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Describing normal development in an African setting: The utility of the Kilifi Developmental Inventory among young children at the Kenyan coast

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ABSTRACT

The Kilifi Developmental Inventory (KDI) is a tool developed in Kenya for the assessment of psychomotor development in infants and young children. We developed age-appropriate standards against which the developmental progress of individual children could be tracked. The current report is based on three studies completed among 1428 children aged between 5 and 36 months and living within rural and urban locations at the Coast of Kenya. We identified age-appropriate cut-offs and expected ranges of performance to facilitate the identification and monitoring of children with impaired psychomotor development.

1. Introduction

The Kilifi Developmental Inventory (KDI) is a culturally appropriate measure of psychomotor development designed to monitor and characterise the development of at-risk children in resource-constrained settings (Abubakar, Holding, van Baar, Newton, & van de Vijver, 2008). The KDI was developed to overcome the limitations presented by the use of standardised ready-made assessment tools developed in western countries, given that the transfer of tests to a non-western context may result in test bias and limited validity (van de Vijver, 2002). A number of these standardised Western tests such as the Bayley Scales of Infant Development (BSID; Bayley, 2006), the Ages and Stages Questionnaire (ASQ; Squires, Potter, & Bricker, 1999), the Mullen Scales of Early Development (Mullen, 1995) and the Griffiths Mental Development Scale (GMDS; Griffiths, 1984) have been used in studies of very young children in low and middle income countries (LMICs) (Boivin et al., 2013; Laughton et al., 2010; Peterson, Drotar, Olness, Guay, & Kiziri-Mayengo, 2001; Smith, Adnams, & Eley, 2008; Tsai, McClelland, Pratt, & Squires, 2006; van Rie, Harrington, & Robertson, 2007). However, the tests have required modifications in language, procedures and materials to overcome issues such as: lack of familiarity with test demands (Mulenga, Ahonen, & Aro, 2001); unfamiliarity of stimulus materials (Sigman et al., 1988); poor sampling of behaviours associated with a construct (Sternberg et al., 2002); and, difficulty in scoring. These issues may compromise test score interpretation. The KDI has undergone a rigorous process of development to take into account the local context, and is psychometrically valid and reliable in the assessment of typically developing children aged three years and under.

When developmental problems go undetected and untreated, there is an increased probability of behaviour problems, low self-esteem and loss of developmental potential (Solarsh & Hofman, 2006). In many resource-constrained settings, children with developmental delay are often denied access to appropriate education or opportunities to acquire life skills. Having an instrument which allows us to track the developmental progress of children and identify those at risk of impaired

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performance therefore provides information on typical and atypical behaviours that will inform the implementation of services to support optimal child development.

During the first two years, skill development varies widely across children (WHO Multicentre Growth Reference Study Group, 2006). For instance, while some children may walk at 8 months, others are not able to do so until 18 months; performance at both levels falls within normal ranges. Variation in skill acquisition is related to specific child-rearing practices within the child's environment which contribute to differences in the niches of development (Super, Harkness, Barry, & Zeitlin, 2011). The influence of culture has been shown on both the age at which specific skills are acquired as well as on performance levels (Lohaus et al., 2014). In the current study setting where some motor skills are specifically taught by caregivers and numerous opportunities for practice are provided, the early attainment of certain milestones was expected (Super, 1976).

The need to establish context-specific expected ranges of performance in young children is informed by the lack of normative data in many resource-constrained settings (Anderson, 2001), which in turn deters efforts to detect mild or subtle developmental impairments early in life. The current study developed age-appropriate standards against which the developmental progress of individual children could be tracked and thus promotes our understanding of normal development among young children living in coastal Kenya. Such information will contribute to a more efficient application of the KDI, and facilitate the early identification and monitoring of developmental impairments.

2. Methods

The dataset for this study was constructed from three separate studies conducted among children living in coastal Kenya and resident in one of the following districts, Kilifi, Mombasa and Msambweni. Study 1 was a cross-sectional study carried out in 2004–5, the objective of which was to develop the KDI as an instrument for monitoring child development (Abubakar, Holding, et al., 2008). Study 2 (2009–2013) and Study 3 (2010–2013) were longitudinal and children were assessed over multiple time points. The objective of Study 2 was to investigate the impact of prenatal exposure to infection on subsequent development, while Study 3 investigated the benefits of micro-nutrient supplementation in weaning foods to infant growth and development. The findings from these two latter studies are as yet unpublished.

The populations in the predominantly rural Kilifi and Msambweni Districts belong mainly to the Mijikenda ethnic/linguistic group. Two Bantu languages are commonly spoken in the area, namely Kigiriama and Kidigo (members of the Mijikenda group of languages). A typical home in these areas comprises a large homestead with several small huts built in the compound. Extended families, often including members from three generations, live together and share in the daily chores such as cooking, fetching water and childrearing duties. The pattern of child-care is common to both areas with children spending the majority of their time with older siblings/young relatives. The majority of the productive labour force years is largely engaged in agriculture-related activities on family farms or involved in trading and informal employment. Adult literacy levels are at approximately 44.9% and lower among women.

Mombasa District is more metropolitan, and has a more diverse ethnic make-up. Mombasa is Kenya's second biggest city with a population of approximately 665,000 people (National Coordinating Agency for Population and Development, 2005). Approximately 38% of the population lives below the poverty line; many live as squatters on land owned by absentee landlords or in informal settlements. Kiswahili is widely spoken as a *lingua franca*. Literacy rates for Mombasa District, at 85.8%, are significantly higher than in the rural locations. The majority of the economically active labour force is engaged in wage employment (61%), with the remainder engaged in family business and family small-holdings (National Coordinating Agency for Population and Development, 2005). Most families live in single rooms as nuclear rather than extended families, sharing utilities with other tenants, such as common water source and toilets (Kenya National Bureau of Statistics, 2010). Help with child-care, when available, is largely provided either by a hired 'ayah' (nanny) or an older sibling or neighbour.

2.1. Study participants

The combined dataset comprised a total of 1428 children. Children from Study 1 ranged in age from 5.78–35.42 months with a mean (SD) age of 18.76 (8.44). Study 2 recorded data on children aged from 4.9 months to 43.24 months, while Study 3 included assessments from age 4.3 to 35.09 months. Boys and girls were equally distributed within all the datasets. For this analysis, children were identified as falling within one of four sub-groups: Normal Growth, Underweight (Weight-for-Age Z-scores [WAZ] less than −2SD), HIV-exposed, and Both Underweight and HIV-exposed. Table 1 provides a summary of the background characteristics of the study sample.

2.2. Data collection procedures

Children's psychomotor performance was assessed using the KDI, and information on their background characteristics as detailed in Table 1 was collected through each study. The KDI psychomotor scale was designed and validated as part of a comprehensive assessment of infant development in coastal Kenya (Abubakar, Holding, Newton, van Baar, & van de Vijver, 2009; Abubakar, Holding, et al., 2008; Abubakar, van de Vijver, et al., 2008). The version of the tool used for the current study consists of 69 items, scored by a trained assessor through direct interaction with children on a range of activities. Items were scored on a dichotomous scale (0: child cannot perform the task, 1: child can perform the task). A description of the KDI locomotor and eye–hand coordination items is provided in Tables 2 and 3.

A summed scale score is calculated for two functional domains, locomotor skills and eye–hand coordination. These domain scores are combined to provide an overall psychomotor score. Locomotor items assess the child's movement in space, static and dynamic balance, and motor coordination. Items include ball and reaching skills, mobility in prone position, supine position and standing, development in climbing, and jumping. Eye–hand coordination assesses the child's ability to manipulate objects and to co-ordinate fine motor movement. Items include manipulation of coins, bead threading and block building.

All the assessment teams in the three projects comprised local residents who were fluent in the local dialects, had a minimum of 12 years of formal education, and had experience of working with young children. Each team was trained and supervised by developmental psychologists working on each project. The training consisted of a residential workshop where the team was introduced to child development concepts and assessment of children, followed by supervised practice sessions in the field. During training, the assessor was taught to recognise the developmental progression of items and to assign an appropriate score to all items.

2.3. Ethical considerations

Ethical approval for Studies 1 and 2 was provided by the Kenya Medical Research Institute's National Ethics Review Committee (KEMRI/NERC). Study 3 was approved by the Kenyatta National Hospital/University of Nairobi Ethics Review Committee (KNH/UoN ERC). The procedures used in evaluating children required that caregivers withdraw from daily activities or household chores. Permission was therefore sought from them beforehand. The risks related to child assessment, such as children or their caregivers becoming anxious, were minimised by employing examiners who were well trained in work with children and families, and who were knowledgeable of ways to reduce test-related anxiety, and sensitive to any parent or