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## The development of depression in children and adolescents with ADHD

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## CHAPTER 3

### Trajectories of family functioning in adolescents with ADHD and depression

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Based on:

Roy, A., Hartman, C.A.H., Kretschmer, T., Oldehinkel, A.J. (*under review*). Trajectories of family functioning in adolescents with ADHD and depression.

## ABSTRACT

**Objective:** To assess whether family functioning trajectories differ amongst adolescents with no Attention Deficit Hyperactivity Disorder (ADHD) and no depression, only ADHD, only depression, and ADHD plus an onset of depression.

**Methods:** Using DSM-IV diagnostic criteria, 1875 adolescents were classified into four groups: comparison (with neither ADHD nor depression), only ADHD, only an onset of depression, and ADHD plus an onset of depression. Family functioning was assessed at four time-points (mean ages 11, 13, 16 and 19 years) using the McMaster Family Assessment Device (FAD). Mean-centred FAD scores were used to calculate family functioning trajectories (mean, linear trend, quadratic trend) for each participant. Multinomial logistic regressions were used to assess whether family functioning trajectories were associated with membership in any of the four groups.

**Results:** Adolescents with an onset of depression, either with or without ADHD, showed on average poorer family functioning than the comparison healthy adolescents. Adolescents with ADHD plus depression did not differ in their family functioning from adolescents with only ADHD or only depression. Adolescents with only ADHD showed an improving trend of family functioning.

**Conclusion:** These results suggest that adolescents with an onset of depression show poorer family functioning than those without depression, irrespective of a diagnosis of ADHD. If adolescents with ADHD do not develop a depression, their family functioning tends to improve over time.

**Keywords:** ADHD; Depression; Family functioning; Prospective study; Adolescents

## INTRODUCTION

Attention Deficit/Hyperactivity Disorder (ADHD) is a common childhood-onset psychiatric problem that often continues into adolescence (American Psychiatric Association, 2013). Symptoms of ADHD include hyperactivity, impulsivity and inattention. Affected individuals face difficulties in daily functioning and problems in maintaining social relationships (Danckaerts et al., 2010; Wehmeier, Schacht, & Barkley, 2010). In particular, difficult family relationships and poor family functioning has been reported in children and adolescents with ADHD (Johnston & Mash, 2001).

Family functioning may be defined as the ability of a family to support the social, psychological, and biological development of its members (Epstein & Keitner, 2005). According to the McMaster Model of Family Functioning, six characteristics of the family are important for a healthy mental and physical functioning: problem solving, communication, roles (how the family shares responsibility), affective responsiveness, affective involvement, and behaviour control (Epstein, Bishop, & Levin, 1978). Numerous studies have shown that difficulties in these functioning domains are associated with psychiatric problems (Staccini, Tomba, Grandi, & Keitner, 2014).

Specific to ADHD, studies on family functioning have mostly focussed on children (Deault, 2010; Johnston & Mash, 2001), and shown that relationships among family members are often strained and conflicting. Parents are likely to be assertive and less warm in their interactions with their children (Gerdes et al., 2007). Additionally, poor parenting practices, parental criticism, and impaired marital relationships are common features in the families of children with ADHD (Deault, 2010; Johnston & Mash, 2001; Ostrander & Herman, 2006; Theule, Wiener, Tannock, & Jenkins, 2013). While studies on the families of adolescents with ADHD are few, evidence suggests that several domains of functioning may be affected in them as well (Deault, 2010; Johnston & Mash, 2001). The developmental changes in family functioning that may happen during adolescence are less well documented (Johnston & Mash, 2001). Family functioning may worsen over time due to stress accumulation or may improve due to an adaptation or reduction in ADHD symptoms. How these trajectories may be further influenced by the development of a comorbid disorder during adolescence is also not yet understood.

When studying family functioning during adolescence, the development of depression is highly relevant and must be considered. Comorbid depression is a common occurrence in

adolescents with ADHD (Biederman, Mick, & Faraone, 1998; Biederman, Ball, Monuteaux, Mick, Spencer, McCreary, Cote, & Faraone, 2008), and is further known to impair prognosis (Blackman, Ostrander, & Herman, 2005; Brunsvold, Oepen, Federman, & Akins, 2008). Depression by itself is known to be associated with an impaired family functioning (Davies & Windle, 1997; Lucia & Breslau, 2006; Martin, Rotaries, Pearce, & Allison, 1995; Heru & Ryan, 2004). In adolescents with ADHD, an additional development of depression may change the existing patterns of family functioning.

This study was set up to better understand trajectories of family functioning associated with diagnoses of ADHD and depression, separately and as comorbid disorders. To achieve this, we compared longitudinal family functioning characteristics of adolescents with no ADHD and no depression, only ADHD, only an onset of depression, and ADHD plus an onset of depression.

## METHODS

### **Cohort**

The data were collected as part of the TRacking Adolescents' Individual Lives Survey (TRAILS), an ongoing Dutch prospective cohort study on psychosocial development and mental health of adolescents. A detailed description of the TRAILS cohort is available in previous reports (de Winter et al., 2005; Huisman et al., 2008; Oldehinkel et al., 2014; Ormel et al., 2012). In brief, TRAILS involves bi- or triennial measurements from ages 11 onwards, and consists of two separate cohorts: one population-based and another clinic-based. In both cohorts largely the same data were collected at the same ages. The general aims of TRAILS are to assess the development of mental health throughout adolescence; identify determinants and mechanisms of normal and abnormal mental health development; evaluate existing therapeutic interventions; to develop newer strategies to optimize mental health care for adolescents and young adults; and describe the impact of mental health problems on academic, professional, and social functioning.

For the population cohort of TRAILS, children and adolescents were recruited from five municipalities in the north of The Netherlands, including both urban and rural areas. Primary school participation was requisite for inclusion. Exclusion criteria were incapability to participate due to intellectual disability or a serious physical illness or handicap, and lack of available Dutch-speaking parent or parent surrogate. Of the 2935 children who were eligible

for inclusion, 2230 (76.0%) provided informed consent from both parent and child to participate in the study. Comparisons between the response and non-response groups showed no significant differences regarding gender, parental education, proportion of single-parent families, teacher-rated problem behaviour, and school absence. The present study used data from the first four assessment waves, which ran from March 2001 to July 2002 (T1), September 2003 to December 2004 (T2), September 2005 to August 2007 (T3), and October 2008 to September 2010 (T4). The mean age at T1 was 11.1 years ( $SD = 0.56$ ), and 50.8% were girls. Of the 2230 participants at T1, 96.4% participated at T2 ( $N = 2149$ , mean age 13.6,  $SD = 0.53$ , 51.0% girls). The response rates at T3 and T4 were, respectively, 81.4% ( $N = 1816$ , mean age 16.3,  $SD = 0.73$ , 52.3% girls) and 83.4% ( $N = 1881$ , mean age 19.1,  $SD = 0.60$ , 52.3% girls). Of the 1881 participants at T4, 1584 (84.2%) completed the below-described diagnostic interview.

The clinical cohort of TRAILS consists of children and adolescents who contacted one of two child psychiatric outpatient clinics in the Northern Netherlands before the age of 10 years. Exclusion criteria were unknown address, and incapability to participate due to intellectual disability. In total, 1264 children met these criteria, of whom 543 (42.9%) provided informed consent from both parent and child to participate in the study. The clinical cohort of TRAILS is representative for the population of children referred to child psychiatric outpatient clinics in the northern Netherlands. Four assessment waves have been completed to date, between September 2004 and December 2005 (T1;  $N = 543$ , mean age = 10.6 years,  $SD = 0.56$ , 34% girls), September 2006 and November 2007 (T2;  $N = 462$ , mean age = 12.9,  $SD = 0.62$ , 33.8% girls), September 2009 and February 2011 (T3;  $N = 419$ , mean age = 15.9,  $SD = 0.66$ , 33.9% girls), and September 2012 to February 2014 (T4;  $N = 392$ , mean age = 19.1,  $SD = 0.71$ , 37.2% girls).

In total, data from 1933 participants were available; 81.9% from the population and 18.1% from the clinical cohort. In order to study the association between family functioning trajectories and an onset of depression during adolescence, we excluded participants who developed depression prior to T1 ( $n=58$ ). This resulted in a final sample size of 1875 adolescents. The study was approved by the Dutch Central Committee on Research Involving Human Subjects (CCMO). Participants were treated in accordance with the Declaration of Helsinki, and all measurements were carried out with their adequate understanding and written consent.

## Measures

Psychiatric disorders were assessed at T4 by means of the World Health Organization Composite International Diagnostic Interview (CIDI), version 3.0. The CIDI is a structured diagnostic interview that yields lifetime and current diagnoses according to the definitions and criteria of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV). The CIDI has been used in a large number of surveys worldwide, and shown to have good concordance with clinical diagnoses. In addition to the occurrence of psychiatric disorders, the CIDI yields their age at onset and age at last occurrence. The CIDI has good reliability and validity for most diagnoses (Kessler et al., 2009; Wittchen, 1994). In this study, information on CIDI diagnoses of ADHD and depression were used. Criteria for a diagnosis of ADHD were: (1) a history of concentration problems prior to the age of seven that lasted a minimum of six months and seemed excessive compared to peers, and/or (2) a history of hyperactivity-impulsivity present before the age of seven that lasted a minimum of six months. Depression was operationalized as a lifetime diagnosis of Major Depressive Episode (with or without (hypo)manic symptoms), Dysthymia, or Minor Depressive Disorder. In addition to the CIDI, prospective parent, teacher and self-reports (as assessed by the Child Behaviour Checklist, Teacher's Checklist of Pathology, Youth Self Report, and Adult Self Report respectively) of ADHD and depressive symptoms were available from the first wave onwards. The validity of the CIDI diagnoses for ADHD and depression was supported by these reports (please see appendix 4).

Family functioning was assessed using the McMaster Family Assessment Device (FAD) (Epstein, Baldwin, & Bishop, 1983; Mansfield, Keitner, & Dealy, 2014) at all four waves (from T1 to T4). The version used is a 12-item General Functioning scale, which is a short version of the original 60-item FAD, and assesses emotional relationships and functioning within the family. Parents have to report their agreement with statements about their families on a 4-point scale ranging from 1 = strongly disagree to 4 = strongly agree. Family dysfunction as measured with this scale reflects avoiding discussing concerns or fears, having bad feelings within the family, not being able to turn to each other for support or to confide in each other, not being able to talk about sadness or express feelings to each other, difficulty in making decisions, not accepting family members as they are, and difficulty planning family activities. A low score on the scale indicates a healthy family climate; a high score a dysfunctional family climate. The general functioning scale scores represent the average of the 12-item scores. The general functioning scale has been shown to be a valid and

reliable (Cronbach's  $\alpha = 0.85$ ) measure of family functioning in surveys (Byles, Byrne, Boyle, & Offord, 1988) with adequate test-retest reliability (Miller, Epstein, Bishop, & Keitner, 1985).

### Analysis

Based on lifetime CIDI diagnoses at T4, participants were categorized into four groups: (1) comparison: no ADHD and no depression (Group C), (2) only ADHD (Group A), (3) only an onset of depression (Group D), and (4) ADHD with an onset of depression (Group A + D). Self-reported ADHD and depressive symptom scores (as assessed using the Youth Self Reports at T1, T2, T3 and the Adult Self Reports at T4) were plotted for each group at the four time-points to visualise mean symptom severity in each group.

At all four assessment waves, data on family functioning was missing in some individuals (missing  $FAD_{T1}$  : 4.9%,  $FAD_{T2}$  : 7.6%,  $FAD_{T3}$  : 16.4%,  $FAD_{T4}$  : 9.4%). A fully conditional specification method of multiple imputations was used to impute missing data (10 iterations; linear regression model). The results across 20 imputed data sets were averaged. Using mean-centred FAD scores, family functioning trajectories were calculated (Kleinbaum, Kupper, & Muller, 1988) for each participant as follows:

$$\text{Mean family functioning} = (FAD_{T1} + FAD_{T2} + FAD_{T3} + FAD_{T4})/4$$

$$\text{Linear trend family functioning} = (-3 \times FAD_{T1}) + (-1 \times FAD_{T2}) + (1 \times FAD_{T3}) + (3 \times FAD_{T4})$$

$$= 3(FAD_{T4} - FAD_{T1}) + (FAD_{T3} - FAD_{T2})$$

$$\text{Quadratic trend family functioning} = (FAD_{T2} + FAD_{T3}) - (FAD_{T1} + FAD_{T4})$$

$$= FAD_{T2} + FAD_{T3} - FAD_{T1} - FAD_{T4}$$

Multinomial logistic regressions were used to determine associations between family functioning trajectories (mean, linear trend, and quadratic trend) and the four groups, after adjusting for age at the first assessment wave. Multinomial logistic regressions predict the odds of membership in a particular group relative to a comparison group as a function of the independent variables. First, the associations between family functioning and the four groups were tested using group C (comparison group) as the reference category. Next, to assess if FAD trajectories differed among groups A + D, A and D, additional multinomial regressions



were conducted using groups A and D as reference categories. Results are presented as odd ratios (ORs) and their 95% confidence intervals (CIs).

Analyses were performed using SPSS v. 22.0 (IBM Corp., Armonk, NY) and plots were made with MATLAB (2011b, The MathWorks, Inc.). All tests were two-tailed, and a  $p$ -value  $\leq .05$  was considered statistically significant.

## RESULTS

Of the 1875 adolescents in our study, 5.4% received a diagnosis of ADHD ( $n=102$ ), and 19.8% a diagnosis of depression ( $n=371$ ). Amongst those with ADHD, 35.3% developed depression between the first and the fourth assessment waves ( $n=36$ ). Table 3.1 presents mean ages at onsets of ADHD and depression, and mean FAD scores at all four assessment waves for the four groups.

Figure 3.1 illustrates mean self-reported ADHD and depressive symptoms for each group from T1 to T4. In accordance with the CIDI diagnoses, the groups A + D (ADHD with depression) and A (only ADHD) showed higher mean ADHD symptoms than groups D (only depression) and C (comparison). Mean depressive symptom scores increased between T1 and T4 for the CIDI diagnosed depressed groups (A + D and D). For groups A and C, depressive scores remained more or less stable between T1 and T4.

Figure 3.2 presents the mean-centered FAD scores and their SEs across the four assessment waves for all participant groups. A low FAD score indicates healthy family functioning while a high score indicates poor family functioning. Figure 2 illustrates that groups A + D, A, and D have higher FAD scores at T1 than group C. Between T1 and T4, groups A + D and D showed an increase in their FAD scores, while the scores of group A declined during that time-period. Overall, group A + D had the highest FAD scores throughout all assessment time-points.

Table 3.2 presents results from the multinomial logistic regression analyses on the associations between FAD scores and group membership. Compared to the comparison group C, mean FAD was significantly higher in groups A + D and D. Further, the linear trend of group A was (marginally) significantly more negative than that of groups C and D, indicating that family functioning in the group with only ADHD improved more than in the other two groups. Although figure 3.2 and the effect sizes of the associations indicated a substantially higher mean (estimated) FAD in group A+D than in groups A and D, these differences were

not statistically significant. There were no associations between group membership and quadratic trends in FAD scores.

## DISCUSSION

This study assessed whether family functioning trajectories differed among adolescents with no ADHD and no depression, only ADHD, only an onset of depression, and ADHD plus an onset of depression. Results indicated that families of depressed adolescents, either with or without ADHD, functioned on average worse than families of non-depressed adolescents. Thus, whether ADHD was associated with poor family functioning over time depended on the emergence of comorbid depression. Family functioning of adolescents with ADHD but no depression showed an improving trend over time.

The intrusive and disruptive behaviours shown by adolescents with ADHD evoke negative reactions from family members and have been associated with poor family functioning. These family functioning characteristics are not stable (Johnston & Mash, 2001) and, as our findings suggest, may actually improve over time. An onset of depression seems to moderate this positive prospect, probably because family characteristics and depression are also interlinked. Although the differences between adolescents with ADHD with and without depression did not reach statistical significance, the effect sizes of these differences were large, and this lack of statistical significance can be attributed to the small group sizes. We therefore postulate that ADHD with an adolescent onset of depression is associated with a unique family functioning trajectory, worse than that of ADHD or depression alone and without the improvement over time seen in adolescents with only ADHD. Considering the relative weakness of the evidence provided by this study, however, this postulation needs confirmation in future studies.

As mentioned before, an onset of depression was associated with poor family functioning irrespective of a diagnosis of ADHD. It is possible that poor family functioning partly underlies the development of depression in adolescents. Conversely, a development of depression may lead to deterioration in family functioning. In either of these scenarios, family functioning appears to be independently associated with depression, not solely in the presence of ADHD.

Thus far, most studies have associated family functioning with ADHD symptom severity or comorbid disruptive disorders. We found only three studies on the association

between family functioning and depression in those with ADHD. First, Harris, Boots, Talbot, and Vance (2006) in a cross-sectional study compared 6-10 year olds with ADHD and comorbid dysthymia to those with only ADHD, and found all children, irrespective of comorbid dysthymia, to show poor family functioning. We did not find evidence for poor family functioning in all adolescents with ADHD, and this may have been related to the age range of our sample. Family functioning improved between age 11 and 19 in adolescents with only ADHD, and it is possible that this group differed from comparisons at preadolescence. Second, Biederman et al. (2008) found that poor family functioning did not predict comorbid depression in 6-18 year-old girls with ADHD. Third, and in contrast to Biederman et al. (2008), Drabick, Gadow, and Sprafkin (2006) reported that poor family functioning did predict depressive outcomes in boys with ADHD aged 6 to 10 years. These contrasting findings hint at gender differences in the associations between family functioning and depressive outcomes, but our study lacked the statistical power to investigate that.

Limitations of this study must be taken into account while interpreting its results. First, and most importantly, it is recommended that the Family Assessment Device be administered to all members in a family in order to accurately assess functioning (Sawyer, Sarris, Baghurst, Cross, & Kalucy, 1988). Especially adolescents are known to rate family functioning more poorly than their parents (Sawyer et al., 1988). In our study, this questionnaire was administered to one parent (usually the mothers) and adolescents' perception of family functioning was not included. This may have led to an underestimation of family dysfunction. Second, family characteristics are influenced by other members in the family. Considering that psychopathology in family members of individuals with ADHD is high (Deault, 2010; Larsson et al., 2013; Ma, Roberts, Winefield, & Furber, 2014), disrupted family functioning may have been exacerbated due to affected siblings or parents. Clearly, in such cases, family functioning characteristics may not be attributable to the course of ADHD of one family member alone. Third, as explained above, effects of family functioning characteristics on depressive outcomes may differ between boys and girls with ADHD. Due to a lack of sufficient power, possible gender-based differences could not be assessed.

It is well understood that family plays an important role in the development of children and adolescents. As explained by Johnston and Mash (2001), most studies have studied the concurrent associations of family functioning with ADHD and further prospective studies are needed to address the developmental changes that may occur in family characteristics. Our study took these developmental issues into account and assessed family

functioning at multiple time points, linking it to changes in psychopathology over the course of adolescence.

This study reveals functioning differences among families of adolescents with neither ADHD nor depression, only ADHD, only an onset of depression, and ADHD plus an onset of depression. In short, the development of depression in adolescence is associated with worsening family functions. In adolescents with ADHD, the development of depression hampers an age-dependent improvement in family functioning. It cannot be said with certainty whether depression drives the worsening family functioning or vice versa. Future studies may focus on understanding this aspect and incorporate an assessment of the possible gender differences in these associations.

Table 3.1 Means and standard deviations of ages at onset and recency of ADHD and depression, and FAD\* scores at four assessment time-points for all groups

	<b>C</b>	<b>A</b>	<b>D</b>	<b>A + D</b>
	N = 1438	N = 66	N = 335	N = 36
	(mean, SD)	(mean, SD)	(mean, SD)	(mean, SD)
Age at onset of ADHD (in years)	-	5.33, 1.75	-	5.47, 2.05
Age at onset of depression (in years)	-	-	15.04, 2.23	13.89, 2.34
ADHD recency (in years)	-	16.86, 3.20	-	18.22, 1.76
Depression recency (in years)			17.53, 1.82	17.82, 1.71
FAD <sub>T1</sub>	1.80, 0.38	1.85, 0.33	1.82, 0.37	1.88, 0.42
FAD <sub>T2</sub>	1.64, 0.38	1.72, 0.41	1.69, 0.37	1.82, 0.42
FAD <sub>T3</sub>	1.64, 0.38	1.64, 0.41	1.73, 0.37	1.83, 0.42
FAD <sub>T4</sub>	1.69, 0.38	1.69, 0.41	1.74, 0.37	1.84, 0.48

*C = comparison; A = only ADHD; D = only depression; A + D = ADHD with an onset of depression*

*\*Family assessment device: measures family functioning on a scale of 1-4. Raw mean scores of the groups are presented here. Lower scores represent better functioning*

Table 3.2 Multinomial regression analyses of FAD scores (mean, linear slope and quadratic slope) as predictors of CIDI diagnosed groups (only ADHD, only depression, ADHD with depression) at the fourth assessment wave

Adjusted <sup>4</sup> odd ratio of membership in groups <sup>5</sup> A, D or A + D relative to group C						
Predictor	A v/s C		D v/s C		A + D v/s C	
	OR (CI)	p	OR (CI)	p	OR (CI)	p
Mean FAD	1.73 (0.77 – 3.90)	.018	1.81 (1.22 – 2.68)	.003	4.67 (1.56 – 14.01)	.006
Linear slope FAD	0.84 (0.70 – 1.01)	.056	1.02 (0.93 – 1.12)	.72	1.04 (0.79 – 1.37)	.77
Quadratic slope FAD	0.91 (0.56 – 1.49)	.71	1.09 (0.86 – 1.39)	.47	1.29 (0.67 – 2.49)	.44
Adjusted <sup>1</sup> odds ratios contrasting groups A, D, and A + D						
Predictor	A v/s D		A + D v/s A		A + D v/s D	
	OR (CI)	p	OR (CI)	p	OR (CI)	p
Mean FAD	0.96 (0.40 – 2.28)	.91	2.70 (0.71 – 10.33)	.14	2.58 (0.83 – 8.04)	.10
Linear slope FAD	0.82 (0.68 – 1.00)	.053	1.24 (0.91 – 1.71)	.17	1.02 (0.77 – 1.36)	.87
Quadratic slope FAD	0.84 (0.50 – 1.39)	.49	1.42 (0.64 – 3.13)	.38	1.19 (0.60 – 2.35)	.62

<sup>4</sup> Adjusted for age at the first assessment wave

<sup>5</sup> A + D: ADHD with an onset of depression; A: only ADHD; D: only an onset of depression; C: comparison

Figure 3.1 Mean self-reported ADHD and depressive symptom scores of groups at all four assessment waves

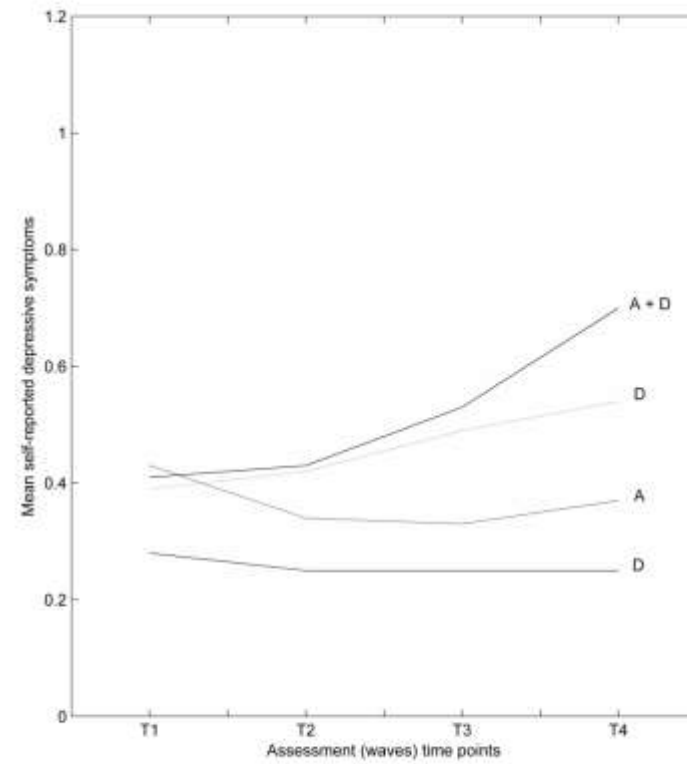
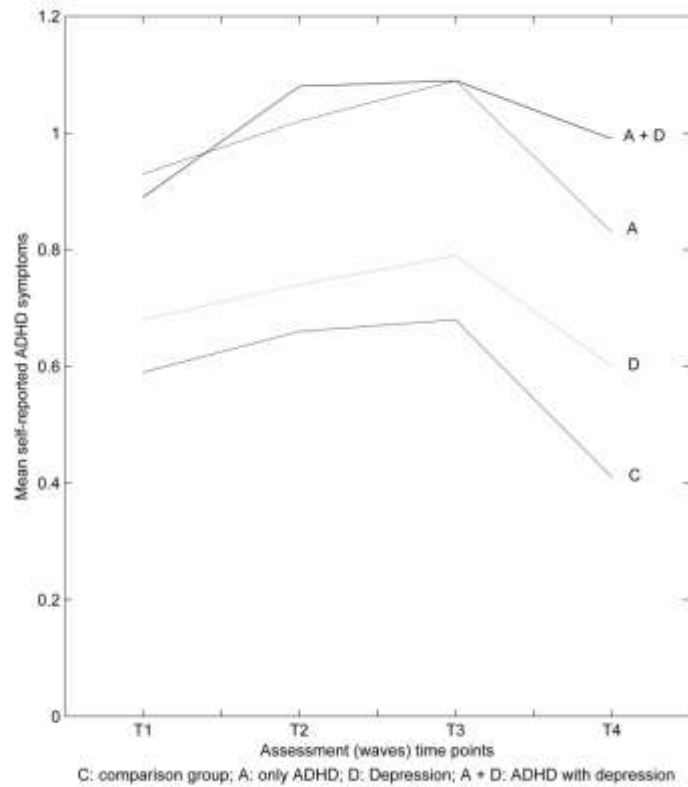


Figure 3.2 Family functioning (mean-centred scores from the Family Assessment Device) of groups at all four assessment waves

