Normative Neurobehavioral Performance of Healthy Infants on the Neonatal Intensive Care Unit Network Neurobehavioral Scale

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ABSTRACT. - Descriptive statistics for the Neonatal Intensive Care Unit Network Neurobehavioral Scale summary scores are provided for a sample of 125 full-term, healthy 1- to 2-day-old infants. The study sample is described, including demographic characteristics and infant and maternal medical characteristics. Descriptive statistics and percentiles are provided for the Neonatal Intensive Care Unit Network Neurobehavioral Scale summary scores. These tables can be used as quasinorms for comparison with other infants of this age. Pediatrics 2004;113:676–678; healthy, neurobehavior, newborn, NNNS, norms, preterm.

Effectively, the data can be used in the way that standardized data such as the Bayley Scales of Infant Development–Second Edition are used.

The data reported include means, medians, ranges, standard deviations (SDs), and percentiles for the NNNS 13 summary scale scores. Tables of individual items can be obtained from the first author. These data were gathered as part of a larger project to standardize the NNNS.

METHODS

Subjects

The sample consisted of 125 newborns. Of the 639 screened, 217 met criteria. Mothers of infants who met criteria were asked for their informed consent. Of the 217 mothers approached, 203 agreed to the study. Of these, 61 could not be examined for technical reasons (eg, went home, were nursing at the time of the examination). This left a sample of 142. Examinations were administered to these 142 newborns, but after additional examination of the medical records, 17 newborns were found not to have met selection criteria. This resulted in a final sample of 125 newborns. Neither the refusers nor the technical failures differed from the final sample of 125 on demographics or medical status.

Selection Criteria

Infants were selected to meet the following conditions: infants had to be full-term at delivery, have a gestational age of 38 weeks 0 days through 41 weeks 6 days, have a birth weight between the 10th and 90th percentiles, and have a score of 7 or higher on the 5-minute (or second) Apgar. In addition, infants had to be discharged from the hospital with the mother within 3 days of the infant’s birth (or 4 days for infants who were delivered by cesarean section). Both male and female infants were recruited. Infants with the following conditions were excluded: admission to the neonatal intensive care unit (NICU) for any reason, major malformations (eg, spina bifida), chromosome abnormalities (eg, trisomy 21, 18, 13), major sensory deficits (eg, blindness), neurologic syndromes or disorders (eg, neonatal white matter disorder, any intraventricular hemorrhage, hypoxic ischemic event, seizures), 1 of a multiple birth, surgical intervention, exposure to illegal substances, evidence of fetal alcohol syndrome or evidence of exposure to high levels of alcohol during gestation, any bilirubin treatment within 24 hours of examination (which effectively excluded infants with high bilirubin levels), or circumcision within 12 hours of examination. Infants were also excluded when their mother was not between 18 and 39 years of age and did not have 2 prenatal visits, had a condition or illness known to affect the fetus or newborn (eg, insulin dependence, hypothyroidism, chemotherapy treatment), was hospitalized during the pregnancy for a condition that might affect the infant (eg, infectious disease), was positive for human immunodeficiency virus or using medications for chronic conditions (eg, seizures, affective disorders), had an identified psychosis, or was mentally retarded. Mothers were recruited regardless of race/ethnicity.

Recruitment Procedure

Newborns were recruited on the well-child nurseries at Brigham and Women’s Hospital. All infants who met criteria were
identified on the basis of nursing reports and review of the medical record. When >1 infant met criteria, the infants were ordered randomly. The parents of the first infant were approached and recruited. If the parents refused, then the next parents of an infant who met criteria were approached until a subject was recruited. Informed written consent was obtained from the parent(s).

**Examiner Training and Reliability**

Two research assistants were trained by 2 NNNS certified trainers. Both their administration and reliability of scoring were evaluated. Reliability was set to the criteria used on other neurobehavioral examinations of no more than two 2-point disagree-
ments on items with ≥9 scale points, and for items with ≤5 scale points, agreement had to be exact with no more than 5 disagreements. At the end of training, reliability of scoring of each research assistant was evaluated by having each research assistant administer the NNNS with the NNNS trainer observing and then scoring the examination independently. Reliability was checked over the course of data collection by having the research assistants evaluated against the master trainer and also by having 1 research assistant administer the NNNS with the other research assistant observing and then scoring the examination independently. All examinations were observed and scored independently by a second, trained, and reliable research assistant. Disagreements were resolved in conference with the NNNS trainer. These procedures maintained a high level of quality control for this gold standard study.

Data Reduction
Means, SDs, range, median, mode, and 10th through 90th percentiles were calculated for the NNNS summary scores: habituation, attention, arousal, regulation, number of handling procedures, quality of movement, number of nonoptimal reflexes, number of asymmetric reflexes, hypertonicity, hypotonicity, and stress/abstinence, excitability, and lethargy (see Appendix 2 later in this issue).

RESULTS
Demographic data on the mothers and fathers of the infants are shown in Table 1. The data indicate that the sample is at low social and demographic risk.

Medical data on the infants and mothers are shown in Table 2. The data demonstrate that the infants and mothers were at low medical risk. Table 3 presents the data on the NNNS summary scores. These scores indicate the NNNS performance levels of a sample of ~1-day-old (mean age of testing was 30 hours) healthy infants.

DISCUSSION
The data presented are for a sample of infants who were selected for clinically optimal health status. Using these data, clinicians will be able to assess the neurobehavioral performance of an infant in their care and compare the infant’s performance against the NNNS data and to integrate this information with their clinical experience. Researchers will be able to evaluate the performance of infants who have specific medical conditions or are receiving specific treatments.

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REFERENCES
Normative Neurobehavioral Performance of Healthy Infants on the Neonatal Intensive Care Unit Network Neurobehavioral Scale
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The online version of this article, along with updated information and services, is located on the World Wide Web at:
/content/113/Supplement_2/676.full.html