Early childcare type predicts children's emotional and behavioural trajectories into middle childhood. Data from the EDEN mother–child cohort study

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1. ABSTRACT

Background: The scientific literature on the impact of early childcare on children's behavioural and emotional difficulties shows contrasting results. We studied this association in France, where childcare is of high quality and children enter preschool at the age of three.

Methods: 1428 children from the EDEN mother-child cohort set up in France (Nancy and Poitiers) were followed up since pregnancy to age 8 years. Group-based trajectory modelling was used to model their trajectories of behavioural and emotional symptoms (emotional symptoms, peer relationship problems, hyperactivity-inattention, conduct problems, prosocial behaviours) ascertained by three measures (3, 5.5 and 8 years) of the Strengths and Difficulties Questionnaires. Using propensity scores and Inverse Probability Weights to account for selection and confounding factors we compared children in a childminder's care or in centre-based childcare (from birth to age 3) to those in informal childcare.

Results: Compared to children in informal childcare, those who attended centre-based childcare had a lower likelihood of having high levels of emotional ($OR_{IPW-adjusted} = 0.35$, 95% CI: 0.17-0.71), peer relationship problems ($OR_{IPW-adjusted} = 0.31$, 95% CI: 0.15-0.67), and low prosocial behaviours ($OR_{IPW-adjusted} = 0.50$, 95% CI: 0.28-0.90). Those who were looked after by a childminder had a higher likelihood of following a high trajectory of conduct problems ($OR_{IPW-adjusted} = 1.72$, 95% CI 1.05-2.81). Attendance of centre-based childcare for more than one year was especially protective of high levels of emotional, peer-related difficulties and low prosocial behaviours. Girls and children from a favourable socioeconomic background reaped more benefits of childcare than boys and those from a less favourable background.

Conclusion: High quality centre-based childcare may be linked to lower levels of emotional symptoms.

2. SUMMARY BOX

What is already known on this subject?

The scientific literature on the relationship between childcare and behavioural and emotional difficulties shows contrasting results. More recent studies suggest that if childcare is of high quality, it is associated with lower levels of symptoms, especially in children growing up in socioeconomically disadvantaged families.

What does this study add?

We studied this topic in France, where early childcare is subsidised and universally accessible. Children's behavioural and emotional symptoms in middle childhood (3 to 8 years) were studied in relation to childcare during the first 3 years of life (centre-based, childminder, informal care). Formal childcare in the first three years of life predicts a lower likelihood of high levels of behavioural and emotional symptoms in middle childhood, especially in children who were in centre-based childcare. This was particularly true for emotional symptoms and peer-relationship problems. Those who were in centre-based childcare for at least one year benefitted the most, as did girls and children from socioeconomically disadvantaged backgrounds. Overall, high quality centre-based childcare specifically predicts lower levels of emotional difficulties, peer problems, and low prosocial behaviours into middle-childhood.

3. <u>INTRODUCTION</u>

3.1.Background

Early childcare has a positive impact on children's academic readiness as well as cognitive, language and pre-academic skills.[1,2] However, its impact on behaviour is debated.[3,4]

While some studies reported that childcare prior to school entry was associated with elevated levels of behavioural difficulties,[5,6] particularly externalizing problems,[5] others found no such effects.[7] To the contrary, other researchers found no negative effect of childcare on children's behaviour,[8] or only in the very short-term.[4] Finally, some studies suggested that the protective effects of early childcare are strongest among children growing up in high-risk families.[9]

Existing discrepancies in prior studies may result from several factors: varying childcare policies, childcare quality, age(s) at which children's behaviour was ascertained, and the use of parental vs. teacher reports of children's behaviour. Studies tend to compare either centre-based childcare to informal care, i.e. childcare by non-professional caregivers such as grandparents, relatives, friends or neighbours, or formal care, i.e. childcare by a professional, to informal care. Few studies were conducted in countries with universal childcare policy. Policies concerning early childcare differ from country to country and therefore not only may the age at which children enter preschool differ but also the time spent in childcare, its quality and availability. Furthermore, with notable exceptions,[6] prior studies only focused on short-term behavioural, and sometimes emotional difficulties, and little is known about the potential long-term consequences of early life childcare.

France provides an interesting setting to examine this question: a) the number of places in formal childcare for children under three years of age is high (approximately 52% of children

can attend compared to 33% on average in Europe);[10] b) childcare is of high quality (UNICEF Report Card);[11] c) nearly all children enter the formal school system at 3 years of age (97% start by age 3 and 99% by age 4), [12] making it possible to isolate the role of childcare prior to age 3; d) early childcare is based on the principle of universality, i.e. all children, irrespective of their background can access.

French families tend to use two different types of formal childcare: centre-based care (approximately 27% of children) and childminders, professional caregivers with a state degree, authorised to take care of 2 to 6 children in their own home (approximately 49% of children).[10,13] Childcare is subsidised and the two types have similar cost but vary in terms of educational content, centre-based care being generally more structured and standardised than care provided by a childminder. The number of available places is under the supervision of municipalities and varies across place and time.[13] Centre-based childcare, highly regarded by families, is in high demand. However, the number of places is limited and the hours are not always flexible, leading some families to turn to childminders.[14]

Taking advantage of this unique, quasi-experimental, situation, where families choose whether or not their child attends childcare but where the type of childcare is determined by availability, we test associations between childcare type and children's trajectories of behavioural and emotional symptoms between ages 3 and 8, using data from the mother-child EDEN cohort study. Contrary to other studies where childcare was defined as care received up to the age of 5 to 7 years, we aimed to study whether childcare in the first 3 years of life is linked to behavioural and emotional levels between ages 3 and 8. We further investigated whether time spent in childcare (< 1 year vs. $>= 1$ year) plays a role.

Finally, based on studies showing that childcare use and influence vary depending on maternal education and psychological, as well as the child's gender,[15–17] we test whether the effects on behaviour vary across these 3 characteristics.

4. **METHODS**

4.1. Study design, setting and participants

The EDEN mother-child cohort received approval from the ethics committee (CCPPRB) of Kremlin Bicêtre on 12 December 2002 and from CNIL (Commission Nationale de l'Informatique et des Libertés), the French data privacy institution. It included 2002 women recruited at 24 weeks of amenorrhea in two maternity wards in two cities in France: Nancy and Poitiers (2003-2006). All women (N = 3758) who visited the prenatal clinic of the local university hospitals were invited to take part in the study. Exclusion criteria included multiple pregnancies, known diabetes, French illiteracy and mothers planning to leave the area in the following 3 years.[18] 1,907 women with a live birth agreed (95 refusals) to take part in a regular follow-up of their child. Participating children underwent 4 clinical examinations: at birth, 1 year, 3 years and during the 6th year (average of 5 years and 8 months). Self-reported questionnaires were administered during these examinations, as well as in-between (at 4 months, 8 months, 2 years, and 8 years of age). Compared to the general population, mothers participating in the EDEN cohort were slightly more educated, urban, and from higher income households than non-participants. Children's characteristics such as preterm births or admission to neonatal care unit were however of the same level.[18]

Childcare use depends not only on measurable factors, such as the number of childcare places available, parents' financial and employment status, but also on unmeasurable factors, such as

personal preference. We excluded children with no information on childcare and behaviour between ages 3 and 8 years, resulting in a final analytical sample of 1,428 children.

Compared to families included in our analysis, those who did not participate were characterized by lower maternal (12.86, SD = 2.67 vs. 13.92, SD = 2.59 years; $p < 0.0001$) and paternal (12.46, SD = 2.54 vs. 13.28, SD = 2.63 years; $p < 0.0001$) educational level, higher maternal (31.6 vs. 18.4%; $p < 0.0001$) and paternal (13.6 vs. 5.9%; $p < 0.0001$) levels of unemployment, higher family financial difficulties (61.0 vs. 50.7%; $p < 0.0001$), and lower maternal social support (64% vs. 71.5%; $p = 0.002$); however there were no significant differences in terms of children's sex, birth weight, prematurity or parental history of childhood behavioural difficulties.

4.2. Variables

4.2.1. Childcare

Data about childcare arrangements in the first 3 years of life were reported by mothers at 4, 8, and 12 months, and at 2 and 3 years of age. Based on this information, we created three mutually exclusive groups:

1. **Childminder, CM** (636, 44.5%).
2. **Centre-based childcare, CBC** (367, 25.7%): day-care centre, day nursery or crèche staffed with professionals.
3. **Informal childcare, IC** (425, 29.8%): primarily parents exclusively (71.3%), sometimes complemented by grand-parents or other non-professional caregivers (e.g. other relatives, friends, neighbours, occasional babysitters).

If the mother reported that the child was in centre-based care on at least one assessment, children were included in the 'centre-based childcare' group. If not, and if children were looked after by a childminder on at least one assessment, they were included in the

'childminder' group. Children who were looked after exclusively by their parents (n = 303, 21.2%) or by their parents along with other non-professional caregivers (n = 122, 8.5%) had similar characteristics and outcomes and were grouped in 'informal care'. Transitions from one type of childcare to another (mainly from informal care to either type of formal care) primarily occurred during the first year of life (n = 823).

Depending on the type of childcare reported at each time point, we found that children either spent a few months in childcare (< 1 year) or several months (>= 1 year). To take into account time spent in childcare from birth to age three, in additional analyses, children were classified in 5 groups, using 1 year in childcare as cut-off (CM < 1 year; CM >= 1 year; CBC < 1 year; CBC >= 1 year; IC).

4.2.2. Childhood behavioural and emotional development: SDQ score

To ascertain children's emotional and behavioural patterns we used the French version of the Strengths and Difficulties Questionnaire (SDQ) reported by the children's mother at ages 3, 5.5, and 8 years.[19]

The SDQ includes 25 items which make up 5 scales of 5 items each: one positive (pro-social behaviours) and four negative (emotional symptoms, conduct problems, symptoms of hyperactivity/inattention and peer relationship problems). Each scale ranges from 0 to 10 points with higher scores representing more problematic behaviours/symptoms except in the case of prosocial behaviours.[20]

4.2.3. Covariates

Characteristics potentially associated with childcare type or children's psychological development and ascertained prior to age 3 years were studied as covariates.

These include:

- Study centre (Nancy or Poitiers): there were no differences in the methods of assessment between the two centres, but Nancy, an urban environment, has a higher density of childcare centres than Poitiers, therefore the probability of being in centre based childcare differs between these two settings;

- Child characteristics: sex, birth weight (< vs. >=2500g), premature birth (< vs. >= 37 weeks of amenorrhea), birth order (firstborn vs. not firstborn), maternal age at delivery, duration of breast-feeding (in months), and age at preschool entry;

- Parents' socio-demographic characteristics measured longitudinally between pregnancy and age 3: marital status (single vs. married/cohabiting), partner support (the mother reported whether she felt her partner was supportive, at inclusion: yes vs. no), parental educational level (< vs. >= higher education), parental employment status (unemployed vs. employed), family financial difficulties (to pay for medical care, food or electricity at least once during the first 3 years of life, yes vs. no), family income (< vs. >= 1500 euros/month), parents' activities with the child (e.g. playing, reading stories, etc. between 4 months and 2 years: almost daily, often or rarely);[21,22]

- Parents' mental health: maternal depression during pregnancy, identified using the 20 item version of the Centre for Epidemiological Studies Depression scale (CESD)(Cronbach's alpha = 0.88), and dichotomized using a cut-off of 23;[23] maternal postnatal depression ascertained using the Edinburgh Postnatal Depression Scale (EPDS)(Cronbach's alpha = 0.85) at 4, 8 and 12 months post-partum and dichotomized using a threshold of 13;[24] maternal treatment of mental health difficulties (e.g. use of tranquilizers, antidepressants, sleeping aids, counselling) during the follow-up; maternal history of psychiatric problems prior to pregnancy; parental

history of childhood behavioural difficulties and maternal use of psychoactive substances in pregnancy and afterwards (cigarettes, cannabis, alcohol).

4.3. Statistical methods

All analyses were performed with SAS, version 9.4.

Children may have fluctuating levels of symptoms at the 3 times SDQ was reported, i.e. some children may have high levels at 3 years but then decrease over time while for others it may be the opposite or stable. To identify groups of children with similar patterns of SDQ symptoms over time, we used group-based trajectory modelling.[25] The best-fitting model for each SDQ subscale was defined based on a maximized BIC (Bayesian Information Criterion) and group parsimony.[25]

On average, 6.4% of data on study covariates were missing (with a maximum of 22% for maternal depression at 12 months). Missing data were handled using the multiple imputation (MI) technique with the Fully Conditional Specification (FCS) method [26](10 imputations). The imputation model included all variables included in our substantive analysis or predictive of missingness.[27]

To render the three different childcare groups as similar as possible we used propensity scores, calculated based on all observed variables associated with childcare or behavioural difficulties. [28] All variables predictive of children's behavioural difficulties and/or childcare attendance were used to calculate propensity scores using multinomial logistic regression.

Propensity scores were included in our statistical models via inverse probability weights (IPWs), which are the reciprocal of receiving the predicted exposure.[28] Extreme weights were curtailed at the 99th percentile and the stabilised mean weight was approximately 1.

Finally, we verified that confounding factors were more evenly distributed across the 3 childcare groups after applying the IPWs.[28,29]

To test whether childcare type predicts children's trajectories of emotional and behavioural symptoms, we carried out multinomial logistic regression analyses adjusted for IPWs.

Additionally, we also tested whether children's behaviour varied with the time spent in formal childcare (< vs. >=1 year). Finally, we tested for statistical interactions between childcare type and (i) child sex, (ii) maternal educational level, (iii) maternal depression and stratified on these factors.

5. RESULTS

5.1. Descriptive analysis

In our study population (**Table 1**), 48.0% of children were female and the average age at preschool entry was 3.45 years (SD = 0.6). Average SDQ scores were 9.94 (SD = 4.8) at 3 years, 8.75 (SD = 5.2) at 5.5 years and 8.62 (SD=5.2) at 8 years. Overall, characteristics of children in centre-based care or cared for by a childminder were similar, while children in informal care systematically had systematically less favourable profiles.

Table 1: Characteristics of the study population (N = 1428), means (SD) or N (%); p for differences across childcare types.

Variables % (N)	Child-minder 44.5 % (N = 636)	Centre-based 25.7 % (N = 367)	Informal childcare 29.8 % (N = 425)	*p*
Child characteristics				
Centre of birth (Nancy)	43.1	55.0	49.2	*0.0011*
Gender (Female)	47.3	51.8	45.7	*0.2071*
Mother's age (years)	29.8 (4.3)	29.8 (4.7)	30.2 (5.4)	*0.2797*
Birth weight < 2500g	4.1	6.0	4.7	*0.3927*
Premature child	5.5	6.0	5.2	*0.8807*
Breastfeeding duration (months)	2.84 (3.37)	3.94 (4.22)	3.98 (5.39)	*<0.0001*
First-born	47.5	48.2	16.5	*<0.0001*
Age of entry in school (years)	3.41 (0.58)	3.44 (0.60)	3.51 (0.66)	*0.0234*
Parental employment status				
Non-working mother at 24 weeks of pregnancy	7,9	11,4	40,7	*<0.0001*
Non-working mother at 1 year	6,1	11,7	42,3	*<0.0001*
Non-working mother at 2 years	4,4	7,6	42,6	*<0.0001*
Non-working at 24 weeks of pregnancy	4,6	9,0	8,9	*0.0052*
Parental educational level				
Low educated mother [a]	43,8	30,2	61,6	*<0.0001*
Low educated father [a]	49,4	40,9	64,2	*<0.0001*
Maternal psychological status				
Depression (CESD)during pregnancy [b]	6.3	5.5	6.0	*<0.0001*
Depression (EPDS) at 12 months [c]	4.7	6.0	30.8	*<0.0001*
Psychological help during pregnancy	12.7	14.4	12.0	*0.5799*
Psychological help at 1 year	7.9	10.6	6.8	*0.1352*
Psychological help at 2 years	10.9	15.8	8.7	*0.0060*
History of mental health problems before pregnancy	12.6	14.4	16.0	*0.2836*
Lack of social support	25.2	29.4	34.2	*0.0256*
Single parent status				
Single mother at 24 weeks of pregnancy	1.6	3.5	3.5	*0.0279*
Single mother at 1 year	1.6	5.7	3.5	*0.0015*
Single mother at 2 years	3.0	5.2	5.4	*0.0977*
Maternal substance use				
Cannabis use prior pregnancy	4.9	5.7	7.3	*0.2551*
Tobacco use prior pregnancy	31.6	29.4	36.0	*0.1236*
Tobacco use during pregnancy	22.5	18.3	27.5	*0.0078*

Alcohol use during pregnancy	29.9	26.4	31.5	*0.2797*
Financial difficulties				
Household income < 1500 E during pregnancy	1.7	4.1	9.2	*<0.0001*
At least 1 financial difficulty (pregnancy)	47.3	49.6	56.7	*0.0100*
Low household income (1st year)	4.9	9.3	31.8	*<0.0001*
At least 1 financial difficulty (1st year)	23.9	25.9	43.3	*<0.0001*
Low household income (2nd year)	3.9	8.2	32.0	*<0.0001*
At least 1 financial difficulty (2nd year)	50.0	55.0	63.1	*0.0002*
Parental childhood difficulties				
Childhood adversity (mother)	24.2	28.6	31.3	*0.0343*
Childhood speech delay (mother)	11.5	14.7	22.4	*<0.0001*
Childhood behaviour problems (mother)	6.1	5.5	7.5	*0.4633*
Childhood behaviour problems (father)	9.4	10.4	16.0	*0.0032*
Childhood speech delay (father)	26.3	24.8	41.7	*<0.0001*
Child activities with the parents				
Daily activities < 1 year (mother)	82.1	80.7	55.1	*<0.0001*
Daily activities at 1 year (mother)	92.8	91.3	94.6	*0.1899*
Daily activities at 1 year (father)	78.8	77.9	70.8	*0.0078*
Daily activities at 2 years (mother)	51.3	66.8	77.2	*<0.0001*
Daily activities at 2 years (father)	72.2	64.0	80.0	*<0.0001*

[a] Low level of education: No tertiary education (high school diploma or lower)

[b] Centre of Epidemiological Studies Depression scale

[c] Edinburg Postnatal Depression Scale

5.2. Childcare type predicts children's emotional and behavioural trajectories

Figure 1 shows children's trajectories of emotional and behavioural symptoms between ages 3 and 8 years. For each SDQ subscale, the best model predicts three distinct trajectories representing three levels of symptoms (low, intermediate and high level symptoms). Children belonging to the 'low level symptoms' group served as the reference category, except for prosocial behaviours where the 'high level symptoms' group was the reference.

The majority of children had low or intermediate level symptom trajectories (except for prosocial behaviours). Overall 15.5% had persistently high levels of conduct problems, 15.1% high symptoms of hyperactivity/inattention, 16.0% of emotional symptoms, 6.8% of peer relationship problems and 13.1% had persistently low levels of prosocial behaviours.

In bivariate analyses (**Table 2**), compared to children in informal childcare, those attending centre-based childcare were less likely to have high levels of emotional symptoms, peer relationship problems, hyperactivity/inattention and conduct problems, while those cared for by a childminder were less likely to have high levels of peer relationship problems. After controlling for child and family characteristics via IPW (**Table 2**), compared to children in informal childcare, those who attended centre-based childcare were less likely to have high levels of emotional ($OR_{IPW-adjusted} = 0.35$, 95% CI: 0.17-0.71) and peer relationship problems ($OR_{IPW-adjusted} = 0.31$, 95% CI 0.15-0.67). Children looked after by a childminder were somewhat more likely to follow a high trajectory of conduct problems ($OR_{IPW-adjusted} = 1.72$ [1.05-2.81]).

Table 2: Early childcare (childminder, centre-based childcare or informal care) from 0 to 3 years and children's trajectories of behavioural and emotional difficulties (low, intermediate or high) from ages 3 to 8 years; EDEN cohort study (n=1428), bivariate multinomial regression and Inverse Probability Weight (IPW)-adjusted analyses (95% CI); reference group = informal care.

SDQ subscales		Bivariate analysis						IPW-adjusted analysis					
		CM vs. IC			CBC vs. IC			CM vs. IC			CBC vs. IC		
		OR	*95% IC*	*p*	*OR*	*95% IC*	*p*	*OR*	*95% IC*	*p*	*OR*	*95% IC*	*p*
Emotional Symptoms	L	Reference			Reference			Reference			Reference		
	I	**0.80**	0.54-1.19	*0.2715*	**0.58**	0.39-0.88	*0.0102*	**0.41**	0.22-0.79	*0.0080*	**0.33**	0.18-0.60	*0.0004*
	H	**1.04**	0.65-1.67	*0.8638*	**0.54**	0.32-0.92	*0.0229*	**0.58**	0.31-1.08	*0.0882*	**0.35**	0.17-0.71	*0.0037*
Peer Relationship Problems	L	Reference			Reference			Reference			Reference		
	I	**0.67**	0.47-0.95	*0.0240*	**0.49**	0.34-0.72	*0.0002*	**0.98**	0.61-1.58	*0.9453*	**0.78**	0.50-1.21	*0.2680*
	H	**0.47**	0.27-0.82	*0.0079*	**0.33**	0.17-0.62	*0.0007*	**0.52**	0.24-1.12	*0.0930*	**0.31**	0.15-0.67	*0.0032*
Hyperactivity / Inattention	L	Reference			Reference			Reference			Reference		
	I	**0.89**	0.67-1.19	*0.4404*	**0.71**	0.52-0.98	*0.0371*	**1.34**	0.86-2.11	*0.1927*	**1.18**	0.75-1.87	*0.4651*
	H	**0.97**	0.66-1.42	*0.8556*	**0.50**	0.32-0.81	*0.0041*	**1.53**	0.98-2.38	*0.0593*	**1.02**	0.54-1.95	*0.9460*
Conduct Problems	L	Reference			Reference			Reference			Reference		
	I	**0.91**	0.67-1.25	*0.5699*	**0.72**	0.51-1.01	*0.0564*	**1.07**	0.75-1.52	*0.7087*	**1.00**	0.71-1.39	*0.9789*
	H	**0.72**	0.48-1.08	*0.1121*	**0.54**	0.34-0.85	*0.0085*	**1.72**	1.05-2.81	*0.0306*	**1.36**	0.67-2.78	*0.3777*
Prosocial Behaviours	L	**1.20**	0.79-1.84	*0.3924*	**0.67**	0.41-1.10	*0.1137*	**1.16**	0.71-1.89	*0.5628*	**0.81**	0.50-1.30	*0.3797*
	I	**1.16**	0.85-1.57	*0.3511*	**0.83**	0.59-1.16	*0.2684*	**0.88**	0.58-1.32	*0.5222*	**0.66**	0.47-0.94	*0.0207*
	H	Reference			Reference			Reference			Reference		

CM = Childminder (45.5%); **CBC** = Centre-based childcare (25.7%); **IC** = Informal care (29.8%).

L = low-level symptoms; *I* = intermediate-level symptoms, *H* = high-level symptoms.

Among children who were in formal childcare, those who attended centre-based childcare had the lowest levels of emotional symptoms and peer relationship problems irrespective of duration (**Table 3**) (respectively: <1 year: high emotional symptoms: $OR_{IPW-adjusted} = 0.23$, 95% CI: 0.11-0.50 and high peer relationship problems: $OR_{IPW-adjusted} = 0.14$, 95% CI: 0.05-0.39; >=1 year: high emotional symptoms: $OR_{IPW-adjusted} = 0.27$, 95% CI: 0.12-0.58 and high peer relationship problems: $OR_{IPW-adjusted} = 0.43$, 95% CI: 0.20-0.91). This was also the case of children who spent one year or more with a childminder (high emotional symptoms: $OR_{IPW-adjusted} = 0.38$, 95% CI: 0.18-0.80) and high peer relationship problems: $OR_{IPW-adjusted} = 0.32$, 95% CI: 0.13-0.76). However, only children who spent at least one year in centre-based childcare had a decreased likelihood of having high levels of hyperactivity/inattention ($OR_{IPW-adjusted} = 0.42$, 95% CI: 0.22-0.82) and low levels of prosocial behaviours ($OR_{IPW-adjusted} = 0.50$, 95% CI 0.28-0.90).

Table 3: Time in early childcare (childminder, centre-based childcare or informal care) from 0 to 3 years and children's behavioural and emotional difficulties from ages 3 to 8 years; EDEN cohort study (n=1428), bivariate multinomial regression and Inverse Probability Weight (IPW)-adjusted analyses (95% CI); reference group = informal care.

SDQ sub-scale & trajectories		CM < 1 year vs. IC			CM >= 1 year vs. IC			CBC < 1 year vs. IC			CBC >= 1 year vs. IC		
		OR	95% IC	*p*	OR	95% IC	*p*	OR	95% IC	*p*	OR	95% IC	*p*
BIVARIATE ANALYSES													
Emotional Symptoms	*L*	Reference			Reference			Reference			Reference		
	I	**1.07**	0.59-1.94	*0.8142*	**0.73**	0.48-1.10	*0.1336*	**0.65**	0.39-1.10	*0.1086*	**0.53**	0.33-0.85	*0.0090*
	H	**1.35**	0.67-2.72	*0.3971*	**0.96**	0.58-1.58	*0.8676*	**0.51**	0.25-1.02	*0.0558*	**0.56**	0.30-1.04	*0.0680*
Peer Relationship Problems	*L*	Reference			Reference			Reference			Reference		
	I	**1.13**	0.65-1.95	*0.6712*	**0.57**	0.39-0.82	*0.0026*	**0.61**	0.38-0.98	*0.0410*	**0.42**	0.27-0.64	*<0.0001*
	H	**0.84**	0.37-1.92	*0.6733*	**0.40**	0.22-0.72	*0.0024*	**0.34**	0.14-0.81	*0.0154*	**0.32**	0.15-0.68	*0.0032*
Hyperactivity / Inattention	*L*	Reference			Reference			Reference			Reference		
	I	**1.23**	0.80-1.90	*0.3440*	**0.80**	0.58-1.08	*0.1463*	**0.83**	0.55-1.26	*0.3857*	**0.63**	0.44-0.92	*0.0160*
	H	**1.10**	0.62-1.97	*0.7426*	**0.93**	0.61-1.40	*0.7126*	**0.73**	0.41-1.30	*0.2836*	**0.36**	0.19-0.65	*0.0009*

Conduct Problems	L	Reference			Reference			Reference			Reference		
	I	**1.39**	0.86-2.26	*0.1796*	**0.80**	0.58-1.11	*0.1837*	**0.78**	0.50-1.20	*0.2563*	**0.68**	0.46-1.01	*0.0541*
	H	**1.25**	0.69-2.28	*0.4646*	**0.60**	0.39-0.92	*0.0200*	**0.74**	0.42-1.32	*0.3100*	**0.40**	0.22-0.71	*0.0019*
Prosocial Behaviours	L	**1.02**	0.55-1.90	*0.9540*	**1.28**	0.81-2.01	*0.2900*	**0.79**	0.42-1.50	*0.4725*	**0.59**	0.32-1.07	*0.0827*
	I	**1.12**	0.72-1.74	*0.6108*	**1.17**	0.84-1.63	*0.3942*	**0.94**	0.61-1.45	*0.7770*	**0.75**	0.51-1.11	*0.1512*
	H	Reference			Reference			Reference			Reference		
INVERSE PROBABILITY WEIGHT (IPW) – ADJUSTED ANALYSES													
Emotional Symptoms	L	Reference			Reference			Reference			Reference		
	I	**0.57**	0.27-1.18	*0.1302*	**0.32**	0.16-0.63	*0.0009*	**0.23**	0.12-0.46	*<0.0001*	**0.36**	0.19-0.69	*0.0022*
	H	**0.92**	0.41-2.06	*0.8413*	**0.38**	0.18-0.80	*0.0103*	**0.23**	0.11-0.50	*0.0002*	**0.27**	0.12-0.58	*0.0009*
Peer Relationship Problems	L	Reference			Reference			Reference			Reference		
	I	**1.07**	0.64-1.81	*0.7927*	**0.85**	0.51-1.40	*0.5179*	**0.74**	0.45-1.22	*0.2340*	**0.62**	0.38-1.02	*0.0622*
	H	**0.62**	0.28-1.35	*0.2238*	**0.32**	0.13-0.76	*0.0106*	**0.14**	0.05-0.39	*0.0002*	**0.43**	0.20-0.91	*0.0279*
Hyperactivity / Inattention	L	Reference			Reference			Reference			Reference		
	I	**1.65**	0.98-2.76	*0.0569*	**1.24**	0.75-2.05	*0.3850*	**1.30**	0.79-2.14	*0.3008*	**0.99**	0.66-1.48	*0.9626*
	H	**1.43**	0.78-2.61	*0.2413*	**1.41**	0.83-2.38	*0.2019*	**1.09**	0.62-1.94	*0.7625*	**0.42**	0.22-0.82	*0.0105*
Conduct Problems	L	Reference			Reference			Reference			Reference		
	I	**1.77**	1.06-2.94	*0.0280*	**0.81**	0.52-1.27	*0.3618*	**0.94**	0.62-1.42	*0.7578*	**0.84**	0.47-1.51	*0.5531*
	H	**3.52**	1.84-6.74	*0.0002*	**1.31**	0.73-2.36	*0.3643*	**1.54**	0.78-3.03	*0.2075*	**0.78**	0.38-1.58	*0.4842*
Prosocial Behaviours	L	**0.78**	0.42-1.44	*0.4245*	**1.56**	0.86-2.84	*0.1400*	**0.94**	0.52-1.71	*0.8414*	**0.50**	0.28-0.90	*0.0216*
	I	**0.89**	0.56-1.41	*0.6156*	**0.93**	0.59-1.48	*0.7652*	**0.71**	0.46-1.10	*0.1227*	**0.40**	0.25-0.66	*0.0003*
	H	Reference			Reference			Reference			Reference		

CM < 1 year: Childminder for less than 1 year (12.2%); **CM >= 1 year**: Childminder for at least 1 year (32.3%); **CBC < 1 year**: Centre-based childcare for less than 1 year (11.7%); **CBC >= 1 year**: Centre-based childcare for at least 1 year (14.0%); **IC**: Informal care (29.8%).

L = low-level symptoms; *I* = intermediate-level symptoms, *H* = high-level symptoms.

5.3. Subgroup analyses

Further analyses (**Figure 2**) showed that girls, children whose mother had higher education and those whose mother was not depressed benefited particularly from formal childcare. Compared to girls who were in informal childcare, those who were in centre-based childcare

or with a childminder had a lower likelihood of a high trajectory of emotional symptoms and peer relationship problems. Compared to boys in informal care, those who were in centre-based childcare seemed to have fewer emotional symptoms but those in a childminder's care were more likely to have conduct problems. Only children whose mother had higher education were less likely to have high levels of emotional symptoms and peer relationship problems in case of centre-based or childminder's care, as compared to informal care. Children whose mother experienced depression were less likely to have high levels of peer relationship or emotional problems if they attended centre-based childcare.

6. __DISCUSSION__

Main results

Our study, conducted among a community sample of children in France, shows three types of trajectories in children's behavioural and emotional symptoms between ages 3 and 8: persistently high, intermediate and low levels of symptoms. Formal childcare prior to age 3 years predicts low levels of emotional symptoms, peer relationship problems and high levels of prosocial behaviours into middle-childhood, particularly if children attend for at least one year. Childcare also appears to confer benefits in terms of prosocial behaviours. The effects of centre-based, collective, childcare are stronger than those conferred by care provided by a childminder. Our data suggest that opportunities for young children's socialization and stimulation, such as those offered by quality centre-based childcare, can serve to prevent children's emotional difficulties and help develop their psychosocial skills over the long term.

Limitations and strengths

Prior to interpreting our data, we need to acknowledge several limitations. First, the EDEN study was conducted in two distinct cities in France and is not nationally representative. The study population is overall more educated has higher household income than families in the general population of France. Nevertheless, our sample is socioeconomically heterogeneous and the distribution of childcare types is comparable to the general population.[10] Second, children's psychological and behavioural symptoms were reported by the mother and may have been influenced by maternal reporting style. Though research has shown that mothers tend to report somewhat higher levels of children's problems than teachers,[30] both types of informants are generally consistent and valid, particularly in early and middle childhood.[31] Third, the time per day spent in childcare and childcare quality are not directly measured in our study. However, centre-based childcare is generally of high quality in France [32]. Time spent in formal childcare is 37-38 hours per week.[10]

Our study's main strengths are: a) a 'quasi-experimental' setting where children with similar characteristics attend either centre-based childcare or a childminder, depending on availability rather than family choice;[13] b) repeated measures of children's and families' characteristics; c) longitudinal assessments of children's psychological and behavioural characteristics from early to middle childhood;[33] d) use of propensity scores and inverse probability weights to render exposure groups strictly comparable [34] to account for selection and confounding factors. This does not entirely rule out the possibility of unmeasured confounders (e.g. contextual factors such as the local availability of childcare), but it is unlikely that these would explain the associations observed.

Findings' interpretation

Ours is one of few studies to examine the association between childcare type and children's psychological development over several years in a country with a policy of universal access to early childcare, directly comparing two different childcare types.

Our data contrast with studies reporting that non-maternal childcare is associated with children's elevated levels of behavioural problems.[8,35] However, one was based in the USA, where childcare is unsubsidized – that is very expensive - or aimed at children from disadvantaged families and of relatively low quality (the USA ranks in the bottom half of industrial countries in this area),[11] and both measured children's behaviour at one time point which can introduce bias.

However, our results are consistent with research from Norway, where childcare access and quality are similar to France.[36] Nevertheless, in contrast to Norway, in France the number of places available in centre-based childcare centres does not entirely cover demand and approximately one third of children 0-3 years are cared for by a childminder. Childminders are trained and qualified, however their activity is less regulated than that of centre-based childcare centres and the quality of care they offer is heterogeneous.[37] This might explain why in our study childminder care appears less beneficial than centre-based care. Enhancing childcare quality might have a positive impact on social and emotional development from early childhood onwards.[38]

Low levels of emotional symptoms, peer relationship problems and hyperactivity-inattention observed among children attending centre-based childcare may reflect the benefits of cognitive stimulation through play, praise and reading,[39] opportunities for socialization and acquisition of rules which can contribute to children's self-esteem,[38] as well as quality caregiver-child interactions (i.e. positive emotionality, sensitivity and responsiveness, the avoidance of harsh physical punishment).[40] The benefits of centre-based childcare in terms

of children's development may result from the combination of these different positive elements.

Interaction between maternal and child characteristics and childcare benefits.

In our study, girls appear to reap more benefits from formal childcare than boys, particularly in terms of peer relations, emotional symptoms and prosocial behaviours. This is in line with studies showing that centre-based childcare mainly reduces internalizing problems which are most frequent in girls.[41] However, in contrast to other studies, we found no extra benefit associated with childcare for children from high-risk families.[15] To the contrary, low-risk children appeared to have especially low levels of psychological difficulties when attending childcare. It may be that the universal curriculum that is proposed to all children does not suffice to compensate the difficulties resulting from family socioeconomic or mental health difficulties.

Conclusion

Access to high quality childcare in the first years of life may improve children's emotional and cognitive development, prevent later emotional difficulties and promote prosocial behaviours. [42] Future research taking into account the daily time spent in childcare in nationally representative samples of children is needed to confirm these benefits on psychological development and whether they translate to a reduced likelihood of psychiatric disorders later in life.

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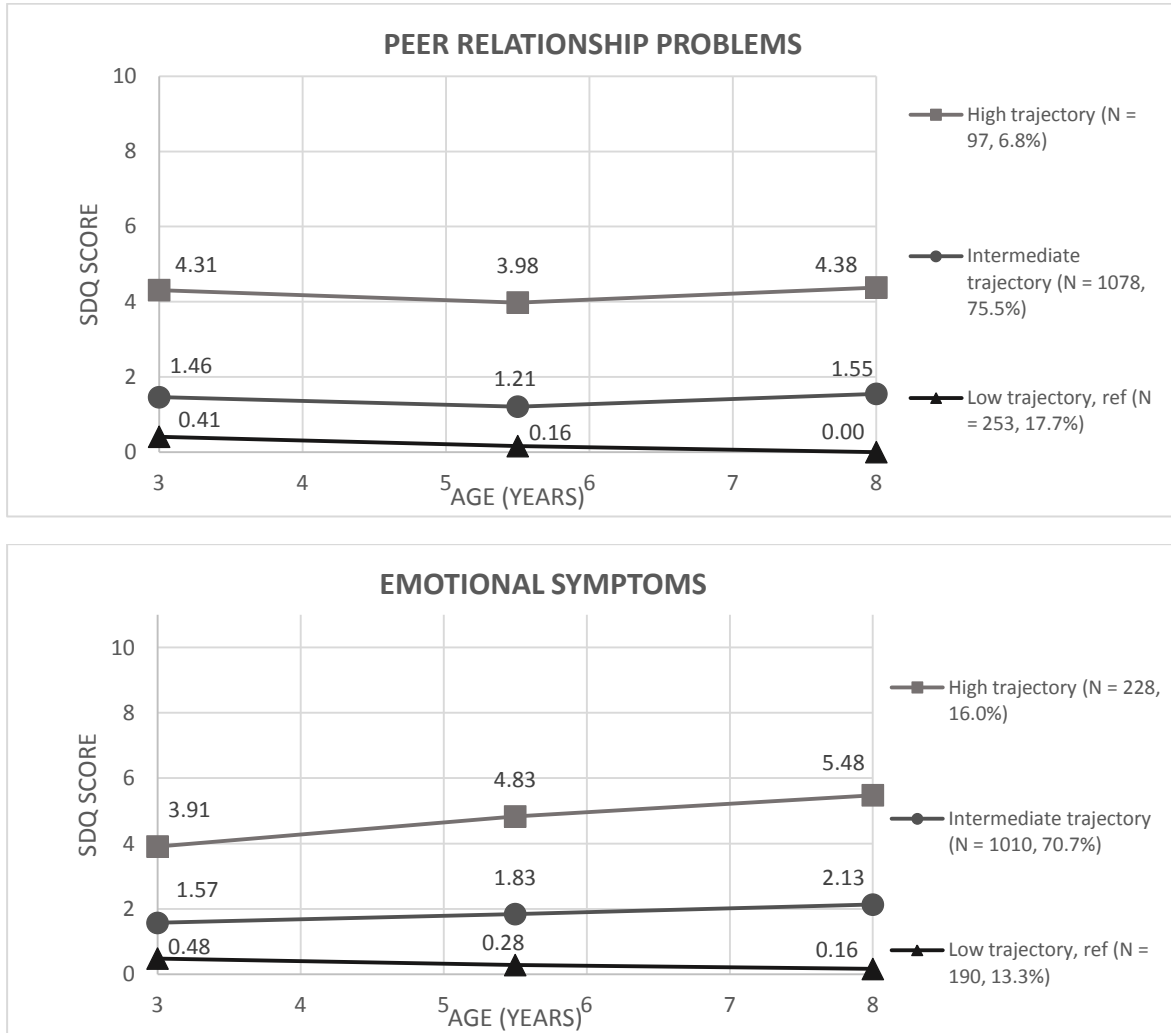
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Figure 1: Children's emotional and behavioural symptoms from 3 to 8 years (EDEN cohort study, N = 1428, 2003-2011, France).
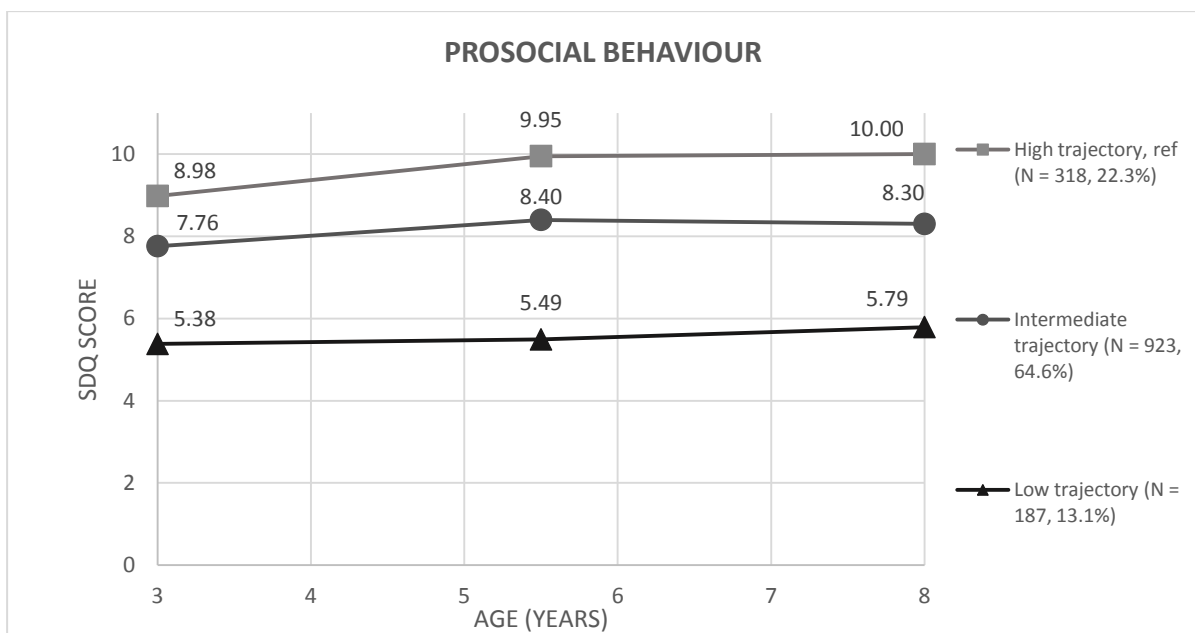
HYPERACTIVITY/INATTENTION

High trajectory (N = 216, 15.1%)
- 6.50
- 6.77
- 7.12

Intermediate trajectory (N = 810, 56.7%)
- 3.72
- 3.27
- 3.45

Low trajectory, ref (N = 402, 28.2%)
- 1.35
- 0.74
- 0.87

CONDUCT PROBLEMS

High trajectory (N = 221, 15.5%)
- 6.19
- 5.60
- 3.80

Intermediate trajectory (N = 881, 61.7%)
- 3.13
- 2.39
- 1.68

Low trajectory, ref (N = 297, 22.8%)
- 1.33
- 0.16
- 0.35

PROSOCIAL BEHAVIOUR

High trajectory, ref (N = 318, 22.3%)
- 8.98
- 9.95
- 10.00

Intermediate trajectory (N = 923, 64.6%)
- 7.76
- 8.40
- 8.30

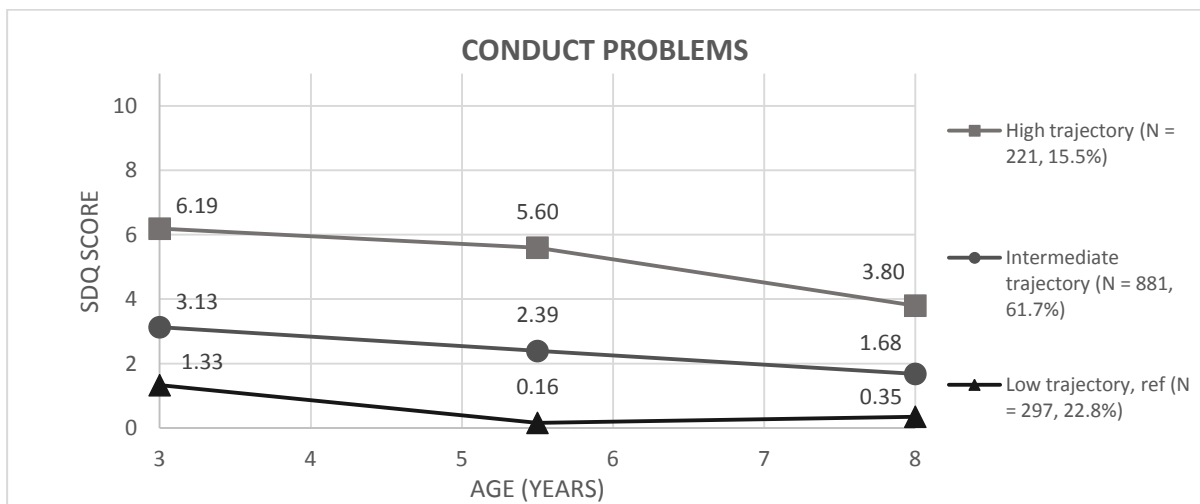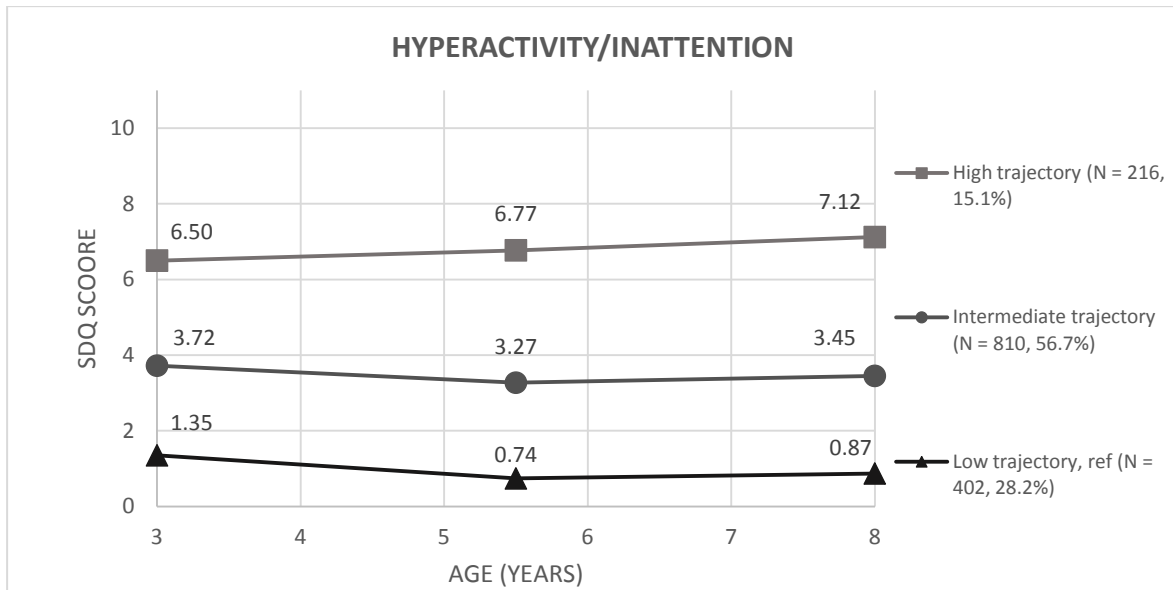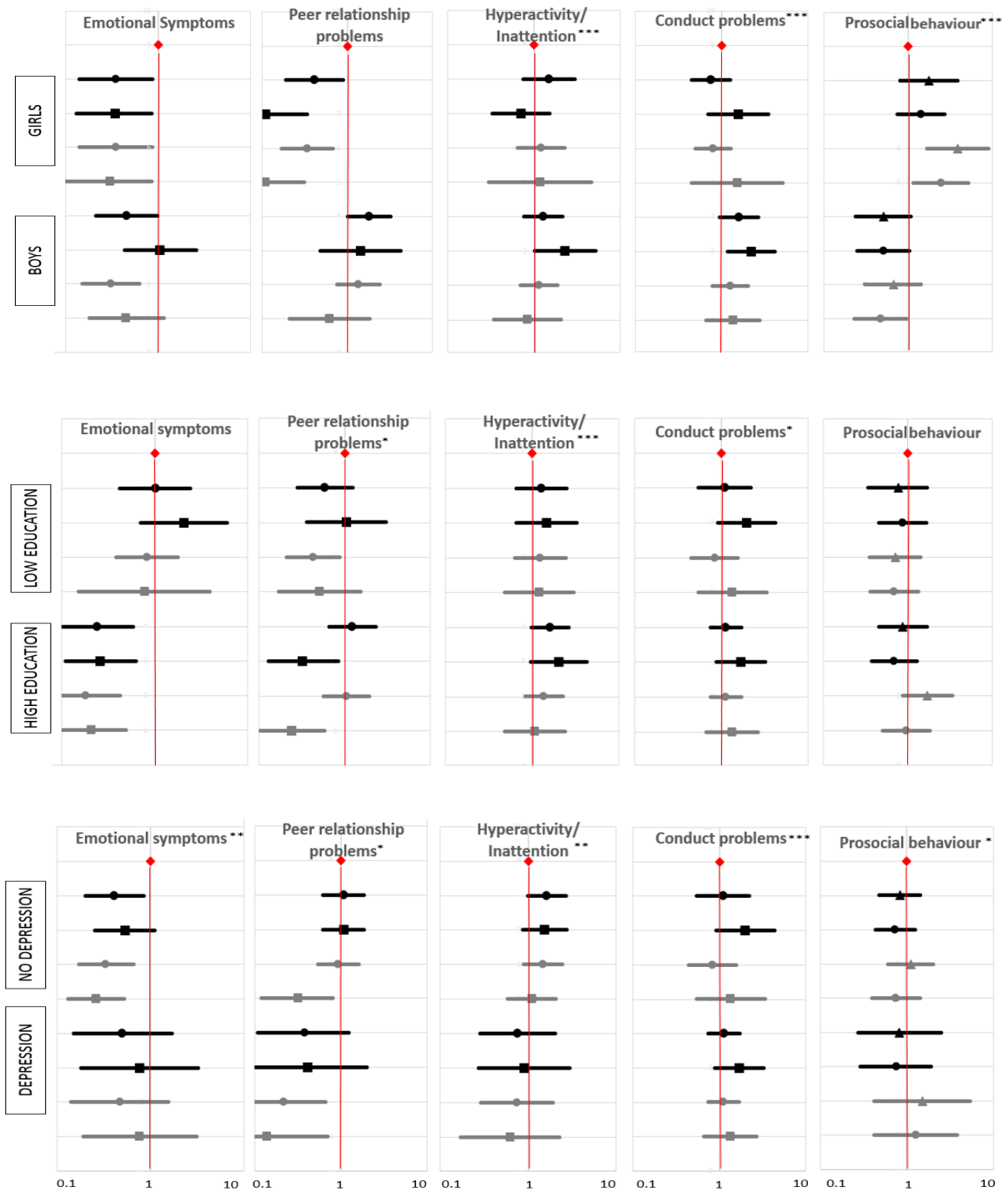Low trajectory (N = 187, 13.1%)
- 5.38
- 5.49
- 5.79

Figure 2: Early childcare (0-3 years) and children's behavioural and emotional difficulties (ages 3-8 years), stratifying by child sex, mother's education and depression. EDEN cohort study (n=1428), Inverse Probability Weight (IPW)-adjusted multinomial regression models (95% CI).

***: p value <0.001   **: p between 0.001 and 0.01   *: p value between 0.01 and 0.05

◆ Informal (reference) ▲ Childminder (Low) ▲ Centre-based (Low)

● Childminder (Intermediate) ● Centre-based (Intermediate)

■ Childminder (High) ■ Centre-based (High)