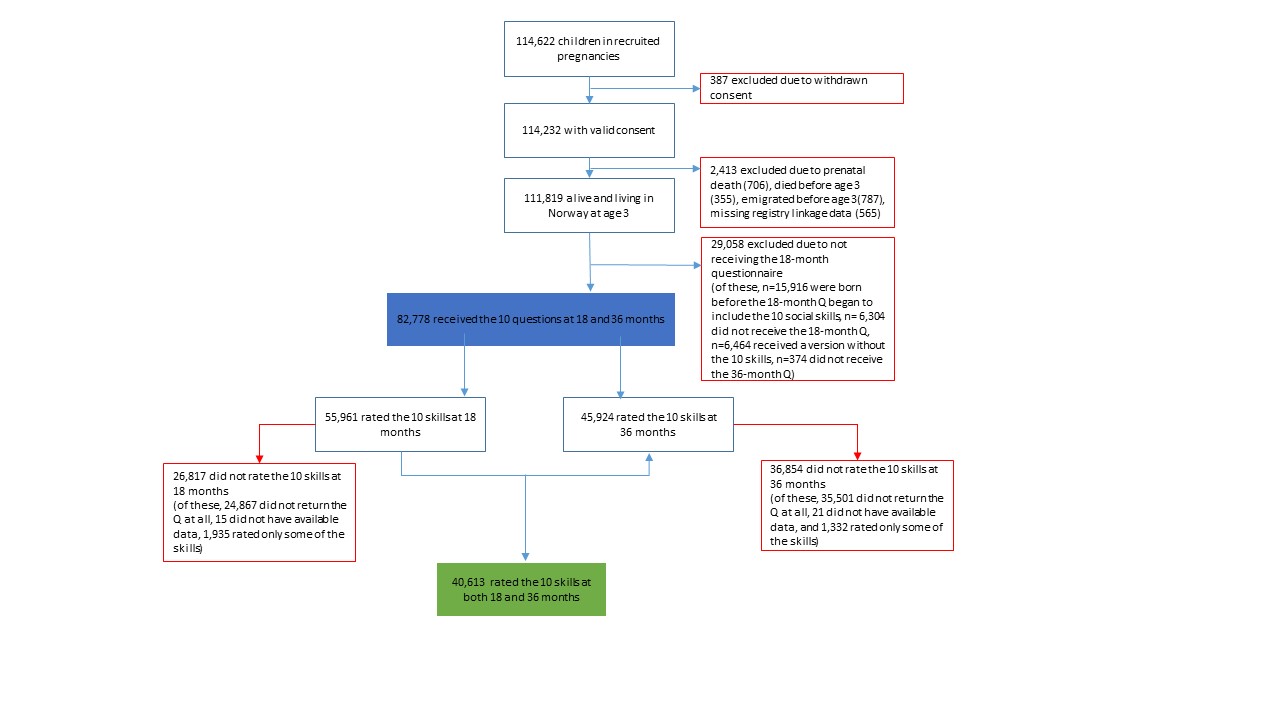
**SUPPLEMENTAL MATERIALS**

**Figure S1. Participant disposition.**

**Note:** The sample was defined based on available data for all 10 social skills in the 18- and 36-month questionnaires.



**Table s1: Social skills item wording and MoBa item number.** Participants were included in the analysis if they had data for all ten skills listed below. Each item was coded as “yes” or “no”. The overall pattern of skill attainment was determined by the child’s profile of responses at both the 18-month and 36-month visit.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Item** | **18-month item number** | **18-month item text** | **36-month item number** | **36-month item text** |
| Showing | EE428 (MCHAT9) | Does your child ever bring objects over to you to show you something? | GG244 (MCHAT9) | Does your child ever bring objects over to you to show you something? |
| Imitating | EE879 (MCHAT13) | Does your child imitate you? (e.g., you make a face-will your child imitate it?) | GG245 (MCHAT13) | Does your child imitate you? (e.g., you make a face-will your child imitate it?) |
| Pointing for interest | EE997/EE432 (MCHAT7) | Does your child ever use his/her index finger to point, to indicate interest in something? | GG246 (MCHAT7) | Does your child ever use his/her index finger to point, to indicate interest in something? |
| Interest in children | EE434 (MCHAT2) | Does your child take an interest in other children? | GG247 (MCHAT2) | Does your child take an interest in other children? |
| Following pointing gesture | EE882 (MCHAT15) | If you point at a toy across the room, does your child look at it? | GG248 (MCHAT15) | If you point at a toy across the room, does your child look at it? |
| Responsive smiling | EE1000 (MCHAT12; Missing in version B of the the 18-month questionnaire | Does your child smile in response to your face or your smile? | GG281 (SCQ27) | Does your child smile back if someone smiles at him/her? |
| Response to name | EE901 (MCHAT14) | Does your child respond to his/her name when you call? | GG243 (MCHAT14) | Does your child respond to his/her name when you call? |
| Eye contact | EE890 (ESAT-6. in v. B) /EE1006 (MCHAT10 v.CDE) | Is it easy to make eye-contact with your child? / Does your child look you in the eye for more than a second or two? | GG249 (ESAT6) | Is it easy to make eye-contact with your child? |
| Response to speech | EE897 (ESAT-14) | Does your child react when spoken to, for instance, by looking, listening, smiling, speaking or babbling? | GG250 (ESAT-14) | Does your child react when spoken to, for instance, by looking, listening, smiling, speaking or babbling? |
| Facial expression | EE889 (ESAT-5) | Can you easily tell from the face of your child how he/she feels? | GG287 (SCQ33) | Does your child show a normal range of facial expressions? |

**Note: MCHAT = Modified Checklist for Autism in Toddlers; ESAT=Early Screening for Autistic Traits; SCQ=Social Communication Questionnaire**

**Table S2: Item correlations (tetrachoric)**

**Table

Description automatically generated**

**Table S3 Assessment of differential item missingness by outcome group overall and by diagnosed condition (Autism, ID, LD, ADHD)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **No diagnosis (N=78,457)** | | **Autism (N=898)** | | **ID (N=285)** | | **LD (N=606)** | | **ADHD (N=2532)** | | **Total (N=82,778)** | | **Overall p-value** | **P-value for comparison of the NDD diagnostic groups** |
|  | **No.** | **%** | **No.** | **%** | **No.** | **%** | **No.** | **%** | **No.** | **%** | **No.** | **%** |
| **Brings things to show parent** | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| nonmissing | 40,595 | 51.74 | 420 | 46.77 | 114 | 40.00 | 277 | 45.71 | 1,161 | 45.85 | 42,567 | 51.42 | <0.001 | 0.244 |
| missing | 37,862 | 48.26 | 478 | 53.23 | 171 | 60.00 | 329 | 54.29 | 1,371 | 54.15 | 40,211 | 48.58 |  |  |
| **Imitates when parent makes a face at them** | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| nonmissing | 40,254 | 51.31 | 412 | 45.88 | 115 | 40.35 | 273 | 45.05 | 1,154 | 45.58 | 42,208 | 50.99 | <0.001 | 0.388 |
| missing | 38,203 | 48.69 | 486 | 54.12 | 170 | 59.65 | 333 | 54.95 | 1,378 | 54.42 | 40,570 | 49.01 |  |  |
| **Points to indicate interest** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| nonmissing | 40,345 | 51.42 | 417 | 46.44 | 117 | 41.05 | 279 | 46.04 | 1,151 | 45.46 | 42,309 | 51.11 | <0.001 | 0.447 |
| missing | 38,112 | 48.58 | 481 | 53.56 | 168 | 58.95 | 327 | 53.96 | 1,381 | 54.54 | 40,469 | 48.89 |  |  |
| **Shows interest in other children** | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| nonmissing | 40,635 | 51.79 | 416 | 46.33 | 117 | 41.05 | 280 | 46.20 | 1,162 | 45.89 | 42,610 | 51.48 | <0.001 | 0.437 |
| missing | 37,822 | 48.21 | 482 | 53.67 | 168 | 58.95 | 326 | 53.80 | 1,370 | 54.11 | 40,168 | 48.52 |  |  |
| **Looks toward a toy across the room if parent points at it** | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| nonmissing | 40,303 | 51.37 | 416 | 46.33 | 115 | 40.35 | 274 | 45.21 | 1,151 | 45.46 | 42,259 | 51.05 | <0.001 | 0.358 |
| missing | 38,154 | 48.63 | 482 | 53.67 | 170 | 59.65 | 332 | 54.79 | 1,381 | 54.54 | 40,519 | 48.95 |  |  |
| **Smiles at others** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| nonmissing | 40,343 | 51.42 | 415 | 46.21 | 113 | 39.65 | 276 | 45.54 | 1,150 | 45.42 | 42,297 | 51.10 | <0.001 | 0.262 |
| missing | 38,114 | 48.58 | 483 | 53.79 | 172 | 60.35 | 330 | 54.46 | 1,382 | 54.58 | 40,481 | 48.90 |  |  |
| **Responds when spoken to (e.g., looks, babbles, speaks)** | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| nonmissing | 40,535 | 51.67 | 415 | 46.21 | 119 | 41.75 | 276 | 45.54 | 1,156 | 45.66 | 42,501 | 51.34 | <0.001 | 0.610 |
| missing | 37,922 | 48.33 | 483 | 53.79 | 166 | 58.25 | 330 | 54.46 | 1,376 | 54.34 | 40,277 | 48.66 |  |  |
| **Responds to their name** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| nonmissing | 40,576 | 51.72 | 419 | 46.66 | 119 | 41.75 | 275 | 45.38 | 1,157 | 45.70 | 42,546 | 51.40 | <0.001 | 0.547 |
| missing | 37,881 | 48.28 | 479 | 53.34 | 166 | 58.25 | 331 | 54.62 | 1,375 | 54.30 | 40,232 | 48.60 |  |  |
| **Easy to make eye contact with** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| nonmissing | 40,436 | 51.54 | 418 | 46.55 | 117 | 41.05 | 275 | 45.38 | 1,155 | 45.62 | 42,401 | 51.22 | <0.001 | 0.442 |
| missing | 38,021 | 48.46 | 480 | 53.45 | 168 | 58.95 | 331 | 54.62 | 1,377 | 54.38 | 40,377 | 48.78 |  |  |
| **Easy to tell how the child feels from their facial expressions** | |  |  |  |  |  |  |  |  |  |  |  |  |  |
| nonmissing | 40,367 | 51.45 | 420 | 46.77 | 115 | 40.35 | 276 | 45.54 | 1,154 | 45.58 | 42,332 | 51.14 | <0.001 | 0.303 |
| missing | 38,090 | 48.55 | 478 | 53.23 | 170 | 59.65 | 330 | 54.46 | 1,378 | 54.42 | 40,446 | 48.86 |  |  |

**Table S4 item responses by diagnostic group**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **No NDD diagnosis** | | **Autism** | | **ID** | | **LD** | | **ADHD** | |
|  | *No.* | *%* | *No.* | *%* | *No.* | *%* | *No.* | *%* | *No.* | *%* | |
| **Total** | 38,773 | 100.00% | 383 | 100.00 % | 104 | 100.00 % | 253 | 100.00 % | 1,100 | 100.00 % | |
| **Brings things to show parent** |  |  |  |  |  |  |  |  |  |  | |
| attained&maintained | 38,309 | 98.80 % | 344 | 89.82 % | 61 | 58.65 % | 241 | 95.26 % | 1,084 | 98.55 % | |
| delayed | 434 | 1.12 % | 34 | 8.88 % | 43 | 41.35 % | 11 | 4.35 % | 14 | 1.27 % | |
| lost | 30 | 0.08 % | 5 | 1.31 % | 0 | 0.00 % | <5 | - | <5 | - | |
| **Imitates when parent makes a face at them** |  |  |  |  |  |  |  |  |  |  | |
| attained&maintained | 35,759 | 92.23 % | 313 | 81.72 % | 75 | 72.12 % | 213 | 84.19 % | 1,007 | 91.55 % | |
| delayed | 2,341 | 6.04 % | 49 | 12.79 % | 26 | 25.00 % | 30 | 11.86 % | 76 | 6.91 % | |
| lost | 673 | 1.74 % | 21 | 5.48 % | <5 | <4.81% | 10 | 3.95 % | 17 | 1.55 % | |
| **Points to indicate interest** |  |  |  |  |  |  |  |  |  |  | |
| attained&maintained | 37,158 | 95.83 % | 330 | 86.16 % | 65 | 62.50 % | 228 | 90.12 % | 1,047 | 95.18 % | |
| delayed | 1,185 | 3.06 % | 42 | 10.97 % | 35 | 33.65 % | 19 | 7.51 % | 39 | 3.55 % | |
| lost | 430 | 1.11 % | 11 | 2.87 % | <5 | <4.81% | 6 | 2.37 % | 14 | 1.27 % | |
| **Shows interest in other children** |  |  |  |  |  |  |  |  |  |  | |
| attained&maintained | 38,608 | 99.57 % | 356 | 92.95 % | 96 | 92.31 % | 249 | 98.42 % | 1,090 | 99.09 % | |
| delayed | 127 | 0.33 % | 10 | 2.61 % | 5 | 4.81 % | <5 | - | <5 | - | |
| lost | 38 | 0.10 % | 17 | 4.44 % | <5 | <4.81% | <5 | - | 7 | 0.64 % | |
| **Looks toward a toy across the room if parent points at it** |  |  |  |  |  |  |  |  |  |  | |
| attained&maintained | 37,284 | 96.16 % | 322 | 84.07 % | 57 | 54.81 % | 228 | 90.12 % | 1,041 | 94.64 % | |
| delayed | 1,270 | 3.28 % | 45 | 11.75 % | 41 | 39.42 % | 23 | 9.09 % | 47 | 4.27 % | |
| lost | 219 | 0.56 % | 16 | 4.18 % | 6 | 5.77 % | <5 | - | 12 | 1.09 % | |
| **Smiles at others** |  |  |  |  |  |  |  |  |  |  | |
| attained&maintained | 38,378 | 98.98 % | 370 | 96.61 % | 97 | 93.27 % | 252 | 99.60 % | 1,085 | 98.64 % | |
| delayed | 57 | 0.15 % | <5 | - | 6 | 5.77 % | <5 | - | <5 | - | |
| lost | 338 | 0.87 % | 11 | 2.87 % | <5 | <4.81% | <5 | - | 12 | 1.09 % | |
| **Responds to their name** |  |  |  |  |  |  |  |  |  |  | |
| attained&maintained | 38,468 | 99.21 % | 361 | 94.26 % | 90 | 86.54 % | 248 | 98.02 % | 1,074 | 97.64 % | |
| delayed | 147 | 0.38 % | 10 | 2.61 % | 8 | 7.69 % | <5 | - | 10 | 0.91 % | |
| lost | 158 | 0.41 % | 12 | 3.13 % | 6 | 5.77 % | <5 | - | 16 | 1.45 % | |
| **Easy to make eye contact with** |  |  |  |  |  |  |  |  |  |  | |
| attained&maintained | 37,882 | 97.70 % | 340 | 88.77 % | 81 | 77.88 % | 235 | 92.89 % | 1,045 | 95.00 % | |
| delayed | 745 | 1.92 % | 21 | 5.48 % | 9 | 8.65 % | 9 | 3.56 % | 32 | 2.91 % | |
| lost | 146 | 0.38 % | 22 | 5.74 % | 14 | 13.46 % | 9 | 3.56 % | 23 | 2.09 % | |
| **Responds when spoken to (e.g., looks, babbles, speaks)** |  |  |  |  |  |  |  |  |  |  | |
| attained&maintained | 38,474 | 99.23 % | 361 | 94.26 % | 95 | 91.35 % | 247 | 97.63 % | 1,084 | 98.55 % | |
| delayed | 95 | 0.25 % | 5 | 1.31 % | 5 | 4.81 % | <5 | - | 5 | 0.45 % | |
| lost | 204 | 0.53 % | 17 | 4.44 % | <5 | <4.81% | <5 | - | 11 | 1.00 % | |
| **Easy to tell how the child feels from their facial expressions** |  |  |  |  |  |  |  |  |  |  | |
| attained&maintained | 38,631 | 99.63 % | 363 | 94.78 % | 94 | 90.38 % | 250 | 98.81 % | 1,093 | 99.36 % | |
| delayed | 118 | 0.30 % | 10 | 2.61 % | 6 | 5.77 % | <5 | - | 6 | 0.55 % | |
| lost | 24 | 0.06 % | 10 | 2.61 % | <5 | <4.81% | <5 | - | <5 | - | |

ID=intellectual disability, LD=language disability, ADHD=attention deficit hyperactivity disorder

Cells with <5 individuals are shown as <5 for anonymity.

**Table S5 Comparison of background characteristics and diagnostic outcomes in complete-case sample (included) and the rest of the cohort (excluded)**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Excluded (N=71,206)** | | **Included (N=40,613)** | | **Total (N=111,819)** | | **Pvalue for difference from chi-squared test** | **P-value from multiple regression** |
|  | **No.** | **%** | **No.** | **%** | **No.** | **%** |
| Male sex | 36,638 | 51.45 % | 20,665 | 50.88 % | 57,303 | 51.25 % | 0.066 | 0.038 |
| Maternal education ≥13 years | 35,598 | 49.99 % | 28,878 | 71.11 % | 64,476 | 57.66 % | <0.001 | <0.001 |
| Paternal education ≥13 years | 27,457 | 38.56 % | 21,768 | 53.60 % | 49,225 | 44.02 % | <0.001 | <0.001 |
| Single mother | 3,643 | 5.12 % | 1,346 | 3.31 % | 4,989 | 4.46 % | <0.001 | <0.001 |
| Maternal age (y) | M=29.91 | SD=4.77 | M= |  |  |  | <0.001 | <0.001 |
| <18 | 93 | 0.13 % | 19 | 0.05 % | 112 | 0.10 % |  |  |
| 18-19 | 906 | 1.27 % | 163 | 0.40 % | 1,069 | 0.96 % |  |  |
| 20-24 | 8,580 | 12.05 % | 3,119 | 7.68 % | 11,699 | 10.46 % |  |  |
| 25-29 | 23,208 | 32.59 % | 13,222 | 32.56 % | 36,430 | 32.58 % |  |  |
| 30-34 | 26,342 | 36.99 % | 16,507 | 40.64 % | 42,849 | 38.32 % |  |  |
| 35-39 | 10,631 | 14.93 % | 6,709 | 16.52 % | 17,340 | 15.51 % |  |  |
| 40-44 | 1,411 | 1.98 % | 850 | 2.09 % | 2,261 | 2.02 % |  |  |
| 45+ | 35 | 0.05 % | 24 | 0.06 % | 59 | 0.05 % |  |  |
| Maternal parity |  |  |  |  |  |  | <0.001 | <0.001 |
| 0 | 28,918 | 40.61 % | 20,211 | 49.76 % | 49,129 | 43.94 % |  |  |
| 1 | 26,712 | 37.51 % | 13,551 | 33.37 % | 40,263 | 36.01 % |  |  |
| 2 | 11,948 | 16.78 % | 5,439 | 13.39 % | 17,387 | 15.55 % |  |  |
| 3 | 2,739 | 3.85 % | 1,097 | 2.70 % | 3,836 | 3.43 % |  |  |
| 4 | 639 | 0.90 % | 222 | 0.55 % | 861 | 0.77 % |  |  |
| 5 | 250 | 0.35 % | 93 | 0.23 % | 343 | 0.31 % |  |  |
| Not smoking in pregnancy | 30,575 | 72.51 % | 31,054 | 76.46 % | 61,629 | 30,575 | <0.001 | <0.001 |
| Birth year |  |  |  |  |  |  | <0.001 | <0.001 |
| 1999 | 55 | 0.08 % | 0 | 0.00 % | 55 | 0.05 % |  |  |
| 2000 | 2,229 | 3.13 % | 0 | 0.00 % | 2,229 | 1.99 % |  |  |
| 2001 | 4,435 | 6.23 % | 0 | 0.00 % | 4,435 | 3.97 % |  |  |
| 2002 | 9,183 | 12.90 % | 0 | 0.00 % | 9,183 | 8.21 % |  |  |
| 2003 | 11,207 | 15.74 % | 1,992 | 4.90 % | 13,199 | 11.80 % |  |  |
| 2004 | 7,353 | 10.33 % | 6,859 | 16.89 % | 14,212 | 12.71 % |  |  |
| 2005 | 8,353 | 11.73 % | 7,828 | 19.27 % | 16,181 | 14.47 % |  |  |
| 2006 | 9,666 | 13.57 % | 8,399 | 20.68 % | 18,065 | 16.16 % |  |  |
| 2007 | 9,233 | 12.97 % | 7,586 | 18.68 % | 16,819 | 15.04 % |  |  |
| 2008 | 7,669 | 10.77 % | 6,341 | 15.61 % | 14,010 | 12.53 % |  |  |
| 2009 | 1,823 | 2.56 % | 1,608 | 3.96 % | 3,431 | 3.07 % |  |  |
| Multiple birth | 2,628 | 3.69 % | 1,183 | 2.91 % | 3,811 | 3.41 % | <0.001 | <0.001 |
| Low birth weight (<2500 gram) | 3,169 | 4.45 % | 1,514 | 3.73 % | 4,683 | 4.19 % | <0.001 | 0.024 |
| Preterm\* (<37 weeks) | 4,646 | 6.55 % | 2,311 | 5.71 % | 6,957 | 6.25 % | <0.001 | 0.773 |
| Congenital malformation | 3,293 | 4.62 % | 2,031 | 5.00 % | 5,324 | 4.76 % | 0.004 | 0.068 |
| Autism dx | 974 | 1.37 % | 383 | 0.94 % | 1,357 | 1.21 % | <0.001 | 0.060 |
| ADHD dx | 3,247 | 4.56 % | 1,340 | 3.30 % | 4,587 | 3,247 | <0.001 | 0.975 |
| ID dx | 464 | 0.65 % | 135 | 0.33 % | 599 | 0.54 % | <0.001 | <0.001 |
| LD dx | 753 | 1.06 % | 319 | 0.79 % | 1,072 | 0.96 % | <0.001 | 0.942 |
|  | | | | | | | | |
| \*missing data for 281 and 157, respectively. Prematurity was not included in the inverse probability weighting due to missing data (did not change the prediction accuracy, area under the curve (AUC)=0.71. The rest of the variables were included in the logistic regression model used to derive the inverse probability of being a complete case (excluding nonsignificant variables did not affect the prediction accuracy, AUC=0.71). | | | | | | | | |

**Table S6 Sample characteristics by pattern of early social skills development**

**Categorical variables**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Profile | Neither delay nor loss | | Delay with No Loss | | Loss with No Delay | | Combined Delay and Loss | | Total | |
| Total n | n=33,348 (82.10%) | | n=5,080 (12.51%) | | n=1,587 (3.91%) | | n=598 (1.47%) | | N=40,613 (100%) | |
|  | *n* | *%* | *n* | *%* | *n* | *%)* | *n* | *%* | *n* | *%* |
| Background characteristics |  |  |  |  |  |  |  |  |  |  |
| Male sex | 16,451 | 49.33 % | 2,930 | 57.68 % | 905 | 57.03 % | 379 | 63.38 % | 20,665 | 50.88 % |
| Maternal education ≥13 years | 24,012 | 72.00 % | 3,401 | 66.95 % | 1,086 | 68.43 % | 379 | 63.38 % | 28,878 | 71.11 % |
| Paternal education ≥13 years | 18,026 | 54.05 % | 2,587 | 50.93 % | 863 | 54.38 % | 292 | 48.83 % | 21,768 | 53.60 % |
| Single mother | 1,084 | 3.25 % | 177 | 3.48 % | 58 | 3.65 % | 27 | 4.52 % | 1,346 | 3.31 % |
| Not smoking in pregnancy | 25,585 | 76.72 % | 3,819 | 75.18 % | 1,196 | 75.36 % | 454 | 75.92 % | 31,054 | 76.46 % |
| Multiple birth | 908 | 2.72 % | 210 | 4.13 % | 42 | 2.65 % | 23 | 3.85 % | 1,183 | 2.91 % |
| Low birth weight (<2500 gram) | 1,119 | 3.36 % | 295 | 5.81 % | 66 | 4.16 % | 34 | 5.69 % | 1,514 | 3.73 % |
| Preterm\* (<37 weeks) | 1,748 | 5.26 % | 423 | 8.35 % | 95 | 6.03 % | 45 | 7.55 % | 2,311 | 5.71 % |
| Congenital malformation | 1,581 | 4.74 % | 328 | 6.46 % | 80 | 5.04 % | 42 | 7.02 % | 2,031 | 5.00 % |
| Referred by age 36 months (N=37,190) | 597 | 1.96 % | 251 | 5.39 % | 81 | 5.51 % | 90 | 16.57 % | 1,019 | 2.75 % |
| Full diagnostic groups and stratified by ID status |  |  |  |  |  |  |  |  |  |  |
| Autism (all) | 217 | 0.65 % | 93 | 1.83 % | 37 | 2.33 % | 36 | 6.02 % | 383 | 0.94 % |
| *Autism with ID* | 7 | 0.02 % | 9 | 0.18 % | <5 | - | 13 | 2.17 % | 31 | 0.08 % |
| *Autism without ID* | 210 | 0.63 % | 84 | 1.65 % | 35 | 2.21 % | 23 | 3.85 % | 352 | 0.87 % |
| ID (all) | 45 | 0.13 % | 45 | 0.89 % | 8 | 0.50 % | 37 | 6.19 % | 135 | 0.33 % |
| *ID mild (F70)* | 36 | 0.11 % | 25 | 0.49 % | 5 | 0.32 % | 12 | 2.01 % | 78 | 0.19 % |
| *ID moderate (F71)* | 5 | 0.01 % | 6 | 0.12 % | <5 | - | 9 | 1.51 % | 21 | 0.05 % |
| *ID severe/profound (F72-F3)* | <5 | - | 5 | 0.10% | 0 | 0.00% | 10 | 1.67% | 16 | 0.04% |
| *ID unspecified (F78-F79)* | <5 | - | 9 | 0.18 % | <5 | - | 6 | 1.00 % | 20 | 0.05 % |
| *ID without autism* | 38 | 0.11 % | 36 | 0.71 % | 6 | 0.38 % | 24 | 4.01 % | 104 | 0.26 % |
| ADHD (all) | 1,002 | 3.00 % | 206 | 4.06 % | 87 | 5.48 % | 45 | 7.53 % | 1,340 | 3.30 % |
| *ADHD without ID* | 986 | 2.96 % | 195 | 3.84 % | 84 | 5.29 % | 40 | 6.69 % | 1,305 | 3.21 % |
| *ADHD with ID* | 16 | 0.05 % | 11 | 0.22 % | <5 | - | 5 | 0.84 % | 35 | 0.09 % |
| LD (all) | 197 | 0.59 % | 79 | 1.56 % | 20 | 1.26 % | 23 | 3.85 % | 319 | 0.79 % |
| *LD without ID* | 187 | 0.56 % | 71 | 1.40 % | 19 | 1.20 % | 16 | 2.68 % | 293 | 0.72 % |
| *LD with ID* | 10 | 0.03 % | 8 | 0.16 % | <5 | - | 7 | 1.17 % | 26 | 0.06 % |

**Continuous variables**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Profile | Neither delay nor loss | | Delay with No Loss | | Loss with No Delay | | Combined Delay and Loss | |
| Total n | n=33,348 (82.10%) | | n=5,080 (12.51%) | | n=1,587 (3.91%) | | n=598 (1.47%) | |
|  | *n* | *M(SD)* | *n* | *M(SD)* | *n* | *M(SD)* | *n* | *M(SD)* |
| Maternal age (y) | 33,348 | 30.54(4.34) | 5,080 | 30.67(4.49) | 1,587 | 30.99(4.58) | 598 | 30.20(4.72) |
| Maternal parity | 33,348 | 0.72(0.88) | 5,080 | 0.79(0.91) | 1,587 | 0.60(0.83) | 598 | 0.63(0.84) |
| Reported age of walking | 32,379 | 12.68(2.12) | 4,899 | 13.27(2.76) | 1,525 | 12.88(2.17) | 553 | 13.67(3.71) |
| Age of first words1 | 7,161 | 13.02(3.89) | 1,052 | 14.52(5.42) | 321 | 14.09(4.76) | 110 | 15.30(6.58) |
| Age of first phrases1 | 6,925 | 20.05(5.36) | 1,009 | 22.03(6.05) | 317 | 21.64(6.52) | 107 | 24.20(8.65) |
| No. of skills attained and maintained | 33,348 | 10 (0) |  | 8.75 (0.62) |  | 8.84 (0.46) |  | 7.24 (1.19) |
| No. of skills lost | 33,348 | 0 (0) |  | 1.25 (0.62) |  | 0 (0) |  | 1.50 (0.97) |
| No. of skills delayed | 33,348 | 0 (0) |  | 0 (0) |  | 1.16 (0.46) |  | 1.26 (0.63) |

**Table S7: Demographic and developmental characteristics summarized by NDD diagnostic group**

**Categorical variables**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Diagnosis | No NDD diagnosis | | | Autism  (all) | | | ID  (w/o autism) | | | LD  (w/o autism/ID) | | | ADHD  (w/o autism/ID/LD) | | |
| Total n | n=38733 | | | n=383 | | | n=104 | | | n=253 | | | n=1100 | | |
| **Background characteristics** | *n* | *%* | *n* | | *%* | *n* | | *%* | *n* | | *%* | *n* | | *%* |
| Male sex | 19,361 | 49.93 % | 304 | | 79.37 % | 56 | | 53.85 % | 163 | | 64.43 % | 781 | | 71.00 % |
| Maternal education ≥13 years | 27,826 | 71.77 % | 257 | | 67.10 % | 59 | | 56.73 % | 136 | | 53.75 % | 600 | | 54.55 % |
| Paternal education ≥13 years | 21,041 | 54.27 % | 178 | | 46.48 % | 42 | | 40.38 % | 106 | | 41.90 % | 401 | | 36.45 % |
| Single mother | 1,238 | 3.19 % | 20 | | 5.22 % | 5 | | 4.81 % | 13 | | 5.14 % | 70 | | 6.36 % |
| Not smoking in pregnancy | 29,697 | 76.59 % | 278 | | 72.58 % | 81 | | 77.88 % | 197 | | 77.87 % | 801 | | 72.82 % |
| Multiple birth | 1,118 | 2.88 % | 17 | | 4.44 % | <5 | | - | 9 | | 3.56 % | 37 | | 3.36 % |
| Low birth weight (<2500 gram) | 1,396 | 3.60 % | 20 | | 5.22 % | 12 | | 11.54 % | 24 | | 9.49 % | 62 | | 5.64 % |
| Preterm\* (<37 weeks) | 2,156 | 5.58 % | 26 | | 6.81 % | 10 | | 9.62 % | 24 | | 9.60 % | 95 | | 8.69 % |
| Congenital malformation | 1,895 | 4.89 % | 34 | | 8.88 % | 14 | | 13.46 % | 24 | | 9.49 % | 64 | | 5.82 % |
| Referred by age 36 months (N=37,190) | 708 | 2.00 % | 95 | | 26.61 % | 61 | | 64.89 % | 74 | | 32.46 % | 81 | | 7.89 % |
| **Co-occurring diagnoses in the diagnostic groupings** |  |  |  | |  |  | |  |  | |  |  | |  |
| Autism | 0 | - | 383 | | 100% | 0 | | - | 0 | | - | 0 | | - |
| ID | 0 | - | 31 | | 8.09 % | 104 | | 100.00 % | 0 | | - | 0 | | - |
| Mild | 0 | - | 17 | | 4.44 % | 61 | | 58.65 % | 0 | | - | 0 | | - |
| Moderate | 0 | - | <5 | | - | 17 | | 16.35 % | 0 | | - | 0 | | - |
| Severe | 0 | - | 5 | | 1.31 % | 5 | | 4.81 % | 0 | | - | 0 | | - |
| Profound | 0 | - | <5 | | - | 6 | | 5.77 % | 0 | | - | 0 | | - |
| Unspecified | 0 | - | 5 | | 1.31 % | 15 | | 14.42 % | 0 | | - | 0 | | - |
| LD | 0 | - | 47 | | 12.27 % | 19 | | 18.27 % | 253 | | 100.00 % | 0 | | - |
| ADHD | 0 | - | 130 | | 33.94 % | 24 | | 23.08 % | 86 | | 33.99 % | 1,100 | | 100.00 % |

**Continuous variables**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Diagnosis | No NDD diagnosis | | | | Autism  (all) | ID  (w/o autism) | | | LD  (w/o autism/ID) | | | ADHD  (w/o autism/ID/LD) | | |
| Total n | n=38733 | | | | n=383 | n=135 | | | n=253 | | | n=1100 | | |
|  | *n* | *M (SD)* | *n* | *M (SD)* | | | *n* | *M (SD)* | | *n* | *M (SD)* | | *n* | *M (SD)* | |
| **Background characteristics** |  |  |  |  | | |  |  | |  |  | |  |  | |
| Maternal age (y) | 38,733 | 30.60(4.35) | 383 | 30.09(4.45) | | | 104 | 30.73(5.02) | | 253 | 30.06(4.66) | | 1,100 | 29.64(4.93) | |
| Maternal parity | 38,733 | 0.72(0.89) | 383 | 0.65(0.96) | | | 104 | 0.77(0.84) | | 253 | 0.82(0.90) | | 1,100 | 0.72(8.89) | |
| **Milestones** |  |  |  |  | | |  |  | |  |  | |  |  | |
| Reported age of walking | 37,602 | 12.74(2.19) | 366 | 14.14(3.57) | | | 83 | 18.58(5.98) | | 241 | 13.75(2.69) | | 1,064 | 12.90(2.49) | |
| Age of first words1 | 8,225 | 13.20(4.07) | 91 | 16.16(7.74) | | | 20 | 18.10(10.18) | | 56 | 16.30(7.22) | | 252 | 13.64(4.76) | |
| Age of first phrases1 | 7.966 | 20.27(5.38) | 87 | 25.64(11.05) | | | 17 | 27.12(10.35) | | 52 | 25.81(9.85) | | 236 | 21.25(6.48) | |
| **Skill development – number of skills** |  |  |  |  | | |  |  | |  |  | |  |  | |
| No. of skills attained and maintained |  | 9.77 (0.57) |  | 9.03(1.53) | | |  | 7.80(2.47) | |  | 9.45(0.94) | |  | 9.68(0.73) | |
| No. of skills late |  | 0.17 (0.48) |  | 0.60(1.12) | | |  | 1.77(2.14) | |  | 0.40(0.73) | |  | 0.21(0.56) | |
| No. of skills lost |  | 0.06 (0.27) |  | 0.37(0.93) | | |  | 0.43(0.77) | |  | 0.15(0.52) | |  | 0.10(0.37) | |

**Table S8. Results of sensitivity analysis with inverse probability weighting: logistic regression predicting autism (n=386) versus no autism diagnosis (n=40,230) from skill delay and loss.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Odds Ratio | [95% Conf. | Interval] | p-value |
| Delayed skills (reference:0) |  |  |  |  |
| 1 | 1.99 | 1.52 | 2.62 | <0.0001 |
| 2 | 3.77 | 2.47 | 5.74 | <0.0001 |
| >=3 | 6.98 | 4.00 | 12.16 | <0.0001 |
| Lost skills (reference:0) |  |  |  |  |
| 1 | 2.02 | 1.38 | 2.94 | <0.0001 |
| 2 | 5.88 | 3.33 | 10.41 | <0.0001 |
| >=3 | 30.79 | 16.86 | 56.26 | <0.0001 |

Covariates: child’s sex, birthyear, age at questionnaire completion.

**Table S9 A: Results of multinomial logistic regression (N = 40,613).** Relative risk ratios and their 95% confidence intervals are listed for the terms in the model. Autism (n = 383) was the reference outcome category; other categories were No diagnosis (n 38,773), ID (n = 104), language disability (n = 253), and ADHD (n = 1,100). Autism is the reference group.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | No Diagnosis vs Autism | | | | ID vs Autism | | | | Language Disability vs Autism | | | | | ADHD vs Autism | | | | |
|  | Relative Risk Ratio | [95% Conf.  Interval] | | p-value | Relative Risk Ratio | [95% Conf.  Interval] | | p-value | Relative Risk Ratio | [95% Conf.  Interval] | | p-value | Relative Risk Ratio | | [95% Conf.  Interval] | | p-value |
| Skill Loss (ref = 0) |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |
| 1 | 0.52 | 0.36 | 0.74 | <0.0001 | 1.63 | 0.87 | 3.07 | 0.129 | 0.82 | 0.46 | 1.46 | 0.495 | 0.83 | | 0.55 | 1.27 | 0.395 |
| 2 | 0.16 | 0.09 | 0.28 | <0.0001 | 1.22 | 0.52 | 2.90 | 0.647 | 0.28 | 0.08 | 0.98 | 0.046 | 0.25 | | 0.11 | 0.56 | 0.001 |
| >=3 | 0.03 | 0.01 | 0.04 | <0.0001 | 0.53 | 0.12 | 2.26 | 0.388 | 0.23 | 0.07 | 0.78 | 0.019 | 0.10 | | 0.04 | 0.27 | <0.0001 |
| Skill delay (ref = 0) |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |
| 1 | 0.50 | 0.38 | 0.65 | <0.0001 | 1.27 | 0.67 | 2.39 | 0.461 | 1.07 | 0.72 | 1.61 | 0.730 | 0.53 | | 0.39 | 0.73 | <0.0001 |
| 2 | 0.27 | 0.18 | 0.40 | <0.0001 | 2.53 | 1.19 | 5.41 | 0.016 | 0.85 | 0.44 | 1.66 | 0.638 | 0.27 | | 0.15 | 0.47 | <0.0001 |
| >=3 | 0.11 | 0.06 | 0.18 | <0.0001 | 9.19 | 4.70 | 18.00 | <0.0001 | 0.50 | 0.19 | 1.28 | 0.147 | 0.24 | | 0.12 | 0.48 | <0.0001 |

**Table S9 B: Results from sensitivity analysis including inverse probability weighting (same sample as in Table S9 A):**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | No Diagnosis vs Autism | | | | ID vs Autism | | | | Language Disability vs Autism | | | | | ADHD vs Autism | | | | |
|  | Relative Risk Ratio | [95% Conf.  Interval] | | p-value | Relative Risk Ratio | [95% Conf.  Interval] | | p-value | Relative Risk Ratio | [95% Conf.  Interval] | | p-value | Relative Risk Ratio | | [95% Conf.  Interval] | | p-value |
| Skill Loss (ref = 0) |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |
| 1 | 0.48 | 0.33 | 0.70 | <0.0001 | 1.45 | 0.75 | 2.79 | 0.264 | 0.76 | 0.42 | 1.40 | 0.383 | 0.80 | | 0.51 | 1.24 | 0.317 |
| 2 | 0.15 | 0.09 | 0.27 | <0.0001 | 1.11 | 0.46 | 2.71 | 0.813 | 0.25 | 0.07 | 0.89 | 0.032 | 0.26 | | 0.11 | 0.61 | 0.002 |
| >=3 | 0.03 | 0.01 | 0.05 | <0.0001 | 0.43 | 0.09 | 1.93 | 0.269 | 0.28 | 0.08 | 0.99 | 0.048 | 0.09 | | 0.03 | 0.26 | <0.0001 |
| Skill delay (ref = 0) |  |  |  |  |  |  |  |  |  |  |  |  |  | |  |  |  |
| 1 | 0.50 | 0.38 | 0.65 | <0.0001 | 1.31 | 0.69 | 2.50 | 0.408 | 1.00 | 0.66 | 1.52 | 0.991 | 0.52 | | 0.38 | 0.73 | <0.0001 |
| 2 | 0.26 | 0.17 | 0.39 | <0.0001 | 2.76 | 1.27 | 5.98 | 0.010 | 0.77 | 0.38 | 1.53 | 0.450 | 0.28 | | 0.16 | 0.51 | <0.0001 |
| >=3 | 0.11 | 0.06 | 0.18 | <0.0001 | 11.39 | 5.66 | 22.91 | <0.0001 | 0.50 | 0.19 | 1.32 | 0.163 | 0.29 | | 0.14 | 0.62 | 0.001 |

**Table S9 C Results from sensitivity analysis stratifying by ID:**

WITHOUT ID

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | No Diagnosis (38,773) vs  Autism without ID (n=353) | | | | Language Disability without ID (n=253) vs Autism without ID | | | | ADHD without ID (n=1,100) vs  Autism without ID | | | | |
|  | Relative Risk Ratio | [95% Conf. | Interval] | p-value | Relative Risk Ratio | [95% Conf. | Interval] | p-value | | Relative Risk Ratio | [95% Conf. | Interval] | p-value | |
| Skill Loss (ref = 0) |  |  |  |  |  |  |  |  | |  |  |  |  | |
| 1 | 0.56 | 0.38 | 0.83 | 0.004 | 0.89 | 0.49 | 1.62 | 0.699 | | 0.90 | 0.58 | 1.41 | 0.653 | |
| 2 | 0.17 | 0.10 | 0.30 | <0.0001 | 0.30 | 0.08 | 1.06 | 0.061 | | 0.26 | 0.11 | 0.60 | 0.002 | |
| >=3 | 0.03 | 0.02 | 0.07 | <0.0001 | 0.31 | 0.09 | 1.10 | 0.069 | | 0.13 | 0.05 | 0.37 | <0.0001 | |
| Skill delay (ref = 0) |  |  |  |  |  |  |  |  | |  |  |  |  | |
| 1 | 0.51 | 0.39 | 0.68 | <0.0001 | 1.11 | 0.74 | 1.68 | 0.610 | | 0.55 | 0.40 | 0.76 | <0.0001 | |
| 2 | 0.31 | 0.20 | 0.48 | <0.0001 | 0.97 | 0.49 | 1.94 | 0.942 | | 0.31 | 0.17 | 0.55 | <0.0001 | |
| >=3 | 0.21 | 0.11 | 0.41 | <0.0001 | 0.95 | 0.34 | 2.68 | 0.923 | | 0.46 | 0.20 | 1.04 | 0.062 | |

WITH ID:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | ID without autism (n=104) vs Autism with ID (n=31) | | | |
|  | Relative Risk Ratio | [95% Conf.  Interval] | | p-value |
| Skill Loss (ref = 0) |  |  |  |  |
| 1 | 0.90 | 0.29 | 2.73 | 0.848 |
| 2 | 0.92 | 0.21 | 4.07 | 0.917 |
| >=3 | 0.11 | 0.02 | 0.58 | 0.009 |
| Skill delay (ref = 0) |  |  |  |  |
| 1 | 0.76 | 0.20 | 2.82 | 0.682 |
| 2 | 0.42 | 0.10 | 1.69 | 0.221 |
| >=3 | 0.58 | 0.18 | 1.90 | 0.366 |