Early Human Development 89 (2013) 747–754

Contents lists available at SciVerse ScienceDirect

Early Human Development

journal homepage: www.elsevier.com/locate/earlhumdev

Motor skills at 23 years of age in young adults born preterm with very low birth weight

Ingrid Marie Husby [a,*], Jon Skranes [a,b], Alexander Olsen [c,d], Ann-Mari Brubakk [a,e], Kari Anne I. Evensen [a,f,g]

[a] Department of Laboratory Medicine, Children's and Women's Health, Norwegian University of Science and Technology, Trondheim, Norway
[b] Department of Pediatrics, Sørlandet Hospital, Arendal, Norway
[c] MI Lab and Department of Circulation and Medical Imaging, Norwegian University of Science and Technology, Trondheim, Norway
[d] Department of Physical Medicine and Rehabilitation, St. Olavs Hospital, Trondheim University Hospital, Trondheim, Norway
[e] Department of Pediatrics, St. Olavs Hospital, Trondheim University Hospital, Trondheim, Norway
[f] Department of Public Health and General Practice, Norwegian University of Science and Technology, Trondheim, Norway
[g] Department of Physiotherapy, Trondheim Municipality, Norway

ARTICLE INFO

Article history:
Received 20 December 2012
Received in revised form 23 May 2013
Accepted 28 May 2013

Keywords:
Fine motor skills
Gross motor skills
Grooved Pegboard test
High-level Mobility Assessment Tool
Long-term outcome
Motor speed
Movement Assessment Battery for Children-2
Prematurity
Trail Making Test-5

ABSTRACT

Background: Motor skills have previously not been reported in young adults born with very low birth weight (VLBW), although they are commonly reported in children and adolescents.
Aim: To compare fine and gross motor skills in VLBW young adults with matched term-born controls, and to study longitudinal changes in the VLBW group.
Study design: A geographically based follow-up study of a VLBW group and a control group.
Subjects: Thirty-six VLBW (birth weight ≤ 1500 g) young adults, including four participants with cerebral palsy (CP), and 37 matched controls (birth weight ≥ 10th centile) were examined at 14 and 23 years of age.
Outcome measures: Fine and gross motor skills were assessed using Grooved Pegboard test (GP), Trail Making Test-5 (TMT-5), Movement Assessment Battery for Children-2 (Movement ABC-2) and High-level Mobility Assessment Tool (HiMAT).
Results: VLBW young adults were slower than controls on GP ($p = 0.026$) and TMT-5 ($p < 0.001$). Mean total Movement ABC-2 score was 69.7 ± 20.2 in the VLBW group compared with 74.1 ± 14.4 in the control group ($p = 0.017$). Differences were also seen in manual dexterity and balance. Additionally, HiMAT showed reduced balance and speed in gross motor skills in the VLBW group. The proportion of participants with motor problems did not change between age 14 and 23. After exclusion of participants with CP, scores were essentially the same.
Conclusion: VLBW young adults had overall poorer fine and gross motor skills compared with controls. Reduced speed seemed to be an underlying problem. Longitudinal findings indicate that VLBW children have not outgrown their motor problems when entering adulthood.

1. Introduction

Long-term disability as a consequence of prematurity has been increasing during the last decades, as more of these infants survive [1–3]. In very low birth weight children (VLBW; birth weight ≤ 1500 g), the rate of brain injury is high [4], and cognitive, neurosensory and neuromotor disabilities, including cerebral palsy (CP), are common [1,5–7]. Signs of perinatal white matter injury that influences white matter development and maturation are seen on magnetic resonance imaging of the brain in VLBW populations from birth to young adulthood [8–10], which also have been shown to correlate with motor problems in VLBW children and adolescents [11–15]. Myelination deficits also affect connectivity, and may lead to slower signalling in the brain. A meta-analysis of 41 studies on motor outcome, have documented poorer fine and gross motor skills in very preterm and VLBW children from childhood to adolescence [16]. This was most pronounced for balance skills, then manual dexterity and to some extent, ball skills [16]. To our knowledge, none have yet reported on motor skills in adulthood. Both fine and gross motor skills influence leisure and social activities, daily tasks, work and academic achievement, which may be increasingly important as young adults enter independent living.

The aim of this study was to compare fine and gross motor skills in VLBW young adults with matched term-born controls, using well known motor tests and a new assessment tool measuring gross motor skills. Additionally, we wanted to study longitudinal changes from adolescence to adulthood. Based on previous research, we hypothesized that young adults born preterm with VLBW have poorer

* Corresponding author at: Norwegian University of Science and Technology, Faculty of Medicine, Department of Laboratory Medicine, Children's and Women's Health, P.O. Box 8905, 7491, Trondheim, Norway. Tel.: +47 48 13 25 90; fax: +47 73 86 77 08.
E-mail address: ingrihu@stud.ntnu.no (I.M. Husby).

0378-3782/$ – see front matter © 2013 Elsevier Ireland Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.earlhumdev.2013.05.009

fine and gross motor skills than controls, especially regarding balance, manual dexterity and timed performances, and that performance does not improve with time.

2. Methods

2.1. Study design

This is a matched case–control study of 23-year-old adults born preterm with very low birth weight (VLBW) and a control group born at term with normal birth weight. The VLBW children had been admitted to the Neonatal Intensive Care Unit (NICU) at St. Olavs Hospital, Trondheim University Hospital, Norway, in 1986–88. These same VLBW children have previously participated in a longitudinal follow-up study at the Norwegian University of Science and Technology, Trondheim with evaluations at 1, 5 and 14 years of age [17–19]. The controls were from the same geographical area as the VLBW children, born in the same period at the same hospital, and were originally recruited through a multicenter study on causes and consequences of intrauterine growth restriction. This group has served as controls in the follow-up study at all time points. At 23 years of age, fine and gross motor skills were assessed as part of a larger assessment battery, also including MRI and mental health questionnaires.

2.2. Study groups

2.2.1. VLBW group

The VLBW group comprised 36 young adults (15 males and 21 females) born preterm (before 37th week of gestation) with birth weight ≤1500 g. At 14 years of age, 63 adolescents met for examination. At 23 years, seven of these young adults were non-traceable and two were not testable due to severe quadriplegic CP. Thus, we contacted 54 VLBW young adults, thereof 18 (33%) did not consent, leaving 36 (67%) young adults for examination. Four (11%) of these had CP; one female had spastic hemiplegia with functional level I and three males had spastic diplegia with functional levels I, II and IV according to the Gross Motor Function Classification System (GMFCS) [20].

2.2.2. Control group

The control group comprised 37 young adults (15 males and 22 females) born with a birth weight ≥10th centile for gestational age. We contacted 48 controls matched to the VLBW participants by age and sex. Of these, 46 had met at the 14 year examination. Two of the contacted controls were not testable due to pregnancy, five had moved too far away and four did not consent.

2.2.3. Non-participants

There were no significant differences regarding data collected around birth; birth weight, gestational age, head circumference, Apgar scores, days in NICU, days on mechanical ventilator, proportion of infants with intraventricular haemorrhage (IVH) and maternal age, or parental socioeconomic status (SES) and motor skills at 14 years of age between those who participated at follow-up at 23 years of age and those who did not give their consent to participate in the VLBW group. In the control group, we did not find any differences between those who participated at 23 years of age and those who did not consent or were not contacted from previous follow-up (Table 1).

2.3. Methods

2.3.1. Clinical characteristics

Data collected around birth included birth weight, gestational age, head circumference, Apgar scores, days in NICU, days on mechanical ventilator, IVH and maternal age. Parental SES was calculated according to Hollingshead's Two factor index of social position [21] at 14 years of age, based on a combination of parents' education and occupation. CP was diagnosed in childhood, and classified as spastic hemiplegia (unilateral), diplegia (bilateral, most involvement in lower extremities) or quadriplegia (involvement of all extremities). Functional level was assessed according to the GMFCS [20].

At 23 years of age, weight was measured on an electronic scale (to nearest 10 g). Height was self-reported or measured if the participant did not know. Body mass index (BMI) was calculated from these two measures (kg/m^2). Head circumference (occipital frontal circumference) was measured to the nearest 0.1 cm. Handedness was assessed by the Edinburgh Handedness Inventory [22], which gives a laterality index determined by the dominance of a person's right or left hand in 12 everyday activities. The laterality index ranges from −100 for complete left-handedness, to +100 for complete right-handedness. The participants answered questionnaires regarding recent injury, recent illness, current medication usage, pain, exercise and education. Pain was reported with VAS (Visual Analogue Scale). The participants recorded their weekly frequency and duration of exercise (if any) and number of exercise activities performed regularly. Education was dichotomized into “high school completion plus higher education admissions” and “incomplete high school plus vocational training”.

2.3.2. Motor examination

Fine and gross motor skills in young adults were assessed by three examiners; two physiotherapists and one master student in movement science. All testers were blinded to neonatal history, clinical characteristics and results from previous follow-up, but not to group adherence.

2.3.3. Grooved Pegboard test (GP)

The GP [23] is a manipulative dexterity test which requires complex visual–motor coordination and measures how quickly the participants can insert pegs into 25 keyhole-shaped holes with various orientations in a 5 × 5 matrix. Time (in seconds) and number of drops are registered for each hand individually. In the current study, one VLBW participant with spastic diplegic CP was not able to perform this test due to attention problems. Poor performance was defined as scores >2SD of the mean in the control group.

2.3.4. Trail Making Test-5 (TMT-5)

The TMT-5 measures motor speed and consists of 32 circles linked with a dotted line on a paper. The task is to draw a line between the circles in the order directed as fast as possible, touching all the circles. Time (in seconds) and errors (number of circles missed) are measured. The TMT-5 is one of five TMT subtests in the standardized Delis–Kaplan Executive Function System (D–KEFS) [24]. The other TMT subtests measure visual scanning, attention, working memory and number–letter sequencing, which we considered less relevant for the aim of this study because they are more related to executive functions than to motor skills.

2.3.5. Movement Assessment Battery for Children-2 (Movement ABC-2)

The Movement ABC-2 [25] is the revised version of the standardized Movement ABC which identifies and evaluates children's motor development. The test is divided into three age bands, where the highest age band (up to 16 years and 11 months) was used in this study. The test consists of eight items grouped into three subscales of “manual dexterity” (three items), “aiming and catching” (two items), and “balance” (three items). The raw scores (for instance number of seconds to complete a task) are converted into item standard scores, which add up to a component score for the three subscales. The total test score of maximum 108 points is the sum of the three component scores, where a higher score indicates better motor skills. Motor problems were defined as scores <5th centile in the control group.

2.3.6. High-level Mobility Assessment Tool (HiMAT)

The HiMAT [26] is a new test specifically developed to examine high-level mobility following traumatic brain injury (TBI), although