**Supplement 1**

**Measures of Early Social Environment**

| Measure | Items | Coding |
|---|---|---|
| Socio-economic status (SES) | Standardized interview with parents using a weighted composite score of maternal highest educational qualification, paternal highest educational qualification and occupation of the head of the family to assess parents' SES. Scores were grouped into low (32.4%), middle (47.1%), and high (20.5%) SES.[1] | SES1<br>(1) = high SES<br>(0) = low/middle SES<br><br>SES2<br>(1) = low SES<br>(0) = high/middle SES |
| Family Adversity Index (FAI) | Standardized interview with parents to assess potential family risk factors according to criteria by Rutter and Quinton.[2] A sum score was calculated comprising 8 items answered yes (1) or no (0): (1) young parenthood (mother < 20 years), (2) overcrowded living space (<15 $m^2$ per person), (3) mother or father without school qualifications, (4) single parenting, (5) ≥ 4 children, (6) infant needs home or involvement foster care, (7) no social support available in emergency situation, (8) mother or father with psychiatric problems.[3] Sum scores were grouped into low (score 0; 23.5%), middle (score 1; 41.1%), and high (score 2-8; 35.4%). | FAI1<br>(1) = high FAI<br>(0) = low/middle FAI<br><br>FAI2<br>(1) = low FAI<br>(0) = high/middle FAI |
| Psycho Social Stress Index (PSI) | Standardized interview with the most important attachment person of the infant (usually the mother) to assess family-related problems and trouble.[4] A sum score was calculated comprising 14 items answered yes (1) or no (0): (1) recent death of a family member/close relative/friend, (2) financial difficulties, (3) behavior or health problem of a sibling, (4) partnership problems, (5) serious conflicts with family or friends, (6) maternal health problems, (7) maternal psychiatric problems, (8) maternal work-related burnout, (9) mother has no time for her own interests, (10) paternal health problems, (11) paternal psychiatric problems, (12) paternal work-related burnout, (13) social isolation, (14) father has no time for her own interests. Sum scores were grouped into no psychological stress (score 0; 65.0%) and some degree of psychosocial stress (score 1-14; 35.0%) | PSI<br>(0) = no psychosocial stress<br>(1) = some degree of psychosocial stress |
| Parent–Infant Relation-ship Index (PIRI) | Standardized interview with parents (SI) and research nurses' observations (NO) of attachment-related parental concerns, feelings, and behavior.[4] All research nurses were trained in advance, but inter-rater agreement was not assessed. The scale comprised 8 items of yes (1) or no (0) ratings on the | PIRI<br>(0) = no concerns for the parent–infant relationship<br>(1) = some degree of concern for the parent–infant relationship |

| | | |
|---|---|---|
| | following items: (1) mother does not yet know the infant (SI), (2) mother visits the infant once a week or less (SI), (3) father visits the infant less than once a week (SI), (4) mother is insecure when taking care of the child at home (SI), (5) mother shows little pleasure when interacting with the child (NO), (6) father shows little pleasure when interacting with the child (NO), (7) the probability that these parents develop problems in taking care of the infant is high (NO), (8) mother has trouble building a relationship with the child (SI). First, a sum score was calculated by adding one point for each 'yes' answer. As the resulting sum score did not show a normal distribution as most parents reported and demonstrated a good relationship with their infant, the sum score was recoded into no concerns for the parent–infant relationship (score 0; 52.0%) and some degree of concern for the parent–infant relationship (score 1-8; 48.0%). | |
| Breast milk | Standardized interview with the mother at 5 months. Answers were grouped as follows: Has been or still is breastfeeding or has or still is providing expressed breast milk (26.8%) and never breastfed or provided expressed breast milk (73.2%). | Breast milk<br>(0) = no breast milk<br>(1) = some degree of breast milk |

## References


1. Bauer A. Ein verfahren zur messung des für das bildungsverhalten relevanten Status (BRSS) [A procedure for the measurement of social status related to educational behaviour (BRSS)]. Frankfurt: Deutsches Institut für Internationale Pädagogische Forschung 1988.
2. Rutter M, Quinton D. Psychiatric disorders: Ecological factors and concepts of causation. In: McGurk M, ed. Ecological factors in human development. Amsterdam: North Holland Press 1977:173-87.
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4. Riegel K, Ohrt B, Wolke D, et al. Die Entwicklung gefährdet geborener kinder bis zum fünften lebensjahr. [The development of children born at risk until their fifth year of life]. Stuttgart, Germany: Ferdinand Enke Verlag 1995.

## Supplement 2

## Predicting Moderate to Severe Cognitive Impairment

Of the whole VP/VLBW sample, 69 adults (26.5%) were found to have moderate to severe cognitive impairment. Of these 69 adults, 58 (84.1%) were assessed at 26 years, and the remaining 11 adults (15.9%) were diagnosed with cognitive impairment in childhood yet lacked an adult IQ assessment.

Supplementary Table S2.1 presents the results of the logistic regression analyses. Pregnancy complications did not predict which VP/VLBW infants would develop a cognitive impairment in adulthood. Concerning neonatal morbidity, every week that birth was delayed decreased the odds 1.19 times to develop a cognitive impairment. Likewise, every SD increase in head circumference corrected for gestational age decreased the odds 1.35 times. Also, developing a cognitive impairment was more likely when the infant suffered from RDS (2.49 times more likely), BPD (2.40 times), neonatal seizures (4.15 times), and IVH (3.07 times). In addition, every day the infant showed problems in the quantity and quality of mobility, muscle tone, or neurological excitability increased the odds to develop a cognitive impairment, with odd ratios ranging between 1.02-1.03 for each observed day of problems. Corrected for all significant predictors, head circumference was the best predictor (Table S2.2). With regard to neonatal treatment, every day the infant was treated with oxygen supplementation, mechanical ventilation, gavage, or parenteral nutrition increased the likelihood of developing a cognitive impairment with 1.03-1.05 for each day of extra treatment. Taken all significant predictors together, mechanical ventilation and parenteral nutrition uniquely predicted the development of cognitive impairment. With regard to early social environmental factors, developing a cognitive impairment is 2.53 times less likely when VP/VLBW infants came from a family of high SES compared to middle SES, 2.96 times more likely in the case of

poor early parent-infant relationships and 2.27 times more likely when mothers did not provide breast milk to their infant. However, breast milk was not significantly related to cognitive impairment after correction for SES and parent-infant relationships.

As can be seen in Table S2.2, head circumference, mechanical ventilation, parenteral feeding, social economic status, and parent-infant relationships significantly and independently added to the prediction of adulthood cognitive impairment. A receiver operating characteristic curve (ROC) was constructed based on the estimated probabilities of the logistic regression equation containing these five independent predictors. The area under the curve (AUC) varied between .80 and .81 over the 10 imputed datasets, indicating that these predictors could reliable distinguish between VP/VLBW individuals that would and would not develop a cognitive impairment in adulthood.

Table S2.1 Predictors unadjusted estimates of their relationship with cognitive impairment

| Predictor | | unadjusted impact on IQ | | | |
|---|---|---|---|---|---|
| | | *OR* | *95% CI* | | *p* |
| Pregnancy Complications | | | | | |
| Maternal age (years) | | 0.99 | 0.94 | 1.05 | .782 |
| Multiples | | 0.63 | 0.32 | 1.22 | .172 |
| Smoking during pregnancy | | 1.05 | 0.50 | 2.19 | .903 |
| EPH gestosis | | 0.94 | 0.35 | 2.48 | .894 |
| Severe pregnancy illness | | 0.82 | 0.43 | 1.59 | .557 |
| Oligohydramnios | | 1.41 | 0.47 | 4.29 | .541 |
| Amnion infection syndrome | | 0.94 | 0.51 | 1.76 | .855 |
| Complicated fetal lie | | 0.83 | 0.44 | 1.58 | .571 |
| Rapid or prolonged delivery | | 1.29 | 0.71 | 2.34 | .412 |
| Neonatal Morbidity | | | | | |
| Gestational age (weeks) | | 0.84 | 0.73 | 0.96 | **.011** |
| Weight (z-score) | | 0.88 | 0.71 | 1.09 | .241 |
| Length (z-score) | | 0.90 | 0.74 | 1.09 | .277 |
| Head circumference (z-score) | | 0.74 | 0.59 | 0.91 | **.006** |
| Sex (female) | | 1.33 | 0.77 | 2.31 | .309 |
| Hypothermia | | 1.72 | 0.98 | 3.00 | .057 |
| Hyperbilirubinemia | | 0.89 | 0.44 | 1.80 | .746 |
| Apnea-bradycardia syndrome | | 1.71 | 0.97 | 2.99 | .062 |
| RDS | | 2.49 | 1.31 | 4.72 | **.005** |
| BPD | | 2.40 | 1.34 | 4.28 | **.003** |
| Sepsis | | 1.36 | 0.78 | 2.36 | .274 |
| Neonatal seizures | | 4.15 | 2.15 | 8.00 | **<.001** |
| IVH | | 3.07 | 1.22 | 7.73 | **.017** |
| Abnormal mobility (days) | | 1.03 | 1.02 | 1.03 | **<.001** |
| Abnormal muscle tone (days) | | 1.02 | 1.01 | 1.03 | **<.001** |
| Abnormal excitability (days) | | 1.03 | 1.01 | 1.04 | **<.001** |
| Neonatal Treatment | | | | | |
| Volume substitution | | 1.89 | 0.91 | 3.90 | .086 |
| Surgical intervention | | 1.49 | 0.75 | 2.98 | .258 |
| Oxygen supplementation (days) | | 1.05 | 1.02 | 1.08 | **.003** |
| CPAP (days) | | 1.00 | 0.95 | 1.05 | .963 |
| Mechanical ventilation (days) | | 1.04 | 1.03 | 1.06 | **<.001** |
| Gavage nutrition (days) | | 1.03 | 1.02 | 1.04 | **<.001** |
| Parenteral nutrition (days) | | 1.03 | 1.01 | 1.04 | **<.001** |
| Early Social Environment | | | | | |
| SES | High SES | 0.40 | 0.16 | 0.96 | **.040** |
| | Low SES | 1.30 | 0.71 | 2.37 | .393 |
| FAI | High FAI | 1.09 | 0.58 | 2.02 | .794 |
| | Low FAI | 0.72 | 0.34 | 1.51 | .380 |
| High PSI | | 1.00 | 0.55 | 1.80 | .991 |
| Poor PIRI | | 2.96 | 1.64 | 5.35 | **<.001** |
| No breast milk | | 2.27 | 1.07 | 4.80 | **.033** |

*Note.* Unadjusted estimates = simple logistic regressions; RDS = respiratory distress syndrome; BPD = bronchopulmonary dysplasia; IVH = intraventricular hemorrhage; CPAP = continuous positive airway pressure; SES = social economic status; FAI = family adversity index; PSI = psychosocial stress index; PIRI = parent-infant relationship index.

Table S2.2 Predictors adjusted estimates of their relationship with cognitive impairment

| Predictor | | unadjusted impact on IQ | | | |
|---|---|---|---|---|---|
| | | *OR* | *95% CI* | | *p* |
| Neonatal Morbidity | | | | | |
| Gestational age (weeks) | | 0.97 | 0.77 | 1.22 | .790 |
| Head circumference (z-score) | | 0.67 | 0.48 | 0.94 | **.021** |
| RDS | | 1.72 | 0.69 | 4.31 | .244 |
| BPD | | 1.10 | 0.43 | 2.83 | .843 |
| Neonatal seizures | | 1.01 | 0.40 | 2.53 | .987 |
| IVH | | 2.29 | 0.70 | 7.50 | .172 |
| Abnormal mobility (days) | | 1.02 | 1.00 | 1.04 | .118 |
| Abnormal muscle tone (days) | | 0.99 | 0.97 | 1.01 | .324 |
| Abnormal excitability (days) | | 1.00 | 0.98 | 1.02 | .821 |
| Neonatal Treatment | | | | | |
| Oxygen supplementation (days) | | 1.00 | 0.96 | 1.04 | .966 |
| Mechanical ventilation (days) | | 1.06 | 1.02 | 1.09 | **.003** |
| Gavage nutrition (days) | | 1.00 | 0.98 | 1.03 | .724 |
| Parenteral nutrition (days) | | 0.96 | 0.93 | 1.00 | **.025** |
| Early Social Environment | | | | | |
| SES | High SES | 0.26 | 0.08 | 0.79 | **.017** |
| | Low SES | 1.34 | 0.65 | 2.75 | .432 |
| Poor PIRI | | 2.70 | 1.29 | 5.66 | **.009** |
| No breast milk | | 1.43 | 0.57 | 3.61 | .445 |

*Note*. Adjusted estimates = multiple logistic regressions including all significant predictors of cognitive impairment from Table S2.1; RDS = respiratory distress syndrome; BPD = bronchopulmonary dysplasia; IVH = intraventricular hemorrhage; SES = social economic status; PIRI = parent-infant relationship index.