Early developmental risk for subsequent childhood mental disorders in an Australian population cohort.

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Online Supplementary Materials

Table S1. Examples of items comprising the 16 subdomains (within 5 broad domains) of the AEDC (child developmental vulnerability) indicators

SOCIAL COMPETENCE

   Overall social competence — Gets along with peers; plays with various children

   Responsibility and respect — Follows rules and instructions; demonstrates respect for other children

   Approaches to learning — Listens attentively; is able to solve day-to-day problems by him/herself

   Readiness to explore new things — Is curious about the world; is eager to play a new game

EMOTIONAL MATURITY

   Prosocial and helping behaviour — Helps someone who has been hurt; Comforts a child who is crying or upset

   Anxious and fearful behaviour — Seems to be unhappy, sad or depressed; Cries a lot

   Aggressive behaviour — Kicks, bites, hits other children or adults; bullies or is mean to others

   Hyperactive and inattentive behaviour — Can't sit still, is restless; is distractible, has trouble sticking to any activity

PHYSICAL HEALTH AND WELLBEING

   Physical readiness for school day — Arrives too tired and/or too sick to do school work; arrives hungry

   Physical independence — Is independent in toileting habits most of the time; is well co-ordinated

   Gross and fine motor skills — Ability to manipulate objects; ability to climb stairs

LANGUAGE AND COGNITIVE SKILLS

   Basic literacy — Is able to identify some letters of the alphabet; to write his/her own name

   Interest in literacy/numeracy and memory — Is interested in reading; is interested in games involving numbers

   Advanced literacy — Is able to read simple words; is able to write simple words

   Basic numeracy — Is able to count to twenty; is able to say which number is bigger of the two

COMMUNICATION

   Communication and general knowledge — Ability to use language effectively; ability to understand … what is being said

Table S2: Model fit statistics for identifying the latent class baseline model (n=82,891)

Number of latent classes	G^2	df	AIC	BIC	adjusted BIC	Entropy
2	62054.73	65502	62120.73	62428.47	62323.59	0.90
3	48750.64	65485	48850.64	49316.91	49158.01	0.89
4	**37735.20**	**65468**	**37869.20**	**38493.99**	**38281.06**	**0.87**
5	33473.96	65451	33641.96	34425.28	34158.33	0.86
6	31637.27	65434	31839.27	32781.12	32460.14	0.86

Note: The 4-class solution was determined on the basis of examination of the G^2 statistic, the Akaike information criterion (AIC), the Bayesian information criterion (BIC), the adjusted Bayesian information (aBIC) and entropy values. The large decreases in values of G^2, AIC and BIC suggested improvement in fit up to a 4-class model; models with five and six classes did not differ substantively from the 4-class solution other than identifying additional small subclasses that were not meaningful. The 4-class model was thus selected on principles of parsimony and interpretability.

Table S3: Mean posterior probabilities and Item-response probabilities for the 4-class model of developmental vulnerability in 82,891 children

	Class 1: No risk	Class 2: Mild generalised risk	Class 3: Misconduct risk	Class 4: Pervasive risk
Mean posterior probabilities				
Class 1: *No risk* (77.3%; n=64,097)	**0.96** (0.08)	0.03 (0.07)	0.01 (0.03)	0.00 (0.00)
Class 2: *Mild generalised risk* (11.5%; n=9,542)	0.10 (0.14)	**0.81** (0.18)	0.06 (0.10)	0.03 (0.08)
Class 3: *Misconduct risk* (7.0%; n=5,773)	0.03 (0.06)	0.06 (0.12)	**0.89** (0.15)	0.03 (0.07)
Class 4: *Pervasive risk* (4.2%; n=3,479)	0.00 (0.00)	0.06 (0.12)	0.04 (0.09)	**0.90** (0.15)
Item-response probabilities of vulnerability				
Overall social competence	0.00	0.08	0.29	**0.56**
Responsibility and respect	0.01	0.10	**0.58**	**0.63**
Approaches to learning	0.00	0.16	0.28	**0.89**
Readiness to explore new things	0.03	0.26	0.16	**0.55**
Prosocial and helping behaviour	0.02	0.16	0.26	**0.51**
Anxious and fearful behaviour	0.05	0.22	0.27	0.42
Aggressive behaviour	0.02	0.02	**0.68**	0.37
Hyperactive and inattentive behaviour	0.02	0.11	**0.69**	**0.62**
Physical readiness for school day	0.04	0.19	0.20	0.43
Physical independence	0.03	0.18	0.13	0.45
Gross and fine motor skills	0.01	0.19	0.09	**0.54**
Basic literacy	0.01	0.26	0.04	**0.58**
Interest in literacy/numeracy and memory	0.01	0.20	0.08	**0.61**
Advanced literacy	0.01	0.19	0.03	0.48
Basic numeracy	0.02	0.38	0.07	**0.67**
Communication and general knowledge	0.01	0.34	0.08	**0.74**

Note: Standard deviation in parentheses. Mean posterior probabilities in bold type indicate classification accuracy when assigning children to the latent classes; values closer to 1.00 indicate greater precision. Item-reponse probabilities in bold type indicate values >0.5.

Table S4: ICD-10 codes used to define mental diagnoses of parents of the child cohort (categories are not mutually exclusive).

Broad Diagnostic Group	Diagnostic categories	ICD-10 codes	N (Any parent)
Any Mental Disorder	Any one of the diagnoses listed below	Any one of the F-codes listed below	17,653
Severe Mental Disorders	Schizophrenia Spectrum Disorders	F20, F22, F23, F24, F25, F25.0, F25.1, F25.2, F25.8, F25.9, F28, F29.	1,615
	Bipolar Disorders	F30, F31	1,121
	Psychotic Disorders related to Substance Use	F10.5, F11.5, F12.5, F13.5, F14.5, F15.5, F15.50, F15.51, F15.59, F15.70, F16.5, F17.5, F18.5, F19.5, F19.7	527
Common Mental Disorders	Non-psychotic Affective Disorders	F32, F33, F34, F34.8, F34.9, F38.0, F38.1, F38.8, F39	7,387
	Neurotic and stress-related (anxiety) disorders	F40, F41, F42, F43, F44, F45, F48.	9,045
Personality Disorders	Cluster A	F21, F60.0, F60.1	50
	Cluster B	F60.2, F60.3, F60.30, F60.31, F60.4	934
	Cluster C	F60.5, F60.6, F60.7	162
	Other Personality Disorders	F60, F60.8, F60.09, F60.9, F61, F62, F62.0, F62.1, F62.8, F62.9, F68.0, F68.1, F68.8, F69	1004
Substance Use Disorders	Substance Intoxication and Use Disorders	F10, F11, F12, F13, F14, F15 F16, F17, F18, F19, F55.9	6,819
Other Adult Onset Disorders	Other Adult Onset Disorders	F00, F01, F03, F04, F05, F06, F07, F09, F50, F51, F52, F53, F54, F55, F59, F63, F64, F65, F66, F99	9,637
Other Chilhood Onset Disorders	Other Childhood Onset Disorders	F70, F71, F73, F78, F79, F80, F81, F82, F83, F84, F88, F89, F90, F91, F92, F93, F94, F95, F98.	866

Table S5: ICD-10 codes used to define Mental Health conditions experienced by the child cohort[a] (categories are not mutually exclusive).

		ICD-10 codes	(n) From Child's birth to age 13yrs	(n) Child age 6-13yrs[b]	(n) Child age 6-13yrs only[c]
ANY MENTAL DISORDER		Any F-Code evident in MHAMB, APDC, or EDDC records plus R45.81, X84 (self harm)	4689	3531	3074
Anxiety, Stress & Emotional Disorders	Phobias and Anxiety	F40, F40.0, F40.01, F40.1, F40.2, F40.8, F40.9, F40.0PC, F40.10, F40.2, F40.210, F40.248, F41, F41.0, F41.1, F41.2, F41.3, F41.8, F41.9, F41.0P, F41.2P, F41.0PC, F41.2PC	620	590	545
	Stress Reactions	F43, F43.0, F43.1, F43.12, F43.2, F43.20, F43.21, F43.22, F43.23, F43.24, F43.25, F43.29, F43.8, F43.9	233	215	152
	Childhood Onset Emotional Disorders	F93, F93.0, F93.1, F93.2, F93.3, F93.8, F93.9	222	189	187
Hyperkinetic and Conduct Disorders	Hyperkinetic Disorders	F90, F90.0, F90.1, F90.8, F90.9	250	231	200
	Conduct Disorders	F91, F91.0, F91.1, F91.2, F91.3, F91.8, F91.9, F91#	372	301	259
Developmental Disorders	Developmental Disorders	F80, F80.0, F80.1, F80.2, F80.3, F80.8, F80.9, F80.45, F81, F81.0, F81.1, F81.2, F81.3, F81.8, F81.9, F82, F83	684	472	342
	Autism Spectrum Disorders	F84, F84.0, F84.1, F84.2, F84.3, F84.4, F84.5, F84.8, F84.9	385	315	229
	Developmental Disorders Unspecified	F88, F89	301	140	98
Other Non-diagnostic	Self Harm	R45.81, X84	105	104	99
	Mental Health Diagnoses not allocated	F99, F99.1	2898	2496	2175

[a]Records for child include all received within the Emergency Department (2005-2016), Admitted Patient (2001-2016) and Mental Health Ambulatory (2001-2016) record collections from the NSW Ministry of Health; [b]Records for child restricted to age 6-13 years (i.e., 2010- 2016) for the entire NSW-CDS (Wave 2) child cohort (n=91,635); [b]Records for child restricted to age 6-13 years (i.e., 2010- 2016) for the entire NSW-CDS (Wave 2) child cohort (N=91,635); [c]Records for child restricted to age 6-13 years (i.e., January 2009 - December 2016) and exclude children who had a mental disorder diagnosed with a mental disorder prior to the 2009 AEDC (N=90,020).

Table S6. Prevalence of Early Childhood (AEDC) Risk Categories, diagnosed mental disorder (between age 6-13 years), and covariates for the sample of 85,107 children who had no record of diagnosis with a mental disorder before age 5-6 years.

	N (%) within total child cohort (85,107)
AEDC Early Childhood Risk Categories	
Established Special Needs Status	3,389 (4.0)
Pervasive risk	3,408 (4.0)
Misconduct risk	5,625 (6.6)
Mild generalised risk	9,424 (11.1)
No risk	63,261 (74.3)
Childhood mental disorder	
Any mental disorder	2,899 (3.4)
Phobias and Anxiety	518 (0.6)
Childhood Onset Emotional Disorders	145(0.2)
Stress Reactions	173 (0.2)
Hyperkinetic Disorders	186 (0.2)
Conduct Disorders	248 (0.3)
Developmental Disorders (inc. Autism)	328 (0.4)
Autism Spectrum Disorders	221 (0.3)
Self Harm	93 (0.1)
Covariates	
Child sex (male)	43,861 (51.5)
Socioeconomic Disadvantage	21,078 (24.8)
Childhood protection contacts	20,161 (23.7)
Parental mental illness	17,021 (20.0)

Note: AEDC=Australian Early Development Census

Table S7: Unadjusted Odds ratios (and 95% Confidence Intervals) for 'any' and specific mental disorder diagnoses among 85,107 children who had no record of diagnosis with a mental disorder before age 5-6 years, in association with early childhood developmental risk categories ('pervasive', 'misconduct', and 'mild generalised' risk) or those with established 'special needs', relative to the 'no risk' category.

	Overall model fit	Early Childhood (AEDC) Risk Category						
		Pervasive risk		Misconduct Risk		Mild generalised risk		Special Needs
Any mental disorder	x^2=1023.65, df=4, p<0.001	**3.21**	**(2.79-3.69)**	**3.01**	**(2.68-3.38)**	**1.49**	**(1.31-1.66)**	**5.90**	**(5.27-6.61)**
Phobias and Anxiety	x^2=34.79, df=4, p<0.001	1.44	(0.97-2.13)	1.29	(0.93-1.79)	1.02	(0.76-1.36)	**2.65**	**(1.96-3.57)**
Childhood Emotional Disorders	x^2=40.63, df=4, p<0.001	**2.92**	**(1.62-5.23)**	**2.58**	**(1.57-4.25)**	0.89	(0.47-1.67)	**4.29**	**(2.60-7.07)**
Stress Reactions	x^2=59.55, df=4, p<0.001	**4.19**	**(2.58-6.81)**	**3.55**	**(2.32-5.43)**	1.35	(0.82-2.26)	**3.79**	**(2.28-6.30)**
Hyperkinetic Disorders	x^2=277.68, df=4, p<0.001	**10.16**	**(6.23-16.54)**	**12.33**	**(8.25-18.41)**	**2.34**	**(1.32-4.13)**	**20.16**	**(13.46-30.19)**
Conduct Disorders	x^2=207.10, df=4, p<0.001	**6.04**	**(4.02-9.07)**	**5.66**	**(4.00-8.02)**	1.54	(0.97-2.44)	**10.05**	**(7.15-14.14)**
Developmental Disorders[a]	x^2=963.02, df=4, p<0.001	**11.67**	**(7.40-18.09)**	**6.84**	**(3.92-11.92)**	**3.64**	**(2.26-5.87)**	**80.84**	**(58.84-111.06)**
Autism Spectrum Disorders	x^2=687.20, df=4, p<0.001	**10.17**	**(5.72-17.05)**	**6.84**	**(3.92-11.92)**	**2.24**	**(1.13-4.43)**	**81.94**	**(55.97-119.96)**
Self Harm	x^2=29.34, df=4, p<0.001	**4.36**	**(2.26-8.40)**	**3.60**	**(2.01-6.44)**	1.88	(1.01-3.44)	2.78	(1.26-6.16)

Note: bolded ORs are significant at p<0.001; [a]Includes Autism Spectrum and Developmental Disorders Unspecified; AEDC=Australian Early Development Census.

Table S8: Adjusted Odds Ratios (ORs) and 95% Confidence intervals (CI) estimating risk for mental disorder diagnoses (relative to no mental disorder) among 85,107 children who had no record of diagnosis with a mental disorder before age 5-6 years in association with early childhood developmental risk profiles ('pervasive', 'misconduct', and 'mild generalised risk') or those with established 'special needs', relative to the no risk profile (adjusted for male sex, socioeconomic disadvantage, parental mental illness history, child protection contacts), among 85,107 children *who had no record of diagnosis with a mental disorder before age 5-6 years.*

Multinomial Logistic Regression Outcome	Early childhood (AEDC) Risk Category				Covariates			
	Pervasive risk	Misconduct risk	Mild generalised risk	Special Needs	Child Protection contact	Parental Mental Illness	Male sex	Socioeconomic disadvantage
Any mental disorder	**1.99 (1.72-2.29)**	**2.07 (1.83-2.34)**	1.13 (0.99-1.27)	**4.15 (3.68-4.67)**	**3.10 (2.85-3.37)**	**1.95 (1.79-2.11)**	**1.25 (1.15-1.35)**	1.06 (0.97-1.15)
Phobias and Anxiety	1.10 (0.74-1.65)	1.08 (0.77-1.50)	0.87 (0.65-1.17)	**2.18 (1.60-2.97)**	**2.01 (1.65-2.44)**	**1.84 (1.51-2.32)**	0.85 (0.72-1.02)	1.08 (0.89-1.32)
Emotional Disorders	1.80 (0.99-3.29)	1.78 (1.06-2.97)	0.67 (0.36-1.27)	**2.93 (1.75-4.90)**	**3.29 (2.28-4.76)**	**2.15 (1.51-3.06)**	1.07 (0.76-1.50)	1.26 (0.87-1.85)
Stress Reactions	2.07 (1.25-3.41)	**2.06 (1.33-3.20)**	0.88 (0.53-1.47)	2.16 (1.29-3.63)	**5.63 (3.89-8.17)**	**2.64 (1.91-3.64)**	1.14 (0.83-1.55)	0.90 (0.65-1.23)
Hyperkinetic Disorders	**5.32 (3.22-8.81)**	**7.21 (4.76-10.91)**	1.64 (0.92-2.91)	**11.78 (7.76-17.88)**	**3.79 (2.71-5.30)**	**1.54 (1.13-2.10)**	**2.18 (1.53-3.11)**	0.96 (0.70-1.30)
Conduct Disorders	**2.81 (1.85-4.27)**	**3.07 (2.14-4.39)**	0.99 (0.62-1.58)	**5.40 (3.80-7.70)**	**5.98 (4.36-8.18)**	**2.00 (1.53-2.60)**	**1.70 (1.28-2.24)**	0.90 (0.69-1.18)
Developmental Disorders[a]	**7.78 (4.87-12.44)**	**4.70 (2.92-7.56)**	**2.96 (1.83-4.80)**	58.03 (41.72-80.71)	**2.25 (1.76-2.87)**	1.44 (1.12-1.83)	**1.73 (1.33-2.45)**	0.95 (0.75-1.21)
Autism Spectrum Disorders	**6.50 (3.60-11.72)**	**4.67 (2.65-8.24)**	1.79 (0.90-3.57)	56.53 (37.99-84.13)	**2.34 (1.66-3.01)**	1.51 (1.12-2.02)	**2.14 (1.53-3.01)**	0.92 (0.69-1.23)
Self Harm	2.18 (1.11-4.28)	2.18 (1.20-3.96)	1.20 (0.65-2.24)	1.65 (0.73-3.70)	**7.49 (4.43-12.65)**	1.90 (1.24-2.92)	0.86 (0.57-1.31)	0.76 (0.50-1.16)

Note: bolded ORs are significant at p<0.001; AEDC=Australian Early Development Census; [a]Includes Autism Spectrum and Developmental Disorders Unspecified; Chi-square fit statistics for overall models: Any mental disorder (x^2=2403.73, *df=8*, *p*<0.001), Phobias and anxiety (x^2=165.78, *df=8*, *p*<0.001), Emotional Disorders (x^2=126.70, *df=8*, *p*<0.001), Stress Reactions (x^2=256.34, *df=8*, *p*<0.001), Hyperkinetic Disorders (x^2=394.21, *df=8*, *p*<0.001), Conduct Disorders (x^2=460.58, *df=8*, *p*<0.001), Developmental Disorders (x^2=1045.28, *df=8*, *p*<0.001), Autism Spectrum Disorders (x^2=759.14, *df=8*, *p*<0.001), and Self Harm (x^2=139.82, *df=8*, *p*<0.001).