Measurement of the Environment. Caldwell, BM. et al. 1984), was administered by trained interviewers. HOME scores are based on behaviors, materials in the home, and parent report. Mean HOME score in this cohort was 32.1 ± 5.08 with a median of 32, which is comparable to those obtained in the normative samples (12-month mean total=30.9; SD=7.6).

Griffiths test

Out of the 754 children followed up to 24 months, a total of 742 children completed their Griffiths test longitudinally through 6 months (range 5.75–7.50 months), 12 months (11.50–15.00 months) and 24 months (23.60 – 30 months) of age and this cohort forms the basis of this report. The mean general and subquotient scores by the Griffiths scales were all within average (Table 1). The mean general quotient was 96.42 and the mean subquotients in the different domains showed that Filipino children tend to perform better in locomotor (99.16), eye-hand coordination (99.06) and personal and social tasks (98.45). Subquotient measures were lowest in hearing/language (93.97) and performance (91.69). Since a longitudinal assessment of the children's abilities was conducted, it was possible to determine the difference in standard deviations from the mean between children and within each child (Table 1). This analysis showed that the change in rates of development through time is not as great between children as it is within each child, signifying that a child has a greater potential to improve his/her own rate of development, without greatly influencing a change in standard rates of development between other children of the same age. Time, therefore becomes more influential than individual factors in directing developmental trajectories. This may support the consistency of skills acquisition through time regardless of individual differences in children.

In Table 2, the correlation coefficients between the different subquotients scores was low to moderate (0.36 to 0.57) but still of statistical significance ($p<0.05$).

A comparison of the mean general and subquotients scores at the various ages of testing (Table 3) shows that the scores were higher during their 6^{th} month testing, with a decrease in rates of acquiring skills generally observed from the 6th to 12^{th} month. From the 12^{th} to the 24^{th} month, increased rates of development were noted in general quotients, as well as personal and social development. Hearing and language skills were the lowest and encroached borderline values (85.34) at the 24^{th} month.

Table 4 shows the comparison between the Griffiths scores among Filipino and British children. Except for performance subscales, 6 month old Filipino infants have

developmental subquotients (DQ) that were significantly higher ($p < 0.0001$) than British children of equivalent age, but as they grew older, their DQs in all subscales were significantly lower ($p < 0.001$), except for personal/ social skills at 24 months.

Discussion

This study characterizes the patterns of neurobehavioral development in Filipino children on the Griffiths test during the 6th, 12th and 24th months of life and these findings were compared with existing norms of the Griffiths Mental Developmental Scales in British children. Although all mean general quotients and subquotients in the Filipino children were within normative standards of the scales, their DQs in all subscales, compared to the British children were significantly lower ($p < 0.001$), except for personal/ social skills at 24 months. Owing to insufficient information available on the Griffiths test across culture, our discussion on the Griffiths performance of Filipino children, particularly in comparison with British children, remains speculative. Further studies are therefore needed, both from within and between countries, to validate the role of ethnicity, genetics, socioeconomic conditions, etc.., in influencing the Griffiths performance of children across culture.

We propose that the relatively higher mean subquotients in motor tasks, self-help and social behaviors in Filipino infants coincide with developmental expectations during infancy, which is basically to develop ambulation and an awareness of their surroundings (First, L. et al. 1994). Mean subquotient in hearing and language have been found to be amongst the lowest, as emergence of speech is not generally expected until just before the toddler years (Capute, A. et al. 1996). Mean subquotient in performance was also the lowest, due likely to non-familiarity of Filipino children with the materials used for testing like blocks and puzzles which may have been too novel for them to manipulate.

There was a decline, albeit still within average, in all developmental quotients during their 12th and 24th months. We propose that these changes could be attributed to the influence of genetics and environmental factors on the child's development and behavior (Shonkoff J et al, 2000; Schonfeld, D et al, 2008). Adequate nutrition and appropriate stimulation are also important factors and deprivation of these elements which is common in developing countries can negatively affect a young child's intellectual development (Griffiths, R. 1984). The low socioeconomic status of the study population also has an influence on rearing practices that the child may receive. Less than half of the infants in the study were still breastfed by 6 months old, although most received supplemental feeding and mean weight measurements were still typical for age. On the other hand, stimulation at home, as measured by the HOME scores, was comparable to normative samples. Thus, most of the children had ample exposure to materials that could enhance development of manipulative skills. However, the intelligence scores of the mothers using the WAIS (modified for the Filipino cohort) were only modest despite the fact that the mothers represent a better segment of the Filipino population in terms of socioeconomic and educational status,. Thus, the quality and quantity of interaction between child and the mother may not be adequately and appropriately harnessed and these promoters of development could remain merely physical than influential. Opportunities to enhance speech and fine manipulations are also not usual in the average Filipino family between 12 to 24 months of age, thus accounting for the further decline in these domains at this time.

The persistently low language quotients generated from the 12th month onwards may reflect the cultural bias inherent in "borrowed" tests of child development. Hearing and language items have been designed for English speaking populations and may not be suitable for Filipino children. Expectedly, the children performed less in this area, even during the 24th month testing, when spoken language is expected to develop. There is a sensitive period for

speech and language development in the child. Windows of opportunity in these areas are open immediately after birth and until 6 months old allow infants to discriminate speech contrasts from a variety of languages making them familiar with a particular type of speech pattern or language (Kuhl, PK.1994). However, sometime between the 6th to 12th month, this ability is gradually lost and only after do they become proficient again in discriminating speech. Thus, developmental trajectories for language resume after 12 months old to eventually attain developmental expectations by the time a child is 2 yrs old. It is therefore necessary to follow up on language development of the Filipino children, to see whether mean subquotient would remain to be low or whether a catch up will be evident at an older age when language is expected to be fully functional.

As with language development, relative low scores in performance among Filipino children may also be influenced by cultural bias. According to Griffiths, when a child has little experience with the handling of toys or similar materials, his scores in the performance subscales will be lower (Griffiths, R. 1994). A large increment in personal and social quotients during the 12th and 24th months testing may indicate a preference to teach the child skills in activities of daily living, rather than in using words or handling materials that may promote non-verbal problem solving, and subsequently performance. It may also be determinant of contributions from genetic potential in these domains. Again, follow-up studies to retest language and performance scales may help distinguish low genetic potentials from lack of environmental exposure as a probable cause for relatively low subquotients.

The results of the Griffiths test of the Filipino children in this study may not necessarily represent the performance on the Griffiths of Filipino children in general, since the subjects in the study come from a higher socioeconomic and educational status than the general population in the Philippines. Further studies are therefore needed if performance by Filipino children on the Griffiths in the general population is desired..

In summary, this study contributes to our basic understanding of the Griffiths Mental Development Scales as it is used to assess infant and child development. There is a need for validation of this tool across cultures, particularly those with different ethnicity, traditions and limited environmental resources. Recognition of these differences will provide the appropriate evaluation and interpretation of the neurobehavioral performance of children at various ages within each population rather than in comparison to other ethnic or cultural groups.

Key messages

- Adaptation of the Griffiths Mental Development Scales in the Philippines
- Performance on Griffiths Mental Development Scales of Filipino children at ages 6, 12 and 24 months compared to British children
- Mean general and subquotient scores of Filipino children on the Griffiths test were within average for age.
- As Filipino children grew older, their developmental subquotients in all subscales were significantly lower than British children except for personal and social skills.
- Socioeconomic status, genetic predisposition and lack of familiarity with test materials influence performance of Filipino children on the Griffiths test and these factors should be taken into consideration when comparing their performance with other ethnic groups.

- There is a need to validate the Griffiths test when used across cultures, particularly those with different ethnicity, traditions and limited environmental resources.

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Table 1

Aggregated mean scores for the general quotient, developmental subquotients and between and within standard deviations (SD) for the total sample cohort (N=742)

Griffith Scales	N	Mean	Std. Dev.		Performance Classification	Min	Max
General Quotient	742	96.34	between	6.62	Average	62.66	112.33
			within	8.20		69.68	122.23
Locomotor	742	99.07	between	7.23	Average	59.39	123.33
			within	9.59		69.07	124.40
Personal-Social	742	98.26	between	8.58	Average	49.58	128.39
			within	11.91		53.13	143.93
Hearing and Language	742	93.81	between	8.11	Average	51.96	117.33
			within	12.46		58.15	138.48
Eye-Hand Coordination	742	99.06	between	9.26	Average	51.07	119.33
			within	10.78		53.25	140.39
Performance	742	91.62	between	8.67	Average	46.29	113.88
			within	8.93		46.59	131.96

Table 2

Correlation of the developmental subquotient scores for the total sample cohort (N=742)

	Locomotor	Personal-Social	Eye-Hand Coordination	Hearing and Language	Performance
Locomotor	1.00				
Personal-Social	0.49*	1.00			
Eye-Hand Coordination	0.46*	0.45*	1.00		
Hearing and Language	0.49*	0.57*	0.45*	1.00	
Performance	0.30*	0.38*	0.56*	0.26*	1.00

* $p<0.05$ by Pearson's correlation coefficient

Table 3

General quotients and developmental subquotients at 6, 12 and 24 months among Filipino children (N=742)

Scales	Age	n	Mean	SD	Median	95% CI		Min	Max
General Quotient	6mos	742	103.95	9.75	106.00	103.24	104.65	68.38	127.00
	12mos	742	92.00	9.69	92.00	91.30	92.70	56.95	127.30
	24mos	742	92.98	7.27	93.00	92.46	93.51	65.35	114.00
Locomotor	6mos	742	108.31	10.35	111.00	107.57	109.06	70.64	138.00
	12mos	742	94.21	12.97	95.00	93.28	95.15	48.15	129.00
	24mos	742	94.64	4.80	95.00	94.30	94.99	73.07	115.91
Personal-Social	6mos	742	106.47	12.51	108.00	88.36	90.33	59.85	153.16
	12mos	742	89.34	13.68	90.00	88.36	90.33	39.31	131.00
	24mos	742	98.97	12.16	99.00	98.09	99.84	54.66	143.35
Eye-Hand Coordination	6mos	742	105.54	15.40	109.00	104.43	106.65	51.86	159.00
	12mos	742	97.64	13.79	100.00	96.64	98.63	50.29	140.00
	24mos	742	93.79	0.36	94.00	93.09	94.49	93.09	94.49
Hearing and Learning	6mos	742	106.09	11.23	105.00	105.28	106.90	65.90	141.00
	12mos	742	90.10	12.26	89.00	89.21	90.98	46.86	133.45
	24mos	742	85.20	11.90	87.00	84.34	86.06	43.13	117.00
Performance	6mos	742	92.27	13.35	96.00	91.31	93.23	45.13	120.00
	12mos	742	91.02	12.54	92.00	90.12	91.93	46.29	135.00
	24mos	742	91.38	10.73	90.00	90.61	92.16	51.01	131.65

Table 4

Comparisons between the performance of Filipino (RP) and British (UK) children on the 1996 Griffiths Scales

		RP Children			UK Children			p*
Scales	**Age**	**n**	**Mean**	**SD**	**n**	**Mean**	**SD**	
General Quotient	6mos	742	103.95	9.75	665[1]	100.50	11.80	<0.001
	12mos	742	92.00	9.69	665[1]	100.50	11.80	<0.001
	24mos	742	92.98	7.27	2,260[2]	100.18	12.76	<0.001
Locomotor	6mos	742	108.31	10.35	665[1]	100.20	15.90	<0.001
	12mos	742	94.21	12.97	665[1]	100.20	15.90	<0.001
	24mos	742	94.64	4.80	2,260[2]	100.41	16.32	<0.001
Personal-Social	6mos	742	106.47	12.51	665[1]	101.10	16.30	<0.001
	12mos	742	89.34	13.68	665[1]	101.10	16.30	<0.001
	24mos	742	98.97	12.16	2,260[2]	100.26	16.20	<0.05
Eye-Hand Coordination	6mos	742	105.54	15.40	665[1]	100.20	15.90	<0.001
	12mos	742	97.64	13.79	665[1]	100.20	15.90	<0.002
	24mos	742	93.79	0.36	2,260[2]	100.46	15.58	<0.001
Hearing and Learning	6mos	742	106.09	11.23	665[1]	100.60	16.00	<0.001
	12mos	742	90.10	12.26	665[1]	100.60	16.00	<0.001
	24mos	742	85.20	11.90	2,260[2]	99.78	17.75	<0.001
Performance	6mos	742	92.27	13.35	665[1]	100.40	16.00	<0.001
	12mos	742	91.02	12.54	665[1]	100.40	16.00	<0.001
	24mos	742	91.38	10.73	2,260[2]	99.87	17.43	<0.001

[1] From, The Griffiths Mental Development Scales (Huntley, M. 1996) p 24.

[2] From, The Abilities of Young Children (Griffiths, R. 1984), p 66.

* p<0.003 (Bonferroni correction) as level of statistical significance by Student “t” test analysis