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ORIGINAL ARTICLE

Assessing development of urban Aboriginal infants

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Aims: To determine the appropriateness of using the Griffiths' Mental Developmental Scales (birth – 2 years) to assess development in a cohort of urban Aboriginal children at 12 months of age.

Methods: The Gudaga study is a prospective longitudinal cohort study assessing the health, development and service use of urban Aboriginal infants residing in south west Sydney. All infants receive a full heath and development assessment (including the Griffiths' Mental Developmental Scales) when they are 12 months of age. This study analyses the results of the first 55 infants.

Results: The distribution of the General Quotient for the first 55 Gudaga infants is normal with a mean of 98.5 (SD 10.5). There is no significant difference between the Gudaga cohort and the Griffiths' standardisation sample for locomotor, personal-social, hearing and language, and eye and hand coordination sub-quotient scores.

Conclusion: The Griffiths' Mental Developmental Scales may be an appropriate tool to use for the assessment of development in urban Aboriginal infants.

Key words: Aboriginal children; child development; developmental assessment; Griffiths' Mental Developmental Scales; urban environment.

What is already known on this topic

1 The GMDS is a standardised developmental assessment tool widely used by paediatricians in Australia;
2 The GMDS has not been validated for use with Australian Aboriginal infants.

What this paper adds

1 The Griffiths' Mental Developmental Scales may be an appropriate tool to use for the assessment of development in urban Aboriginal infants;
2 The performance scores for the Gudaga cohort are significantly less than the performance scores in the Griffiths' standardisation sample; and
3 There is no significant difference between the Gudaga cohort and the Griffiths' standardisation sample for locomotor, personal-social, hearing and language, and eye and hand coordination subscale scores.

Introduction

The medical literature highlights the poorer health of Aboriginal Australians as a group when compared with the health of the general Australian population.[1] Among Aboriginal Australians, there are higher rates of obstetric complications, infant mortality and failure to thrive, lower birth weights and more frequent infections in childhood, such as otitis media, skin infections and respiratory illnesses than for non-Aboriginal Australians.[2–6] All of these factors may impact adversely on a child's development.

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Although there have been comprehensive studies assessing the health and development of Aboriginal children living in rural and remote areas[7,8] there is comparatively little information about the early development of Aboriginal infants living in an urban setting.

New South Wales has the largest Aboriginal population in Australia and the majority of Aboriginal people in NSW reside in urban areas.[9] In south west Sydney, there is a substantial Aboriginal population comprising 5247 people, 5.8% of the region's total population and 3.5% of children aged 1–4 yeas.[10]

There are difficulties in identifying Aboriginal children within this region at the point of contact with medical and community health services.[11,12] For example in the South West Sydney Area Health Service it is estimated that less than one third of Aboriginal children, prior to 1998, were identified as such in the

Midwives Data Collection.[13] Poor identification has made understanding the health needs and developing interventions and services for this group difficult.

Previous studies undertaken with preschool and school age Aboriginal children using different assessment tools indicate a high rate of developmental delay among Aboriginal children in both rural and urban environments.[7,14] There is evidence regarding the gap between Aboriginal and non-Aboriginal children relating to particular areas of academic achievement, for example literacy and numeracy among Grade 3 and 5 students.[15] Given these disparities, establishing whether the differences in academic achievement stem from longstanding discrepancies in development would be useful. An accurate and early assessment of development of Aboriginal infants could provide an indication of when differences begin to emerge and thus inform the design and timing of early intervention.

The Griffiths' Mental Developmental Scales (GMDS) were devised by Ruth Griffiths and first published in 1954.[16] The scales are used extensively in the United Kingdom by psychologists and paediatricians to assess and monitor the development of young children[17] and are the most frequently used tool for developmental assessments by Australasian Consultant General Paediatricians.[18] The construct validity of the GMDS has been considered with respect to different ethnic groups in South Africa[19], but to our knowledge its appropriateness among Australian Aboriginal infants has not been established.

The aim of this study is to determine the appropriateness of using the GMDS as a research tool to assess the development of a population cohort of urban Aboriginal infants at 12 months of age.

Materials and Methods

The Gudaga study is a prospective longitudinal cohort study assessing the health and development of urban Aboriginal infants residing in the Campbelltown area of South West Sydney.[12] Infants were eligible for recruitment if the mother identified either biological parent as being of Aboriginal or Torres Strait Islander origin. A total of 159 mothers and infants were recruited to the study. Of these 159 infants, the first 55 who were assessed from October 2006 to June 2007 made up this current study. Every available infant was assessed – no parent refused assessment. Of the 55 participants 65% were female, and 35% were male. When compared with the gender ratio of the complete cohort (54% female and 46% male), this gender ratio slightly favours the female infants.

The assessment of infants at 12 months of age in the study comprised a structured questionnaire administered by the Project Officer, and a semi-structured medical interview and physical examination completed by the medical staff, comprising a Paediatrician or a Senior Paediatric Registrar (Advanced Trainee), to assess general health, growth parameters and immunisation status. The parents were given an opportunity to explore any health and developmental concerns. Where developmental delays or medical conditions became apparent the family was directed to the appropriate service for further investigation or intervention. The medical officer also conducted a standardised developmental assessment using the GMDS (birth – 2 years) as outlined in the GMDS administration manual.[17] Children unwell at the time of their initial review had their developmental assessment deferred until they were well.

The GMDS are an individually administered examination that assess the current developmental functioning of infants and children.[17] The GMDS comprise five subscales including:

- Locomotor: assesses gross psychomotor development;
- Personal-social: assesses the child's grasp of the customs or what Griffiths refers to as the 'folk-ways'[17] of the child's particular social group;
- Hearing and language: measures active listening as well as language development;
- Eye and hand coordination: assesses level of manipulation; and
- Performance: measures the developing ability to reason in practical situations or manipulate materials intelligently.[17]

The results of these five subscale scores, or sub-quotients, were combined to produce a General Quotient that reflected the overall level of developmental functioning. As this is a standardised developmental assessment tool the results can be compared with an age matched reference sample. The mean scores obtained for the General Quotient and each subscale score from the five developmental domains were then compared with the corresponding scores from the standardisation sample in the technical manual of the GMDS,[17] using the Student's *t*-test. A significance level of 0.05 was used in the analysis of data.

Ethics

This study was approved by the Ethics Committee of the Aboriginal Health and Medical Research Council and Sydney South West Area Health Services. Mothers participating in the study signed informed consent forms.

Results

The summary scores for the GMDS administered to the 55 participants were compared with the Griffiths' standardisation sample (Table 1). There was no significant difference between the Gudaga sample mean scores and the Griffith standardisation mean scores for the results achieved in the locomotor, hearing and language, personal-social, and eye and hand coordination subscales. Furthermore there was no significant difference between the two groups for the General Quotient scores. There was however a significant difference between the mean scores achieved in the performance subscale between the Gudaga cohort and the Griffiths' revision reference samples with the Gudaga sample scoring lower than those in the Griffiths' standardisation sample.

The following six figures (Figs 1–6) show the frequency distribution of the General Quotient and subscale scores for the Gudaga cohort and the Griffiths' (birth to 2 years) revision reference samples.[17]

Details of the General Quotient scores are reported in Figure 1. There was one infant in the Gudaga cohort with high General Quotient scores, greater than two standard deviations above the mean of the Griffiths' reference sample scores and three infants with scores between one and two standard deviations above the reference sample's mean. There were also two

Table 1 Mean General Quotient and subscale scores for the Gudaga cohort and Griffiths' standardisation samples

Mean score	Gudaga cohort sample (SD)	Griffiths' sample (SD)	Student's *t*-test *t* value	Student's *t*-test *P* value
General Quotient	98.5 (11.8)	100.5 (11.8)	1.38	0.17
Locomotor subscale	99.9 (15.5)	100.2 (15.9)	0.02	0.88
Personal -social subscale	101.4 (12.8)	101.1 (16.3)	0.02	0.88
Hearing and language subscale	101.0 (11.0)	100.6 (16.0)	0.04	0.85
Eye and hand coordination subscale	98.1 (15.6)	100.2 (15.9)	0.85	0.36
Performance subscale	93.4 (14.3)	100.4 (16.0)	9.76	0.002*

*Indicates a statistically significant difference when comparing the Gudaga and Griffiths' samples using the Student's *t*-test.

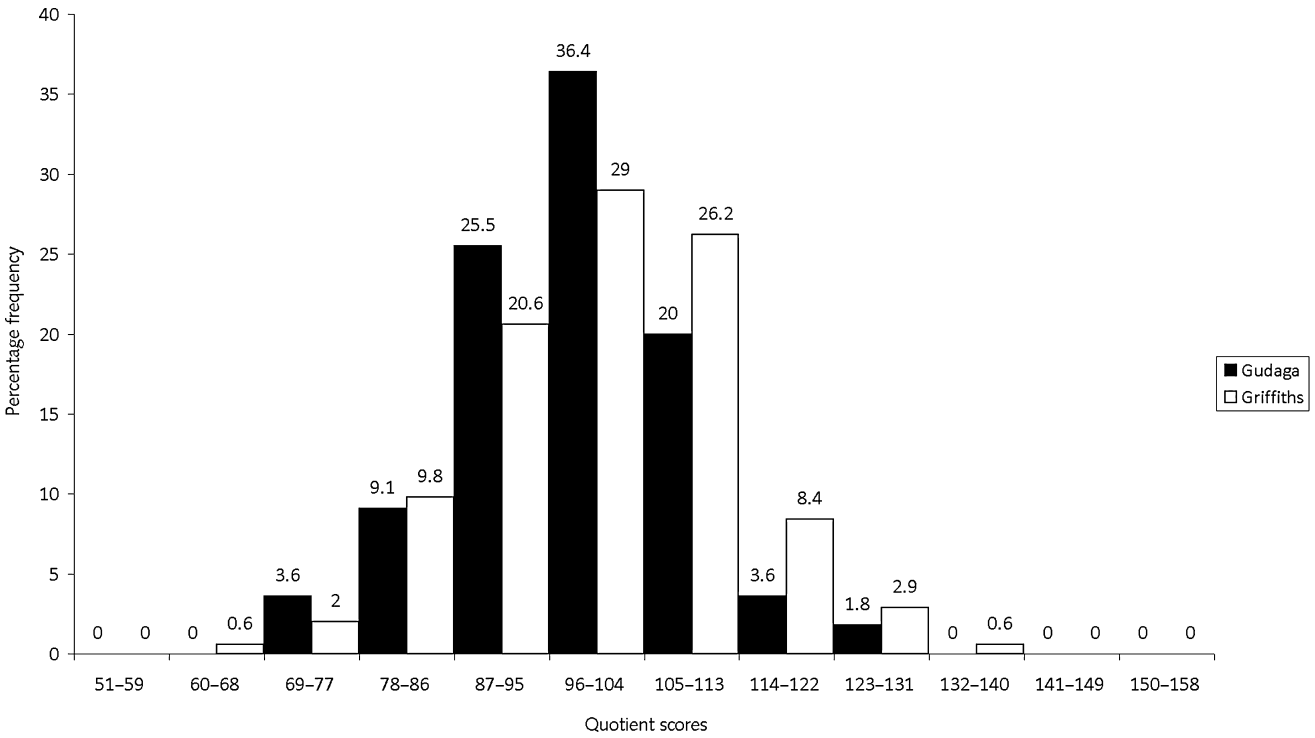

Fig. 1 Frequency distribution comparing the General Quotient scores from the Gudaga cohort sample to the Griffiths' revision sample.[17]

infants in the Gudaga cohort with scores less than two standard deviations from the Griffiths' reference sample mean. One of these infants had been identified as having developmental delay prior to this assessment and was already receiving early intervention with physiotherapy and occupational therapy. There were six infants with scores between one and two standard deviations below the mean.

In the locomotor subscale there were two participants with low scores that were more than two standard deviations below the mean and four with scores between one and two standard deviations. On physical examination there were no obvious abnormalities to account for the delay in gross motor skills of these infants. One participant in the Gudaga cohort demonstrated a high score, greater than two standard deviations from the mean score; five infants scored between one and two standard deviations above the mean.

On the personal-social subscale, no infant scored below two standard deviations from the mean, though five infants scored between one and two standard deviations below the standardised mean. There was one infant who demonstrated a high score greater than two standard deviations above the mean and four infants with scores between one and two standard deviations above the mean.

In the hearing and language subscale one infant in the Gudaga sample had a score that was more than two standard deviations below the mean. This infant was referred for a hearing test to determine whether there was adequate hearing for language development. One other infant scored between

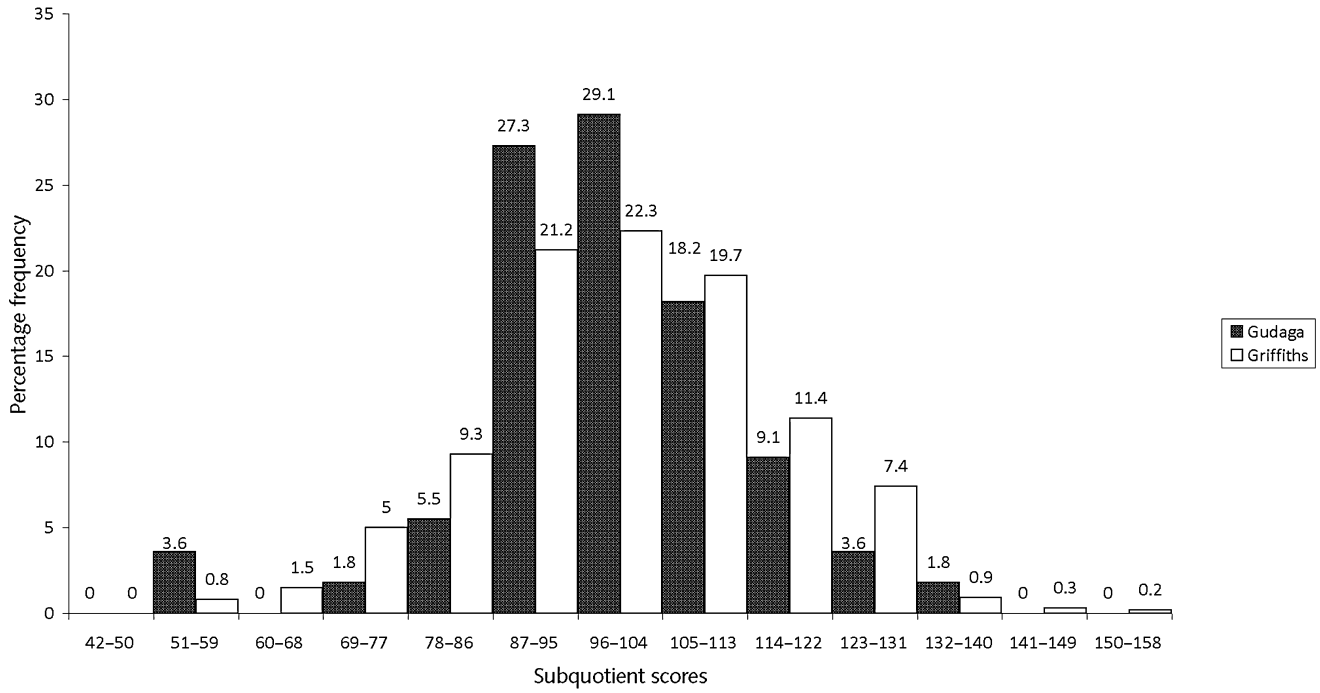

Fig. 2 Frequency distribution comparing the locomotor subscale scores from the Gudaga cohort sample to the Griffiths' revision sample.[17]

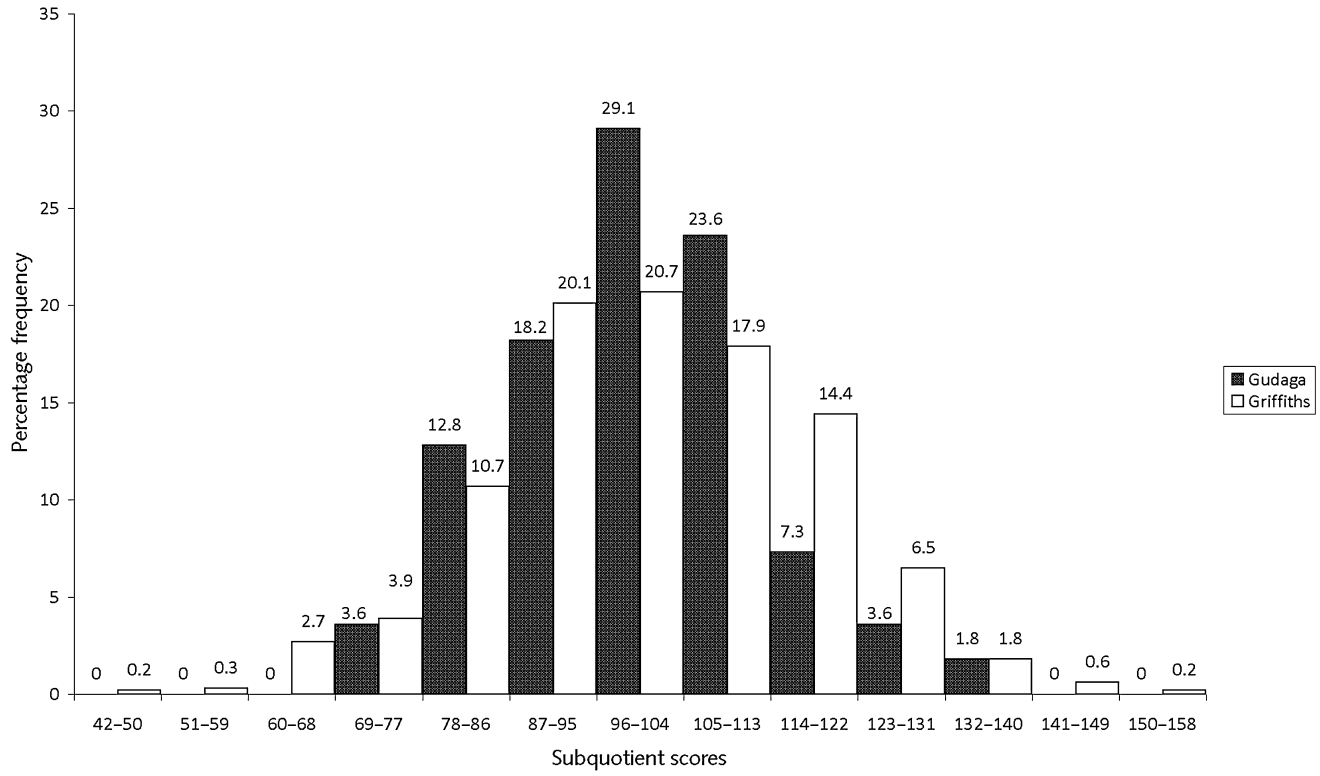

Fig. 3 Frequency distribution comparing the personal-social subscale scores from the Gudaga cohort sample to the Griffiths' review sample.[17]

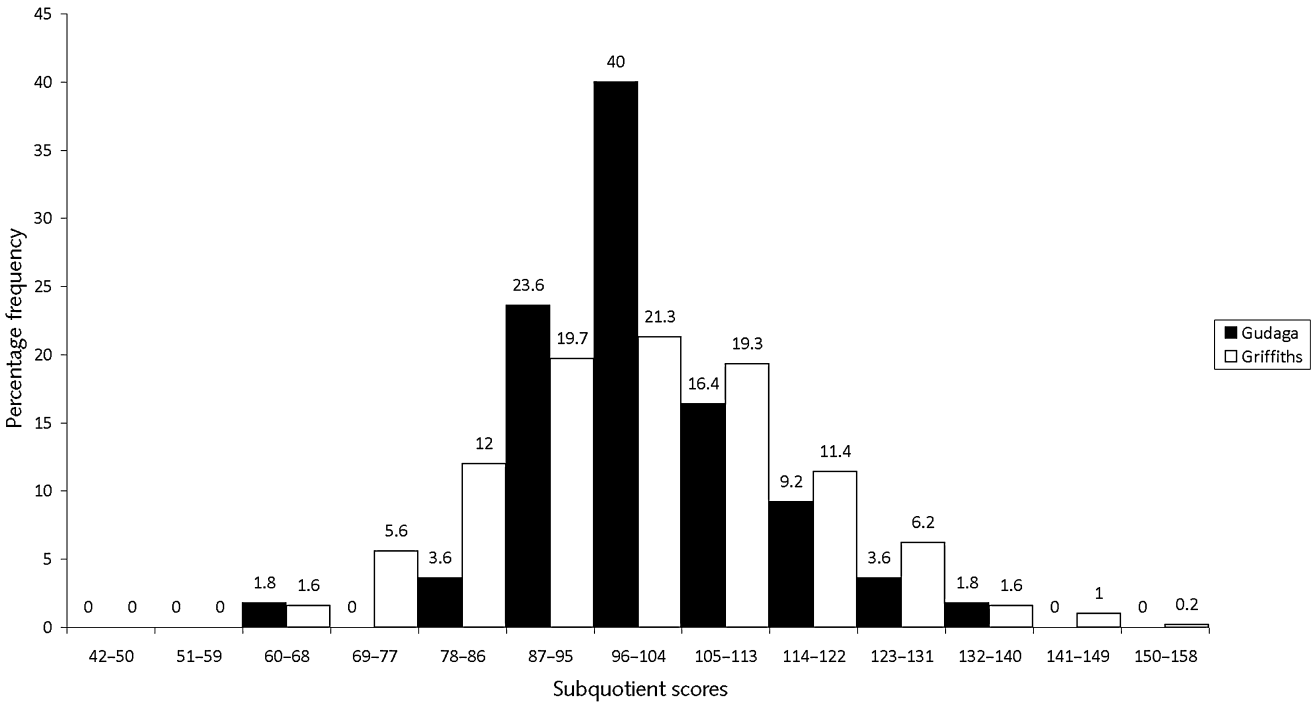

Fig. 4 Frequency distribution comparing the hearing and language subscale scores from the Gudaga cohort sample to the Griffiths' review sample.[17]

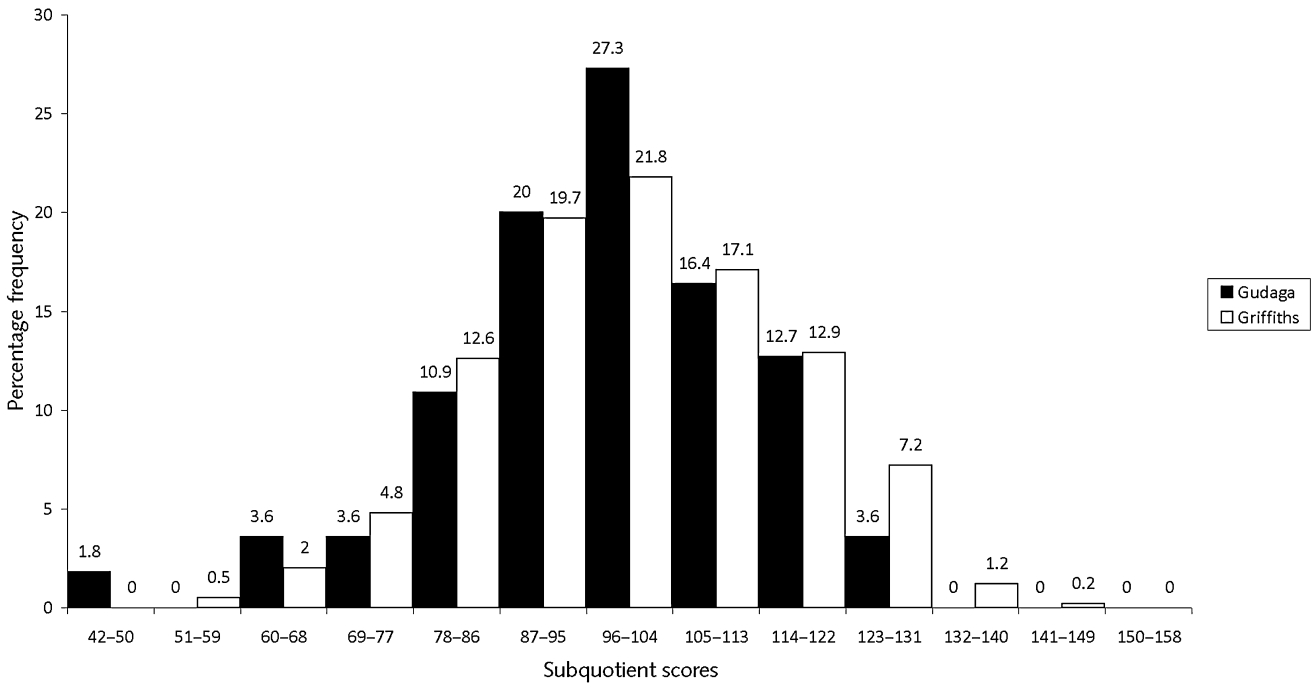

Fig. 5 Frequency distribution comparing the eye and hand coordination subscale scores from the Gudaga cohort sample to the Griffiths' review sample.[17]

one and two standard deviations below the mean. There were four Gudaga participants who scored between one and two standard deviations above the mean; no infant scored two standard deviations above the mean.

In the eye and hand coordination subscale there were three participants with low scores, greater than two standard deviations below the mean and seven with scores between one and two standard deviations below the mean. There were no

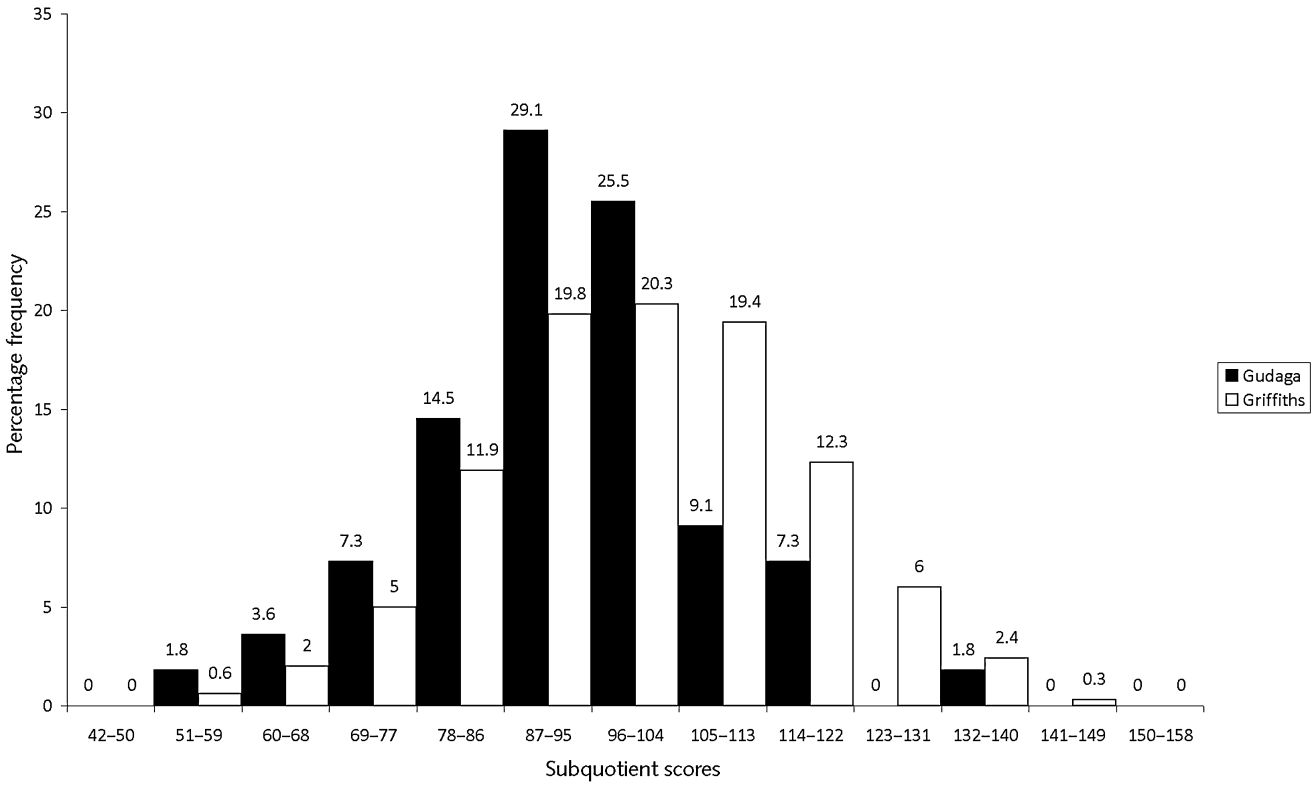

Fig. 6 Frequency distribution comparing the performance subscale scores from the Gudaga cohort sample to the Griffiths' review sample.[17]

participants from the Gudaga cohort with scores greater than two standard deviations above the mean although seven scored between one and two standard deviations above the mean.

The performance subscale was the only domain of Griffiths' testing where the mean score for the Gudaga cohort participants differed significantly to the Griffiths' revision standardisation sample (see Table 1). The Gudaga sample had a mean performance score significantly lower than the Griffiths' standardisation reference sample ($P = 0.002$). There were three participants with low scores that were greater than two standard deviations below the mean and 12 infants with scores one or two standard deviations below the mean. There was one infant in the Gudaga cohort with a high performance score greater than two standard deviations above the mean. No infant scored between one and two standard deviations.

In the individual developmental domains, a total of seven of the 55 infants participating in this pilot study achieved low scores greater than two standard deviations below the mean. A further 21 infants scored between one and two standard deviations below the mean on at least one developmental subscale. There was one infant who had low scores in multiple domains: locomotor, and eye and hand coordination (two standard deviations below the mean); and performance and personal-social (between one and two standard deviations below the mean).

There were three infants in the cohort who demonstrated high scores, greater than two standard deviations from the mean, in individual developmental domains on Griffiths' testing. One of these infants demonstrated high scores in multiple domains: performance (greater than two standard deviations above the mean); personal-social, hearing and language, and eye and hand coordination (between one and two standard deviations above the mean). A total of 14 infants scored between one and two standard deviations above the mean on at least one individual subscale.

Discussion

To our knowledge the appropriateness of using the GMDS to assess the development of a population sample of urban Australian Aboriginal infants aged 12 months of age has not been determined previously. This study was a pilot to ascertain whether the GMDS tool could be used in this population group. The finding of no significant difference between the Gudaga infants and the Griffiths' standardisation reference sample for all but one of the subscales and for the overall General Quotient would suggest that the GMDS (birth-2 years) may be an appropriate tool to use in the assessment of the early development of urban Aboriginal infants. The results also enable initial observations to be made with respect to the individual developmental subscales and function as a baseline for further developmental assessments of this cohort.

The absence of a significant difference in scores for the personal-social and hearing and language domains supports the notion that the GMDS has cultural validity for urban Aboriginal infants. In the personal-social domain parents reported their child's proficiency in early social skills and customs, such as

waving 'bye-bye', playing interactive games and assisting with self care skills.[16] These items depend on parenting skills and expectations that are culturally based. In the hearing and language domain, common household items were presented (ball, spoon, brush, car, doll, cup, sock and block). Our study population performed in the normal range for these activities suggesting these objects are culturally appropriate for urban Aboriginal infants. This was confirmed by parents, who during testing, commented that these were familiar items their infants should recognise.

The results of the performance subscale show the Gudaga cohort achieved statistically significant lower scores than the Griffiths' standardisation sample. By the time infants are 12 months of age, they are developing object permanence and an understanding of cause and effect or causality. They are also beginning to imitate increasingly complex actions such as hand clapping. The GMDS performance subscale attempts to measure the ability to apply skills such as these to new situations and tasks. Situations are presented to the infants to see if they respond at a level indicated by their stage of development as disclosed by the result in the eye and hand coordination subscale. Activities in this subscale include clicking two blocks together (in imitation); manipulating a brick-box, lid and two cubes; removing cubes from a box; inserting a circle into a form board; and unwrapping to find a toy or cube, and putting a lid back on a box.[17]

Like all of the GMDS subscales, it is possible for a well-developed child to score poorly on the performance subscale tests for a variety of reasons such as nervousness or inability to understand what is wanted in solving these simple tests. Unlike the other subsets however, it is also possible for the infant to score poorly due to a lack of experience in handling toys and materials in the very specific ways that are called for in this subscale.

The Campbelltown area contains suburbs with some of the highest levels of socio-economic disadvantage in Australia.[20] Our Project Officers, who regularly visit the mothers and infants in their homes, report that in many homes there is little, if any, evidence of educational play equipment such as puzzles and manipulative toys. Such anecdotal observations may suggest that at least some of the infants had limited experience with the type of activities included in the performance subscale. It is possible that this could be a contributing factor for the significant difference between the Gudaga cohort sample and the Griffiths' standardisation sample on this subscale.

Developmental delays are more common in socially disadvantaged environments when compared with the general population.[21] The data specific to social demographics will be considered in the analysis of the expanded Gudaga cohort rather than considered as a part of this pilot study. In the Griffiths' standardisation samples statistically significant lower scores in all subscales, except the locomotor subscale, were seen in the infants from Social Class V (parents with unskilled occupations) suggesting socioeconomic disadvantage has a significant impact upon early development.[17] Given the general high level of socioeconomic disadvantage of the study location this may impact significantly on the early development of Aboriginal infants assessed in this study. Should this be the case, it would be anticipated the effect would be across the broader developmental profile rather than restricted to the single developmental domain of performance.

Studies specifically looking at developmental delay rates among Aboriginal children suggest the rates are higher than those in non-Aboriginal children.[7,14] These studies of Aboriginal infants were however, conducted in rural and/or remote settings where cultural factors, such as English as a second language, may have impacted upon the scores obtained. All 55 infants in this study came from families where English was the first language spoken in the home. Approximately one in three of the Gudaga mothers (35.7%) are non-Aboriginal. In addition, and possibly unlike those in the cited rural/remote studies, some of the study infants, particularly those from one-parent households where the mother is non-Aboriginal, are growing up with very limited contact and exposure to their Indigenous heritage.

In discussing the results, it must be remembered that only a proportion of the cohort were assessed in this pilot study. Some caution is therefore needed in interpreting the results at this early stage as there may be changes when the results of the complete cohort are analysed. For example the subsample of the Gudaga cohort assessed in this study contained a high proportion of girls (65%); and it has been demonstrated that girls in the Griffiths' standardisation sample scored higher than boys.[17] Nevertheless, these early results are encouraging and suggest that overall the early development of Aboriginal infants is not significantly different to non-Aboriginal infants. As such the language and academic difficulties reported in other studies[15] may be preventable with early intervention.

Once the data from the entire Gudaga cohort have been analysed it will then be possible to see if there continues to be significant differences in the performance, or other, subscales. At that time possible explanations for significant differences need to be considered and recommendations for intervention made. It may then be possible to explore more fully both family and environmental factors that may influence early infant development in this population. Should the performance subscale of the Gudaga cohort infants remain significantly different to the reference group recommendations calling for interventions such as toy libraries, supported playgroups and information to parents on age-appropriate play may be called for.

The Gudaga study has recently received additional funding to continue describing the cohort until the children reach five years of age. Developmental assessments will be conducted when each child is 3 and 5 years of age, prior to school commencement. These results will provide invaluable longitudinal data on the development of the Gudaga children. It will then be possible to see if the encouraging early results in this pilot study, indicating lower than anticipated rates of developmental delay in the Gudaga cohort, remain.

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