VALIDATION OF THE CANADIAN NORMS FOR THE ALBERTA INFANT MOTOR SCALE FOR INFANTS IN A SOUTH AFRICAN REGION AGED FOUR TO TWELVE MONTHS; A PILOT STUDY

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ABSTRACT: *The Alberta Infant Motor Scale (AIMS) is a norm referenced, performance based, observational tool that assesses motor development in infants from birth up to the age of eighteen months. The AIMS has been widely used by researchers and clinicians around the world, but only a few attempts were made to validate the Canadian norms for infants residing outside Canada.*

The purpose of the study was to validate the Canadian norms of the AIMS for infants within the Cape Metropolitan region, South Africa.

A longitudinal study was conducted using the AIMS to assess the gross motor development of 67 healthy full term infants at 4, 8 and 12 months respectively.

At 4 months the mean percentile ranking was significantly higher than the Canadian norm (p=0.01), while no statistical significant differences were found at 8 and 12 months of age.

The AIMS is a valid assessment tool for healthy infants aged 8 and 12 months within the Cape Metropole, South Africa. The infants at four months of age scored higher than the Canadian norm. Further validation which incorporate larger, random samples are required to enable generalisation of the findings for the South African infant population.

KEY WORDS: *ALBERTA INFANT MOTOR SCALE (AIMS); GROSS MOTOR DEVELOPMENT; SOUTH AFRICAN INFANTS; MOTOR DEVELOPMENTAL ASSESSMENT TOOLS; INFANT MOTOR DEVELOPMENT.*

INTRODUCTION

Information on the normal gross motor skills in a healthy population is important since normative data provides a benchmark for health professionals to evaluate deviations from the norm and to provide early intervention (Piper & Darrah 1994; Mayson et al 2007). The early identification of infants with gross motor delays necessitates a reliable discrimination tool that has been standardized on a normative sample representative of the population (Mayson et al 2007). In Canada, normal referenced values for gross motor development has been established in young infants and the Alberta Infant Motor Scale (AIMS) was developed in the early 1990's by Piper & Darrah (1994) to assist with the motor assessment of young infants from birth through to independent walking. The AIMS is a norm referenced, performance based, observational measure that is used to record spontaneous movement abilities of infants from birth up to the age of eighteen months (Piper & Darrah, 1994). Spittle et al (2008) concluded in their systematic review of the clinimetric properties of nine infant neuromotor assessments tools that the AIMS demonstrated the strongest psychometric properties and the best clinical utility. The AIMS is the only infant motor assessment tool that evaluates the qualitative aspects of the infants' acquired gross motor skills as well as the functional aspects of gross motor development (Majnemer & Snider 2005).

The AIMS has sound psychometric properties, is extremely cost effective and has been widely used by researchers and clinicians around the world (Valentini & Saccani, 2012; Uesugi et al, 2008), but after an extensive literature search, only two attempts to validate the Canadian norms for infants residing outside Canada were found (Syrengelas et al 2010; Fleuren et al 2007a). The most recent and, so far, largest study conducted on 424 healthy full term Greek infants, found that except for the 2-3 month age group the mean AIMS score did not differ significantly between Greek and Canadian infants (Syrengelas et al 2010). Fleuren et al (2007a) assessed the motor performance of a 100 full term Dutch infants, aged 0 -12 months, and found that 75% of the Dutch infants scored below the 50th percentile and concluded that new

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AIMS test reference values needs to be established for Dutch children. Fleuren et al (2007a) was criticized for using a small sample (Haastert et al 2007), but argued that normative data should be applicable to small or large sample sizes (Fleuren et al 2007b).

The AIMS can easily be used in South-African government hospitals, clinics as well as rural settings since it does not require extensive training, expensive equipment or a large venue to assess the infants (Piper & Darrah 1994), however, it is not known whether the AIMS norms are appropriate for South African infants from different cultural and socioeconomic backgrounds. Rosenbaum et al (1990) and Mayson et al (2007)cautioned against the interpretation of results from discriminative motor developmental assessment tools on a population that is not the same as that on which it was validated until there is sufficient information regarding the appropriateness of comparisons amongst children of different ethnic origins. The purpose of the study was to ascertain the cross-cultural validity of the Canadian norms of the AIMS for infants aged four to twelve months within the Cape Metropolitan region. This research project served as a preliminary study for a future AIMS validation study on a larger sample of infants from all socio-economic and ethnic groups within the Western Cape, South Africa.

PARTICIPANTS AND METHODS

Recruitment of Sample

A convenient successive sampling method was used to recruit sixty seven healthy full-term (>37 weeks gestation) infants born between 1 June and 30 November 2007 from two Baby Well Clinics; a Private and Public institution, within the Cape Town Metropolitan region, South Africa. The Private Baby Well Clinic caters for infants from all races (White, Black, Coloured and Indian) in the middle to upper socio economic population and the Public Baby Well Clinic caters predominantly for infants in the lower to middle class socio-economic population within the Black, Coloured and Indian communities. At both Baby Well Clinics, a physiotherapist and/or medical doctor screened infants and only healthy full term infants with a typical motor development were included. The following exclusion criteria applied: infants born preterm (< 37 weeks gestation); birth weight of < 2500gram; infants exposed to and/or infected by HIV; infants with congenital and/or genetic disorders; infants using baby walkers as this may influence the development of milestones such as independent sitting and crawling (Burrows & Griffiths 2002; Garret et al 2002) and infants who were hospitalized for more than 25% of their lives (since prolonged hospitalization could temporarily delay gross motor development). Ethics approval was provided by the Stellenbosch University's Ethics Committee for Human Research (Ethics number: N07/09/196) and written informed consent was also obtained from the parents / legal guardians of the infants who participated in the study.

Method of data collection and procedure

A longitudinal study was conducted and incorporated three AIMS assessments opportunities to assess all infants at 4, 8 and 12 months old respectively. At both Baby Well Clinics, the assessments took place in a private room with a 1x1 metre padded mat, toys, a low table and a plinth. The infants were dressed lightly and comfortably to avoid restriction of movements. A digital video camera was used to record the infants' gross motor repertoire in four different positions, namely prone, supine, sitting and standing. The AIMS does not require the assessor to handle the infant or to facilitate movement (Piper & Darrah, 1994), but some infants were encouraged and prompted with toys to move in and out of the prone, supine, sitting and standing position. Testing procedures for the AIMS took approximately 15-20 minutes per infant, part of which was used for the infant to adapt to its surroundings. If the infant started crying, the video recording was temporarily interrupted to allow the infant to be consoled. If the infant did not settle down the mother was asked to bring the infant back and the remainder of the assessment was recorded within a week.

Instrumentation

The AIMS consists of 58 items which measure three key components of motor control namely weight bearing, postural alignment and antigravity movement in the following four positions: prone (21 items), supine (9 items), sitting (12 items) and standing (16 items). Scoring entails a dichotomous option for each of the 58 items, scored as "observed" (one point) or "not observed" (no points). The sum of total raw scores, ranging from 0 to 58, can then be converted into an age-based percentile ranking according to the normative data in the manual (Piper & Darrah, 1994). The reliability and validity of the AIMS have been well established and reported in the literature (Piper & Darrah 1994; Jeng et al 2000; Darrah et al 1998; Blanchard et al 2004; Uesugi et al 2008).

Assessment of the video recordings

The principle researcher, who received training in administrating and scoring of the AIMS, assessed and scored the infants motor capabilities while viewing the video clips directly after each of the assessments. In order to determine the interrater reliability a random subsample of 80% of each age group (4, 8 and 12 months) was assessed and scored by a second researcher (MB) with 18 years experience in the assessment and treatment of paediatric patients. Scoring was administrated exactly as specified in the AIMS administrative guideline manual (Piper & Darrah, 1994).

Statistical analysis

The infants' demographic data and their raw scores and percentile rankings were entered on an Excel spreadsheet. For interrater reliability, the intra-class correlations (ICC) were calculated. For comparison of percentile ranks against a fixed 50% percentile, one-sample t-tests were conducted. Mixed model repeated measures ANOVAs with post-hoc Bonferreni analyses were done to compare 4, 8 and 12-month rankings, taking into account gender and the clinic from which the infants came. The mixed model approach does not require complete measurements over all time points for the subjects. Thus, all data time points were included in the mixed

Table 1: Demographics and Test of means compared with the Canadian norms of Piper & Darrah (1994).

Variable	N	Female/ Male	Infants assessed at the Private Baby Well Clinic	Infants assessed at the Public Baby Well Clinic	Mean	SD	SE	Canadian Reference Constant	t-value	P value
4 Month Percentile Rank	67	37/30	20	47	56.97	22.80	2.79	50.0	2.50	0.01
8 Month Percentile Rank	50	32/18	11	39	50.22	23.98	3.4	50.0	0.06	0.95
12 Month Percentile Rank	39	24/15	9	30	48.38	26.68	4.22	50.0	-0.39	0.70

model analysis. A significance level of 5% ($p < 0.05$) was used as guidance for determining significant differences. Assumptions of normality were assessed and found to be appropriate (results not included as this is not relevant to the objectives of this study).

RESULTS

Demographic profile and the AIMS score results at 4, 8 and 12 months of age

At the 4 month assessment the sample size consisted of 67 infants; of these, 20 infants participated in the study from the Private Baby Well Clinic and 47 infants participated from the Public Baby Well Clinic. At the 8 month AIMS assessment 50 infants were assessed and 17 infants were lost to follow up. A further nine infants were lost to follow up and 39 infants were assessed at 12 months. The majority of infants at four months were Coloured (80%) followed by White (12%) and Black (8%) infants. The infants' mean percentile rankings for the Private and Public Baby Well Clinics were combined at 4, 8 and 12 months. The mean percentile ranking at 4 months was significantly higher than the Canadian norm (p=0.01) (Table 1).

Age and percentile rankings of female and male infants

From the mixed model analysis, a significant interaction effect (p=0.03) for gender and age was found. Post doc analysis revealed that at the 4 month percentile rank, female infants scored significantly higher than their male counterparts (p=0.01). Although the male infants scored slightly higher at 8 and 12 months, the difference was not statistical significant (Figure 1).

Age and percentile rankings of infants attending the Private and Public Baby Well Clinics

The interaction between age and clinic was insignificant (p=0.9) which implies that any possible clinic differences were the same at all the age time points. The clinic main effect (thus ignoring age) was not statistically significant (p=0.18), but did show a trend for the Public Baby Well Clinic to score lower (Figure 2).

Relationship between race and percentile rankings on the AIMS

The mixed model ANOVA analysis indicated an insignificant interaction between race and age (p=0.35).

Interrater Reliability

The Interclass Correlation Coefficient (ICC) for the interrater reliability between the two assessors was very high

Figure 1: Relationship between age and percentile rankings of female and male infants

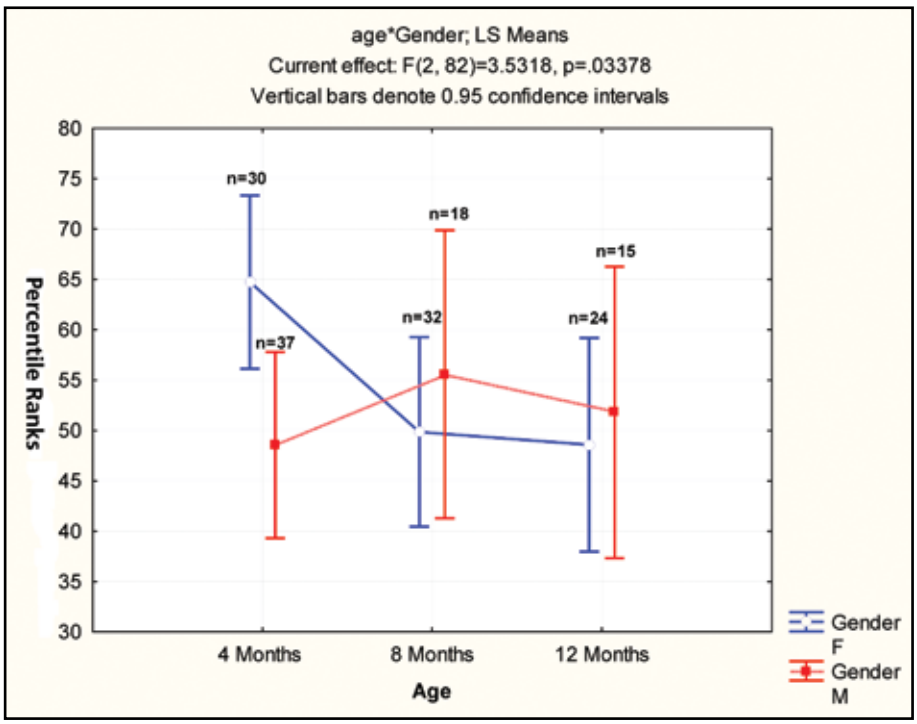
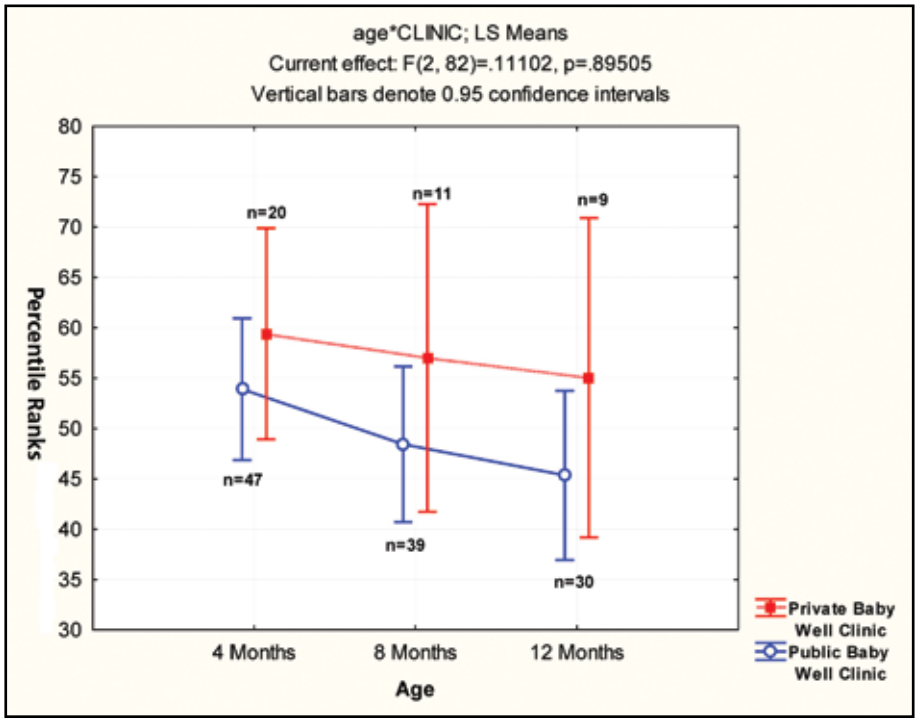


Figure 2: Relationship between age and the percentile ranks of infants attending Private and Public Baby Well Clinics



at the 4 month (ICC =0.995, Spearman r = 0.99 and p<0.01), 8 month (ICC =0.99, Spearman r=0.99 and p<0.01) and 12 month assessments (ICC=0.98, Spearman r=0.98 and p<0.01).

DISCUSSION

The main purpose of the current study was to serve as a preliminary study to validate the AIMS as a gross motor developmental assessment tool in a cohort of infants from different ethnic and socio-economic backgrounds in the Cape Metropolitan region of the Western Cape, South Africa. The overall AIMS scores of the infants included in this study compared well to the Canadian normative sample. The four month old infants (n=67), in particular the female infants, performed significantly better (p=0.01) than the Canadian norms, while the 8 and 12 month age groups did not differ significantly from the Canadian 50th percentile rank (p=0.95 and p=0.70 respectively). The reasons for the significant difference between the Canadian and South African infants at 4 months of age are not clear. One could also argue that although the mean percentile rank of the South African sample was significantly higher than the Canadian 50th percentile rank, the mean percentile difference was small (6.97%) and may not be of clinical significance. Syrengelas et al (2010) also found that the Greek infants (2-< 3 months) scored significantly (0=0.02) higher than Canadian infants, while there were no significant differences for the other age levels from birth to 18 months. They also questioned the clinical significance of the 2-< 3months score and postulated that the differences seen between Greek and Canadian infants at 2-< 3months could be due to possible differences in parental care and child rearing activities during this age period (Syrengelas et al 2010). Factors such as socio-economic status (Capute et al 1985), in addition to culture-specific care and rearing practices (WHO Multicentre Growth Reference Study Group 2006) and ethnicity (Kelly et al 2006) have been suggested to affect infant's gross motor development. However, it was beyond the scoped of this pilot study to determine potential factors that could have led to differences between the South-African and Canadian cohort.

Although comparisons were also carry out between gender, clinics and race groups these correlations were not primary objectives of this study and were exploratory to ascertain whether further investigation into these factors are warranted. A statistical significant difference was found between the motor performance of males and females at 4 months, with female infants scoring significantly better than males, while the percentile ranks of the male infants were slightly higher than the female infants at the 8 and 12 month assessments. Our results are inconsistent with reports that no gender differences could be detected for gross motor development in infants aged 4 - 60 months (Richter & Janson 2007); 6 - 11 months (de Lourdes Drachler et al 2007) and 0-18 months (Syrengelas et al 2010; Piper & Darrah 1994:198). Piper & Darrah (1994:198) initially planned to developed separate developmental AIMS norms for boys and girls, but since they found no significant gender differences at any age period, the scores for the entire sample were combined and analyzed according to age only. The largest study so far assessing sex differences and heterogeneity in motor milestone attainment amongst healthy infants from Ghana, India, Norway, Oman and the USA found that girls tended to achieve gross motor milestones at earlier ages than did boys, but stated that the magnitude of observed differences was too small and sporadic to justify sex-specific motor developmental norms (WHO Multicentre Growth Reference Study Group 2006).

The infants from the Private Baby Well Clinic scored slightly higher percentile ranks (p=0.90) than the infants from the Public Baby Well Clinic. The Public Baby Well Clinic predominantly serves a mixed race lower socio-economic population while Private Baby Well Clinic serves middle to high income residents. After an extensive search of the literature, only one report (Capute et al 1985) could be found assessing the influences of socio-economic status (SES) on gross motor development in full-term healthy infants. Findings by Capute et al (1985) differ from our results by indicated an overall moderate inverse trend between SES and gross motor function; where higher SES infants tend to score lower on gross motor gradients.

The current study reflects excellent interrater reliability values for the AIMS assessments at 4, 8 and 12 months

between two experienced and trained therapists. These findings concur with the results of previous studies using the AIMS in healthy full term infants (Piper & Darrah 1994; Syrengelas et al 2010) as well as infants born preterm (Pin et al 2010) and at risk for developmental delay (Jeng et al 2000). Blanchard et al (2004) found that the AIMS manual provides sufficient information to attain high interrater reliability amongst untrained early intervention providers from diverse professional backgrounds, but recommend that cut-off points for abnormal motor development must be established at monthly intervals. This monthly cut-off points will be extremely useful in the South-African context to assists inexperienced clinicians from diverse professional backgrounds utilizing the AIMS to identify infants who are at risk of developmental delays.

The main limitation of the study was the loss to follow up of infants resulting in only 39 infants assessed at 12 months of age. The following reasons for the lost to follow-up were given (telephonic correspondence with the parents): parent(s) had to go back to work after 4 months maternity leave and enrolled their infants with a crèche or day mother who in turn was not able to bring the infant for the assessments; infants who participated in the study were also healthy and therefore some parent(s) did not see the necessity to participate in follow up assessments. Infants were also lost to follow up because parent(s) changed contact details such as telephone numbers and addresses and did not notify the principal researcher or leave forwarding details of their whereabouts. Loss to follow-up is unfortunately a reality in South-Africa due to inadequate communications systems (with only a few of the mothers being contactable by phone) and migrant families frequently having to change their address details, as well as the insufficient and expensive public transport that is often the only means of accessing the relevant healthcare resources (Kirsten et al 1995).

The second limitation of the study was that the infants were assessed quarterly up to 12 months instead of monthly. We strongly recommend future South-African validation studies follow the methodology described by Syrengelas et al (2010). Rather than follow the same group of infants over time, with the risk of loss to follow-up, a large group of ethnical diverse infants can be divided based on their age into 18 parts (month 1-18) for each month from birth up to 18 months. This will be a feasible way to determine if new normative data and reference values need to be established for South-African infants, particularly around the 4 month, since the current study found significant differences between the Canadian and South African cohort at 4 months of age. Due to the loss of follow-up of infants at the 8 and 12 month assessments as well as the small race group sample for black and white infants, the influences of gender, race and SES on gross motor development were not clear, but did show trends for possible differences between the groups. Further research is necessary to verify and explain the role of gender, SES and race on gross motor development in South-African infants.

CONCLUSION

The results yielded by this pilot study demonstrate that the AIMS can be utilized as a reliable and cost-effective tool by paediatric health care professionals in the Cape Metropole, South Africa to assess the gross motor acquisition of infants at 8 and 12 months of age. Care should be taken when comparing infants at 4 months of age to the Canadian normative sample, since South-African infants, especially the female infants may score significantly higher. Further research also needs to be undertaken to determine if the AIMS is valid for the greater South African infant population and to verify and explain the role of gender, ethnicity and SES on gross motor development.

CONFLICTS OF INTEREST

The authors have no financial, personal, political or intellectual conflicts of interests to disclose. The Harry Crossly Foundation (study sponsor) had no role in the study design; collection, analysis, and interpretation of data; the writing of the report; and the decision to submit the manuscript for publication.

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REFERENCES

Blanchard Y, Neilan E, Busanich J, Garavuso L, Klimas D 2004 Interrater Reliability of Early Intervention Providers Scoring the Alberta Infant Motor Scale. Pediatric Physical Therapy 16: 13-18.

Burrows P, Griffiths P 2002 Do baby walkers delay onset of walking in young children? British Journal of Community Nursing 7:581-586.

Capute AJ, Shapiro BK, Palmer FB, Ross A, Wachtel RC 1985 Normal gross motor development: The influences of race, gender, socioeconomic status. Developmental Medicine and Child Neurology 27:635-643.

Darrah J, Piper M, Watt MJ 1998 Assessment of gross motor skills of at risk infants: predictive validity of the Alberta Infant Motor Scale. Developmental Medicine and Child Neurology 40:485-491.

de Lourdes Drachler M, Marshall T, de Carvalho Leite JC 2007 A continuous-scale measure of child development for population based epidemiological surveys: a preliminary study using Item Response Theory for the Denver Test. Paediatric and Perinatal Epidemiology 21:138–153.

Fleuren KMV, Smit LS, Stijnen TH, Hartman A 2007a New reference values for the Alberta Infant Motor Scale need to be established. Acta Paediatrica 96:424-427.

Fleuren KMV, Smit LS, Stijnen TH, Hartman A 2007b Should new reference values on the AIMS test need to be established for Dutch children? – Reply Acta Paediatrica 96:1111-1112.

Garret M, McElroy AM, Staines A 2002 Locomotor milestones and babywalkers: cross sectional study. British Medical Journal 324:1494.

Haastert IC, Eijsermans MJC, de Vries LS 2007 Should new reference values on the AIMS test need to be established for Dutch children? Acta Paediatrica 96:1110-1111.

Jeng SF, Yau KIT, Chen LC, Hsiao SF 2000 Alberta Infant Motor Scale: Reliability and Validity when used on Preterm Infants in Taiwan. Physical Therapy 80:168-178.

Kelly Y, Sacker A, Schoon I, Nazroo J 2006 Ethnic differences in achievement of developmental milestones by 9 months of age: the Millennium Cohort Study. Developmental Medicine and Child Neurolog 48:825-830.

Kirsten GF, Van Zyl JI, Le Grange M, Ancker E, Van Zyl F 1995 The outcome at 12 months of very-low-birth-weight infants ventilated at Tygerberg Hospital. South African Medical Journal, 85:649-54.

Majnemer A, Snider L. 2005 A Comparison of Developmental Assessments of The Newborn and Young Infant. Mental Retardation and Developmental Disabilities Research Reviews, 11:68-73.

Mayson TA, Harris SR, Bachman CL 2007 Gross Motor Development of Asian and European Children on Four Motor Assessments: A Literature Review. Pediatric Physical Therapy 19:148-153.

Pin TW, de Valle K, Eldridge B, Galea MP 2010 Clinimetric Properties of the Alberta Infant Motor Scale in Infants Born Preterm. Pediatric Physical Therapy 22:278-286.

Piper MC, Darrah J 1994 Motor Assessment of the Developing Infant. Philadelphia: W B Saunders Company.

Richter J, Janson H 2007 A validation study of the Norwegian version of the Ages and Stages Questionnaires. Acta Pædiatrica 96:748–752.

Rosenbaum PL, Russell DJ, Cadman DT, Gowland C, Jarvis S, Hardy S 1990 Issues in Measuring Change in Motor Function in Children with Cerebral Palsy: a Special Communication. Physical Therapy 70:125-131.

Spittle AJ, Doyle LW, Boyd RN 2008 A systematic review of the clinimetric properties of neuromotor assessments for preterm infants during the first year of life. Developmental Medicine and Child Neurology, 50:254-266.

Syrengelas D, Siahanidou T, Kourlaba G, Kleisiouni P, Bakoula C, Chrousos GP 2010 Standardization of the Alberta infant motor scale in full-term Greek infants: Preliminary results. Early Human Development 86:245-249.

Uesugi M, Tokuhisa K, Shimada T 2008 The reliability and validity of the Alberta Infant Motor Scale in Japan. Journal of Physical Therapy Science 20:169-175.

Valentini NC, Saccani R 2012 Brazilian validation of the Alberta Infant Motor Scale. Physical Therapy 92:440-447.

WHO Multicentre Growth Reference Study Group 2006 Assessment of sex differences and heterogeneity in motor milestone attainment among populations in the WHO Multicentre Growth Reference Study. Acta Pædiatrica Suppl 450: 66-75.