

University of Groningen

## Prediction of psychosocial problems in adolescents

Jaspers, Merlijne

**IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.**

*Document Version*

Publisher's PDF, also known as Version of record

*Publication date:*

2012

[Link to publication in University of Groningen/UMCG research database](#)

*Citation for published version (APA):*

Jaspers, M. (2012). *Prediction of psychosocial problems in adolescents: do early childhood findings of the preventive child healthcare help?*. s.n.

### Copyright

Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

The publication may also be distributed here under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license. More information can be found on the University of Groningen website: <https://www.rug.nl/library/open-access/self-archiving-pure/taverne-amendment>.

### Take-down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

*Downloaded from the University of Groningen/UMCG research database (Pure): <http://www.rug.nl/research/portal>. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.*

# **PREDICTION OF PSYCHOSOCIAL PROBLEMS IN ADOLESCENTS**

**Do early childhood findings from routine preventive child  
healthcare help?**

**Merlijne Jaspers**

ISBN 978 90 367 5363 0



Printed by: Gildeprint Drukkerijen - Enschede

© 2012 Merlijne Jaspers. All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior permission in writing from the proprietor.

RIJKSUNIVERSITEIT GRONINGEN

## PREDICTION OF PSYCHOSOCIAL PROBLEMS IN ADOLESCENTS

Do early childhood findings from routine preventive child healthcare help?

### **Proefschrift**

ter verkrijging van het doctoraat in de  
Medische Wetenschappen  
aan de Rijksuniversiteit Groningen  
op gezag van de  
Rector Magnificus, dr. E. Sterken,  
in het openbaar te verdedigen op  
woensdag 4 april 2012  
om 16.15 uur

door

**Merlijne Jaspers**

geboren op 11 juni 1980  
te Amsterdam

Promotor: Prof. dr. S.A. Reijneveld

Copromotor: Dr. A.F. de Winter

Beoordelingscommissie: Prof. dr. F.J.M. Feron

Prof. dr. E.J. Knorth

Prof. dr. A.J. Oldehinkel

Paranimfen:

Andrea Sudara Fokkens

Jelle David Jaspers



## CONTENTS

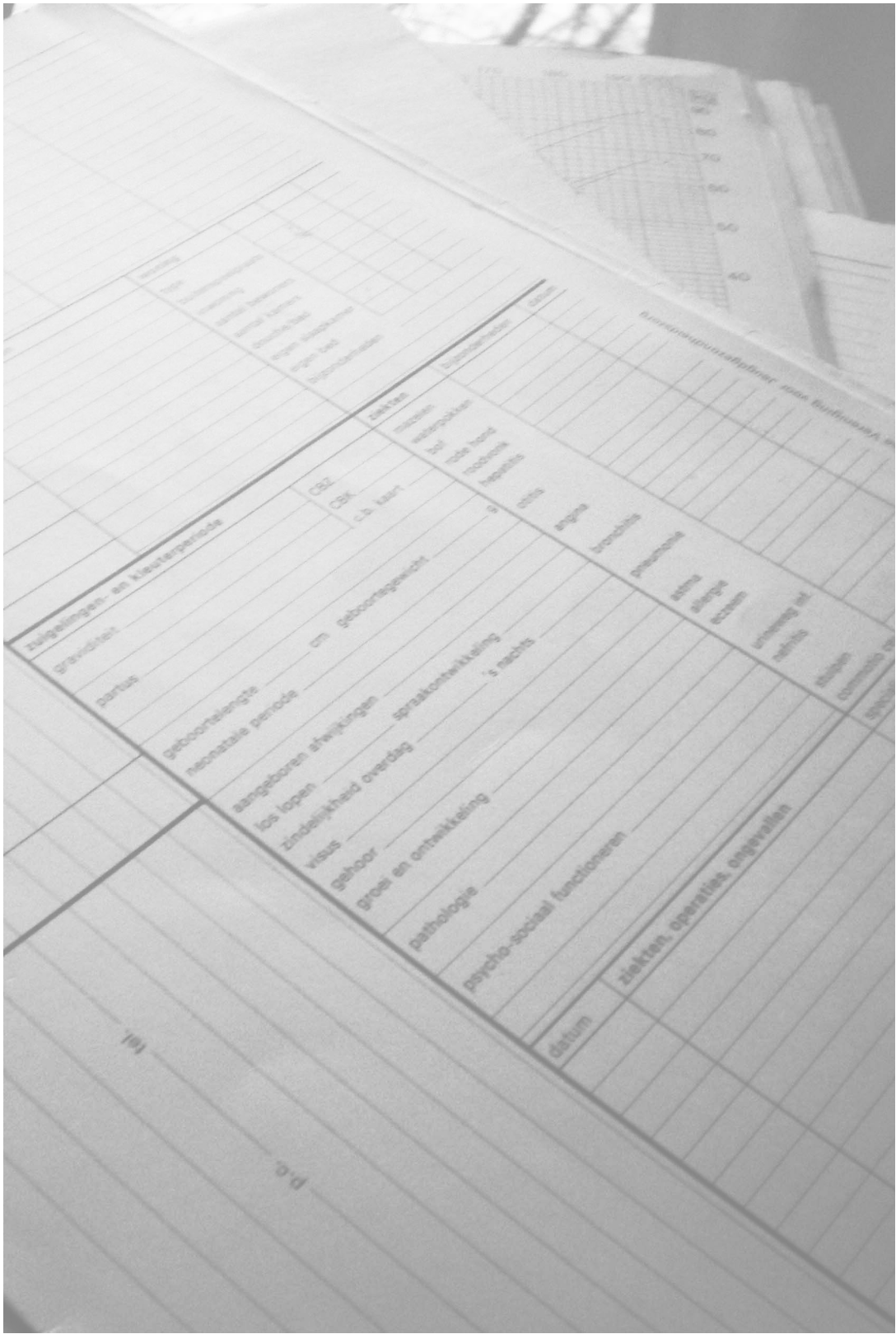
|                  |  |     |
|------------------|--|-----|
|                  | List of abbreviations  | 9   |
| <b>Chapter 1</b> | General Introduction   | 11  |
| <b>Chapter 2</b> | Early findings of preventive child healthcare professionals predict psychosocial problems in preadolescence<br><i>Journal of Pediatrics 2010;157(2):316-321.</i> | 23  |
| <b>Chapter 3</b> | Trajectories of psychosocial problems in adolescents predicted by findings from early well-child assessments<br><i>Submitted.</i>                                | 39  |
| <b>Chapter 4</b> | Early childhood assessments of community pediatric professionals predict autism spectrum and attention deficit hyperactivity problems<br><i>Submitted.</i>       | 59  |
| <b>Chapter 5</b> | Preventive child healthcare findings on early childhood predict peer-group social status in preadolescence<br><i>Submitted.</i>                                  | 77  |
| <b>Chapter 6</b> | Validity of parental recall on pregnancy, birth and early childhood behavior<br><i>Journal of Clinical Epidemiology 2010;63(2):185-191.</i>                      | 91  |
| <b>Chapter 7</b> | General Discussion   | 107 |
|                  | Summary  | 121 |
|                  | Samenvatting   | 129 |
|                  | Dankwoord  | 137 |
|                  | SHARE and previous theses  | 143 |
|                  | TRAILS and previous theses   | 147 |





## List of abbreviations

|        |   |
|--------|---|
| ADHD   | Attention Deficit Hyperactivity Disorder      |
| ASD    | Autism Spectrum Disorder                      |
| AUC    | Area Under the Curve                          |
| BIC    | Bayesian Information Criterion                |
| CBCL   | Child Behavior Checklist                      |
| CI     | Confidence Interval                           |
| CSBQ   | Children's Social Behavior Questionnaire      |
| LC     | Latent Class                                  |
| MNL    | Multinomial Logistic regression               |
| OR     | Odds Ratio                                    |
| PCH    | Preventive Child Healthcare                   |
| SES    | Social Economic Status                        |
| TRAILS | Tracking Adolescents' Individual Lives Survey |
| YSR    | Youth Self Report                             |



# 1

## **General Introduction**





## Introduction

Three-year-old Alex is scheduled for a regular Preventive Child Healthcare (PCH) assessment. Today he is seen by Ina Janssen, a PCH professional, who has seen him several times since he is born. Alex lives with his mother; he cries and clings to her when they enter Ina's office. During the 15 minutes interview and assessment Alex continues to cry. Mother has several concerns about his behavior; at home Alex cannot play alone, his mother needs to help or stimulate him into his play. When mother is doing other things in the house he starts to whine. He only wants to eat when mother feeds him. Ina Janssen wonders if Alex needs more monitoring to follow his development because his behavior stands out compared to other children. In the PCH file there are only a few remarks, it is documented that mother smoked during her pregnancy, that father left when Alex was one year old and that Alex had a delay in his motor development in the first year.

Bert Bakker, another PCH professional, sees fourteen-year-old Tessa and her mother. Tessa's mother is concerned about Tessa because as she puts it: Tessa is very boisterous, disobedient and she rants and raves. Her behavior can spoil the mood of all family members. Bert notices that Tessa is described as highly impulsive and disobedient many times in the PCH file, but there are no other special remarks in the PCH file concerning the previous years. The behavior of Tessa has not been a problem for her mother in the past, but the last three months she cannot put up with it anymore, especially now that Tessa has been arrested for shoplifting. Tessa agrees that things have gone from bad to worse and would like to try to change a bit, but says she doesn't know how. Bert gives Tessa and her mother advice on her behavior and makes a new appointment for them in three months. Bert Bakker wonders if anything could have been done on Tessa's problems earlier on.

These two cases are good examples of what PCH professionals encounter during their job. It is important for professionals to base their assessments and decisions on the best available knowledge. Therefore, more knowledge on the early predictors for psychosocial problems from data of the PCH is relevant because this might improve the prevention and management in PCH.

The aim of this thesis was to investigate whether early findings of PCH professionals predict psychosocial problems in adolescents. In this chapter the key concepts and the broader context of this thesis are introduced. At the end of this chapter the research questions, the methodology of the study and outline of this thesis will be presented.

## Psychosocial problems

In this thesis psychosocial problems are defined as problems in psychosocial functioning of the child, they may be emotional but are often also visible in the child's behavior, following Dutch PCH guidelines.<sup>1,2</sup> Children can experience these problems to varying degrees. One of the main aims of the PCH is (early) detection of problems in order to offer effective care to these children as soon as possible.

Psychosocial problems comprise a number of problems, important ones being: internalizing<sup>a</sup>, externalizing<sup>b</sup>, attention deficit hyperactivity disorder (ADHD) and autism spectrum disorder (ASD) problems. In childhood and adolescence the two broadband categories internalizing and externalizing problems are the most frequent.<sup>3,4</sup> Internalizing problems are problems that cause mainly internal distress, such as anxiety, depression and (psycho)somatic complaints. Externalizing problems are problems that mainly result in conflict with others, such as aggressive and delinquent behavior. Other psychosocial problems are the neurodevelopmental behavior problems: ADHD and ASD problems. Key characteristics of ADHD problems are hyperactivity, inattention and impulsivity. Core symptoms of ASD problems are a lack of social interest, problems with social understanding, stereotyped behavior, and resistance to change.

Worldwide, estimates of prevalence rates for an internalizing disorder range from 4.6% to 8.6% for children and adolescents and between 5.7% and 10.3% for an externalizing disorder.<sup>3</sup> Up to twice as many have functional problems related to internalizing or externalizing problems but do not meet criteria for diagnosis.<sup>5</sup> A recent study shows a prevalence rate of 14.7% for internalizing problems for children and adolescents and of 16.2% for externalizing problems.<sup>6</sup> Co-occurrence can be up to 56%.<sup>7</sup> For ADHD and ASD prevalences range between 6-9%<sup>8-12</sup> and between 0.4% and 1% respectively.<sup>13-16</sup> 30–80% of ASD children meet the criteria for ADHD.<sup>15,17</sup> Recently the field has broadened its focus so that it now views ASD and ADHD as constituting the very severe end of continuous distributions in the general population.<sup>18-21</sup> Prevalence rates of (functional problems related to) ASD and ADHD problems are not (yet) available.

Prevalence rates differ among boys and girls per (type of) psychosocial problem.<sup>3</sup> Age of onset of psychosocial problems varies per specific problem, but substantial evidence suggests that some psychosocial problems may onset in early to middle childhood.<sup>22-26</sup> The above mentioned problems of children and adolescents are a major burden for children, their parents and others in the environment because they severely interfere with everyday functioning of children and their families.

## Screening & early detection

Psychosocial problems are common in children. Prevalence rates of psychosocial problems in children, adolescents and adults suggest high persistence from childhood to adulthood and/or high levels of recurrence.<sup>27-31</sup> Wilson and Jungner defined screening criteria in 1968 to guide the selection on conditions that would be suitable for screening, based on the capacity to detect the condition at an early stage and the availability of an acceptable treatment.<sup>32</sup> Research has shown that early identification of psychosocial problems, if followed by adequate intervention, may improve prognosis.<sup>33,34</sup> It seems important to identify, monitor

---

<sup>a</sup> In this thesis, internalizing problems and emotional problems are synonymous.

<sup>b</sup> In this thesis, externalizing problems and behavioral problems are synonymous.

and, if necessary, intervene in these psychosocial problems as early as possible. PCH services offering routine healthcare to the young population as a whole are in a unique position for early identification of psychosocial problems in children.

As Brugman et al.<sup>35</sup> concluded in 2001, screening for psychosocial problems in school aged children is a promising option to reduce these problems. Reijneveld et al.<sup>36</sup> came to a similar conclusion for preschool children; there is substantial room for improving the early identification of psychosocial problems. Wissow<sup>37</sup> stated that the mental health promotion potential of pediatrics primary care is not being fulfilled. Studies in the US and UK suggest that pediatricians and general practitioners identify only one quarter of children and adolescents with mental health problems.<sup>38,39</sup>

## PCH setting

In the Netherlands and abroad, the PCH services offer an ideal setting for the early detection of psychosocial problems. By seeing so many children, hearing signals and getting questions from children, parents and teachers, they are often the first to see indications of these problems. The Dutch PCH provides health and developmental monitoring for all children from birth until age 19, and the participation rate is over 90%. Among the main tasks is the identification of children with psychosocial problems. The Dutch PCH is transitioning from an organization that was primarily focused on immunization and physical development (in the 1950s) to an evidence based healthcare service where psychosocial development of children is just as important, and where the focus is more on high risk groups and more personalized.

Monitoring is done through semi-structured interviews with parents, general physical examinations and standardized screening procedures, all of which are documented in a PCH file. The PCH has a variety of disciplines working in their services; from specialized community and youth doctors and nurses to dieticians, speech therapists, epidemiologists, and sometimes psychologists. An assessment generally takes approximately 10 to 15 minutes. Up to the age of 4 years children are seen with their parents by a PCH professional, at specific intervals, 15 times as part of the routine procedure of the PCH (at well-baby clinics). During primary and secondary school children are seen three times. Next to these standardized visits children, parents, teachers or PCH professionals can also request an extra visit (for more information on the Dutch PCH system see Vogels<sup>40</sup>). In this thesis data from the well-baby clinics and the PCH assessment in early school age are used.

PCH professionals monitor the development of children and identify many problems but how predictive are these early findings? We actually have little knowledge on what the predictive validity of these early findings is.



## Outline of the thesis

The following research questions will be answered in this thesis.

1. Can we predict which preadolescents are at risk for psychosocial problems with early childhood findings as registered by PCH?
2. Which early risk assessments by professionals are predictive for trajectories of internalizing and externalizing problems in adolescents in a PCH setting?
3. Can we identify early indicators of autism spectrum disorder and attention deficit hyperactivity disorder problems with early childhood findings as registered by PCH?
4. Can we predict which children have a heightened chance of being disliked or ignored by their preadolescent peers with data from the routine PCH?
5. How is the validity of parental recall on pregnancy, birth and early childhood behavior in preadolescence?

In Chapter 2 a prediction model is developed and validated for psychosocial problems in preadolescence using data on early developmental factors. Chapter 3 describes trajectories of internalizing and externalizing problems in adolescents and identifies early indicators of these trajectories among boys and girls. Chapter 4 identifies early indicators of ASD and ADHD problems in adolescents. Chapter 5 focuses on early childhood indicators for being disliked or ignored by peers in preadolescence. Chapter 6 examines the validity and precision of parental recall of maternal lifestyle during pregnancy, birth characteristics and early childhood behavior. Many previous studies on early risk factors for psychosocial problems relied on retrospectively collected data and included a limited number of risk factors. The validity of data collected retrospectively needs to be examined before using them to estimate relationships with health or developmental outcomes. Finally, in Chapter 7 the main findings and conclusions of the previous chapters are presented and discussed.

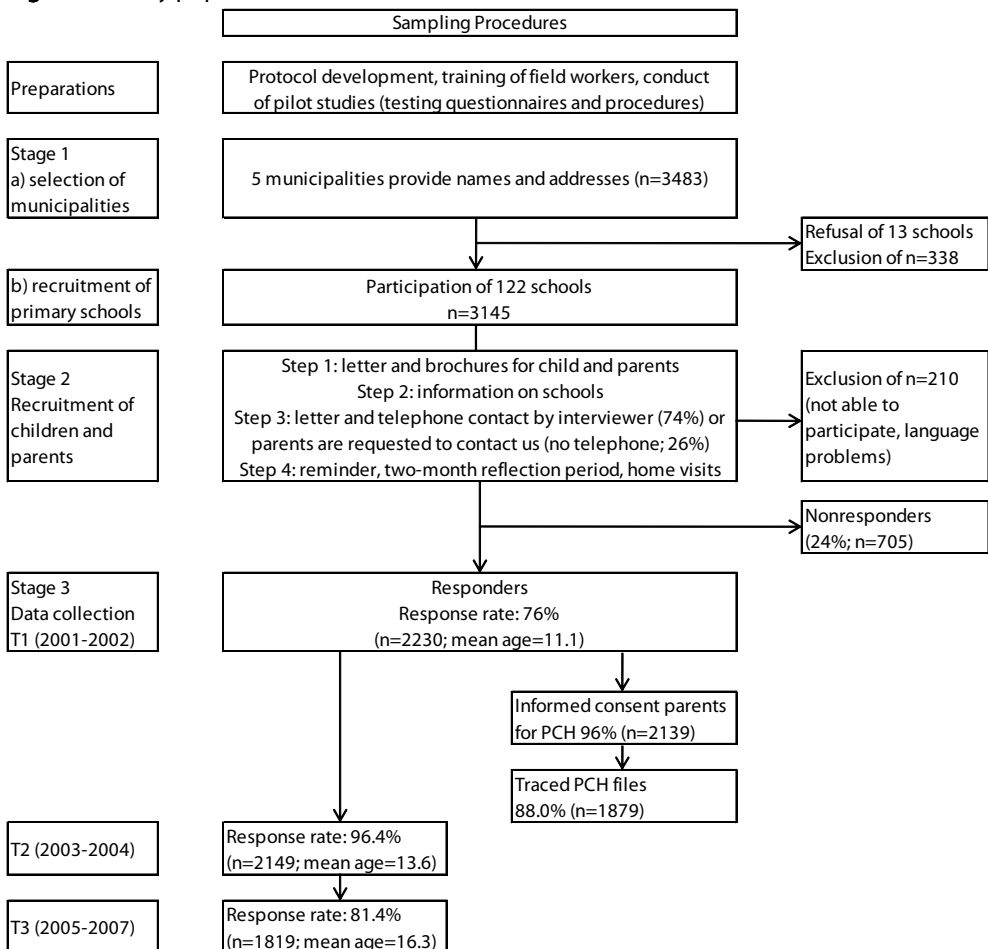
## The study sample

The TRacking Adolescents' Individual Lives Survey (TRAILS) is a prospective cohort study among Dutch children starting at 10-12 years of age that focuses on adolescent psychosocial development and mental health in the general population.<sup>41</sup> The TRAILS target sample was recruited in 2001 from elementary schools in five municipalities –Assen, Dantumadeel, Groningen, Leeuwarden and Winschoten- to obtain a representative sample of the three northern provinces of the Netherlands, also see Figure 1. Out of all the children approached for enrolment in the study (n=3145) 6.7% were excluded because of mental or physical incapability or language problems. Seventy-six percent of the remaining 2935 children (n=2230, mean age=11.1, SD=0.6, 50.8% girls) and their parents agreed to participate. Written informed consent was obtained from parents or custodians. Responders and non-responders did not differ with respect to the prevalence of teacher-rated problem behavior nor in regard to associations between sociodemographic variables and mental health

outcomes.<sup>42</sup> Data collection occurred by parent, child and teacher completed questionnaires and a home-visit by trained interviewers. The first, second (n=2149, mean age=13.6, SD=0.5) and third wave (n=1819, mean age=16.3, SD=0.7) ran, respectively, from March 2001 to July 2002 (T1), from September 2003 to December 2004 (T2), and from September 2005 to December 2007 (T3). Furthermore, participants were asked for permission to retrieve the child's file from the PCH. All procedures were approved by the Dutch Central Committee on Research Involving Human Subjects ("CCMO").

Data were used from the first, second and third wave if data from the PCH files were available (see Figure 1). Written informed consent was given by 2139 (96%) parents to retrieve their child's file from the PCH archives. Out of these, 84.9% could be traced for well-baby files (n=1816 PCH files, mean age=11.1, SD=0.5, 50.9% girls) and 57.6% school PCH

**Figure 1.** Study population



files (n=1233 files, 52% girls). The most common reason for non-retrieval of the PCH file comprised children moving into the research area shortly before inclusion in the TRAILS cohort. Children with and without a PCH file differed in parent-rated ASD ( $M=5.45$ ,  $SE=0.13$  for the retrieved and  $M=7.25$ ,  $SE=0.36$  for the non-retrieved,  $p<0.001$ ) and ADHD problems ( $M=3.83$ ,  $SE=0.08$  vs.  $M=4.41$ ,  $SE=0.19$ , respectively,  $p<0.01$ ) at T1. The number of individuals that were included in the analyses differs for the separate chapters of this thesis, depending on the availability of (complete) data on the measures that were used in the different analyses.

From these PCH files (well-baby and school files) we collected data on pre- and perinatal variables, early physical and psychosocial development and sociodemographic variables (see Box 1). A PCH professional checks these items during consultations of the child at the well-baby clinic or at school. They are checked for children between the ages of zero to 6 years. The professional recorded whether the child's sleeping and eating behavior was normal or abnormal, as was reported by the parent. The professional recorded what kind of behavior(s) the child had, as was reported by the parent or as was judged from observation. Because of the 'complexity/richness' of the data, i.e. the different time measurements both in the PCH files and of the questionnaires, we use different operationalizations for the different chapters.

#### **Box 1. Overview of collected data from PCH files**

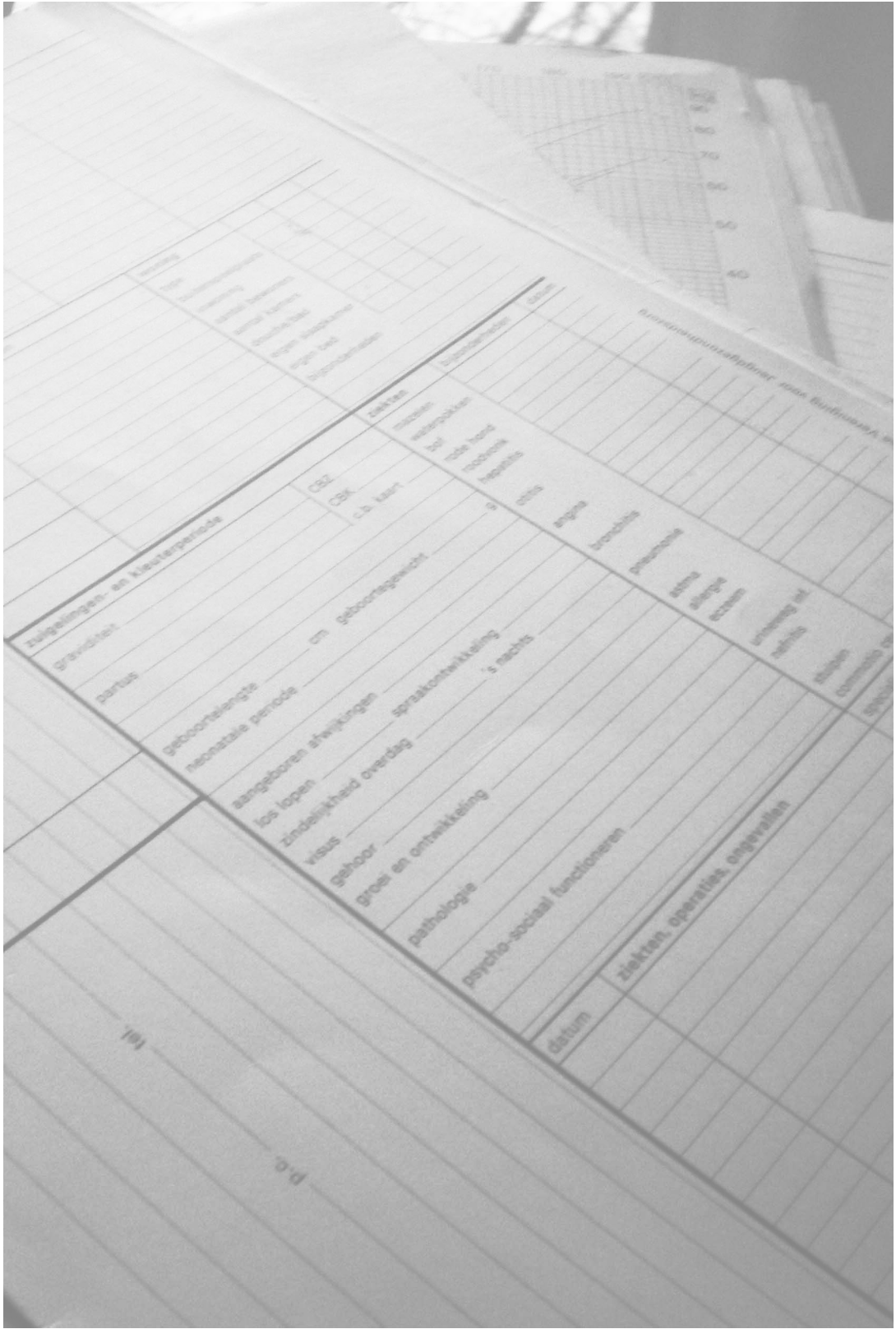
- Maternal smoking during pregnancy
- Maternal alcohol use during pregnancy
- Gestational age
- Birth weight (in grams)
- Birth defects
- Head circumference (age 0-12 mos.)
- Weight (age 0- 4 yrs.)
- Height (age 0- 4 yrs.)
- Psychomotor development with the Van Wiechen Scheme (age 1-15 mos.)
- Motor development (age 1.5- 4 yrs.)
- Language and speech development (age 1.5- 4 yrs.)
- Neurological problems (age 0- 4 yrs.)
- Problems/difficulties with sleeping (age 1.5- 6 yrs.)
- Problems with eating (age 1.5- 6 yrs.)
- Behavior of children (see Table 1 in Chapter 2 for all descriptions) (age 1.5- 6 yrs.)
- Enuresis (age 4 yrs.)
- Educational level of parents
- Structural family characteristics: i.e. living with both biological parents, divorced parents, stepparent(s), or single-parent households.

## References

1. Blokland G. Groepsgerichte opvoedingsondersteuning. *Nederlands Tijdschrift Voor Jeugdzorg* 2002;2:97-103.
2. Ministerie van VWS. Basistakenpakket jeugsgezondheidszorg. Den Haag: Ministerie van VWS; 2002.
3. Costello EJ, Mustillo S, Erkanli A, Keeler G, Angold A. Prevalence and development of psychiatric disorders in childhood and adolescence. *Arch Gen Psychiatry* 2003;60:837-44.
4. Campbell SB. Behavior problems in preschool children: A review of recent research. *J Child Psychol Psychiatry* 1995;36:113-49.
5. Angold A, Costello EJ, Erkanli A. Comorbidity. *J Child Psychol Psychiatry* 1999;40:57-87.
6. Polaha J, Dalton WT, 3rd, Allen S. The prevalence of emotional and behavior problems in pediatric primary care serving rural children. *J Pediatr Psychol* 2011;36:652-60.
7. Vollebergh WA, Iedema J, Bijl RV, de Graaf R, Smit F, Ormel J. The structure and stability of common mental disorders: The NEMESIS study. *Arch Gen Psychiatry* 2001;58:597-603.
8. Simon V, Czobor P, Balint S, Meszaros A, Bitter I. Prevalence and correlates of adult attention-deficit hyperactivity disorder: Meta-analysis. *Br J Psychiatry* 2009;194:204-11.
9. Polanczyk G, de Lima MS, Horta BL, Biederman J, Rohde LA. The worldwide prevalence of ADHD: A systematic review and meta-regression analysis. *Am J Psychiatry* 2007;164:942-8.
10. Biederman J, Petty CR, Evans M, Small J, Faraone SV. How persistent is ADHD? A controlled 10-year follow-up study of boys with ADHD. *Psychiatry Res* 2010;177:299-304.
11. Biederman J, Petty CR, Fried R, Wozniak J, Micco JA, Henin A, Doyle R, Joshi G, Galdo M, Kotarski M, et al. Child behavior checklist clinical scales discriminate referred youth with autism spectrum disorder: A preliminary study. *J Dev Behav Pediatr* 2010;31:485-90.
12. Dopheide JA, Pliszka SR. Attention-deficit-hyperactivity disorder: An update. *Pharmacotherapy* 2009;29:656-79.
13. Fombonne E. Epidemiology of pervasive developmental disorders. *Pediatr Res* 2009;65:591-8.
14. Fombonne E, Quirke S, Hagen A. Prevalence and interpretation of recent trends in rates of pervasive developmental disorders. *McGill J Med* 2009;12:73.
15. Simonoff E, Pickles A, Charman T, Chandler S, Loucas T, Baird G. Psychiatric disorders in children with autism spectrum disorders: Prevalence, comorbidity, and associated factors in a population-derived sample. *J Am Acad Child Adolesc Psychiatry* 2008;47:921-9.
16. Baron-Cohen S, Scott FJ, Allison C, Williams J, Bolton P, Matthews FE, Brayne C. Prevalence of autism-spectrum conditions: UK school-based population study. *Br J Psychiatry* 2009;194:500-9.
17. Holtmann M, Bolte S, Poustka F. ADHD, asperger syndrome, and high-functioning autism. *J Am Acad Child Adolesc Psychiatry* 2005;44:1101.
18. Constantino JN, Todd RD. Intergenerational transmission of subthreshold autistic traits in the general population. *Biol Psychiatry* 2005;57:655-60.

19. Losh M, Adolphs R, Poe MD, Couture S, Penn D, Baranek GT, Piven J. Neuropsychological profile of autism and the broad autism phenotype. *Arch Gen Psychiatry* 2009;66:518-26.
20. Thapar A, Harrington R, McGuffin P. Examining the comorbidity of ADHD-related behaviours and conduct problems using a twin study design. *Br J Psychiatry* 2001;179:224-9.
21. Levy F, Hay DA, McStephen M, Wood C, Waldman I. Attention-deficit hyperactivity disorder: A category or a continuum? genetic analysis of a large-scale twin study. *J Am Acad Child Adolesc Psychiatry* 1997;36:737-44.
22. Mesman J, Bongers IL, Koot HM. Preschool developmental pathways to preadolescent internalizing and externalizing problems. *J Child Psychol Psychiatry* 2001;42:679-89.
23. Shaw DS, Owens EB, Giovannelli J, Winslow EB. Infant and toddler pathways leading to early externalizing disorders. *J Am Acad Child Adolesc Psychiatry* 2001;40:36-43.
24. Campbell SB, Shaw DS, Gilliom M. Early externalizing behavior problems: Toddlers and preschoolers at risk for later maladjustment. *Dev Psychopathol* 2000;12:467-88.
25. Lavigne JV, Arend R, Rosenbaum D, Binns HJ, Christoffel KK, Gibbons RD. Psychiatric disorders with onset in the preschool years: I. stability of diagnoses. *J Am Acad Child Adolesc Psychiatry* 1998;37:1246-54.
26. Barkley RA. Major life activity and health outcomes associated with attention-deficit/hyperactivity disorder. *J Clin Psychiatry* 2002;63 Suppl 12:10-5.
27. Hofstra MB, Van der Ende J, Verhulst FC. Continuity and change of psychopathology from childhood into adulthood: A 14-year follow-up study. *J Am Acad Child Adolesc Psychiatry* 2000;39:850-8.
28. Loeber R, Green SM, Lahey BB, Frick PJ, McBurnett K. Findings on disruptive behavior disorders from the first decade of the developmental trends study. *Clin Child Fam Psychol Rev* 2000;3:37-60.
29. Moffitt TE, Caspi A, Harrington H, Milne BJ. Males on the life-course-persistent and adolescence-limited antisocial pathways: Follow-up at age 26 years. *Dev Psychopathol* 2002;14:179-207.
30. Ferdinand RF, Verhulst FC. Psychopathology from adolescence into young adulthood: An 8-year follow-up study. *Am J Psychiatry* 1995;152:1586-94.
31. Ferdinand RF, Verhulst FC, Wiznitzer M. Continuity and change of self-reported problem behaviors from adolescence into young adulthood. *J Am Acad Child Adolesc Psychiatry* 1995;34:680-90.
32. Wilson JM, Jungner YG. Principles and practice of mass screening for disease. *Bol Oficina Sanit Panam* 1968;65:281-393.
33. Nelson G, Westhues A, MacLeod J. A meta-analysis of longitudinal research on pre-school prevention programs for children. *Prevention and Treatment* 2003;6:1-32.
34. Durlak JA, Wells AM. Evaluation of indicated preventive intervention (secondary prevention) mental health programs for children and adolescents. *Am J Community Psychol* 1998;26:775-802.

35. Brugman E, Reijneveld SA, Verhulst FC, Verloove-Vanhorick SP. Identification and management of psychosocial problems by preventive child health care. *Arch Pediatr Adolesc Med* 2001;155:462-9.
36. Reijneveld SA, Brugman E, Verhulst FC, Verloove-Vanhorick SP. Identification and management of psychosocial problems among toddlers in dutch preventive child health care. *Arch Pediatr Adolesc Med* 2004;158:811-7.
37. Wissow L, Anthony B, Brown J, DosReis S, Gadomski A, Ginsburg G, Riddle M. A common factors approach to improving the mental health capacity of pediatric primary care. *Adm Policy Ment Health* 2008;35:305-18.
38. Horwitz SM, Gary LC, Briggs-Gowan MJ, Carter AS. Do needs drive services use in young children? *Pediatrics* 2003;112:1373-8.
39. Kramer T, Garralda ME. Psychiatric disorders in adolescents in primary care. *Br J Psychiatry* 1998;173:508-13.
40. Vogels AGC. The identification by Dutch preventive child health care of children with psychosocial problems: Do short questionnaires help? 2008.
41. Huisman M, Oldehinkel AJ, de Winter AF, Minderaa RB, de BA, Huizink AC, Verhulst FC, Ormel J. Cohort profile: The dutch 'TRacking adolescents' individual lives' survey'; TRAILS. *Int J Epidemiol* 2008;37:1227-35.
42. de Winter AF, Oldehinkel AJ, Veenstra R, Brunnekreef JA, Verhulst FC, Ormel J. Evaluation of non-response bias in mental health determinants and outcomes in a large sample of pre-adolescents. *Eur J Epidemiol* 2005;20:173-81.



# 2

## **Early findings of Preventive Child Healthcare professionals predict psychosocial problems in preadolescence**

M. Jaspers  
A.F. de Winter  
G. de Meer  
R.E. Stewart  
F.C. Verhulst  
J. Ormel  
S.A. Reijneveld

*Journal of Pediatrics 2010;157(2):316-321.*



## Abstract

### *Objective*

The aim of this study is to develop and validate a prediction model for psychosocial problems in preadolescence using data on early developmental factors from routine Preventive Child Healthcare (PCH).

### *Study design*

The data comes from the 1692 participants who take part in TRAILS, a longitudinal study. Information on early developmental factors (ages 0 to 4 years) was collected from the PCH file. Parents complete the Child Behavior Checklist (CBCL) at age 11. To examine the predictive value of PCH-registered developmental factors on preadolescent problems, several multiple logistic regression analysis were performed, in a derivation sample (n=1058). The predictive performance of the models was then assessed with Area Under the Curve (AUC) in a validation sample (n=643) to evaluate the validity of these models.

### *Results*

PCH-registered behavioral problems, attention hyperactivity problems, enuresis, level of education of the father, and being male were found to significantly predict externalizing problems (odds ratios (OR) between 1.4 and 3.7). Internalizing problems were predicted by maternal smoking during pregnancy, sleep problems and being male (ORs between 1.7 and 3.0). The model for externalizing problems had a modest discriminatory power (AUC 0.66, 95% CI 0.59-0.72). However, for internalizing problems the AUC was 0.54 (95% CI 0.47-0.60), indicating poor discriminatory power.

### *Conclusions*

Findings on early development as registered by PCH are modestly predictive for externalizing problems in preadolescents, but only slightly for internalizing problems.

## Introduction

The psychosocial (emotional and behavioral) problems of children and adolescents are a major burden for children, their parents and others in the environment. There is now substantial evidence that some psychosocial problems have an early age of onset, coupled with high levels of recurrence over the course of life.<sup>1-4</sup> The period from conception until school age is considered extremely important for children's development and especially their socio-emotional development, which affects psychosocial functioning later in life.<sup>5,6</sup> Consequently, early detection and treatment of psychosocial problems may considerably improve prognosis. Several reviews have emphasized the need for early detection and subsequent adequate treatment in order to prevent later negative health effects.<sup>7-9</sup> However, early detection of psychosocial problems is complex.

Community pediatric services that offer routine healthcare services to the young population as a whole, such as those in the USA and Europe, occupy a unique position in terms of early detection of psychosocial problems in children. In the Netherlands, Preventive Child Healthcare (PCH) provides health and developmental monitoring to all Dutch children from birth until age 19, and the participation rate is over 90%.<sup>10</sup> Dutch PCH professionals are fully committed to well-child visits, and are highly trained and experienced in registering those child and family characteristics that are relevant for current and future development. Identification of children with psychosocial problems is one of the explicit tasks of PCH, along with checking a wide range of factors as part of its routine health monitoring.

The literature shows that the detection of psychosocial problems in children is less than satisfactory, with many early psychosocial problems going undetected.<sup>10,11</sup> To assess the validity of early detection, a good standard to use is the occurrence of problems later in life. One of these is the development of future psychosocial problems. To distinguish healthy development from the development of psychosocial problems in children, longitudinal data are necessary to arrive at valid predictions. The aim of this study is to develop and validate a prediction model for psychosocial problems in preadolescence using data on early developmental factors found in routine Preventive Child Healthcare (PCH). This study is the first to use routine data from PCH to predict psychosocial problems in children in a community-based sample.

## Methods

The TRacking Adolescents' Individual Lives Survey (TRAILS) is a prospective cohort study among Dutch children from 10-12 years of age that focuses on adolescent psychosocial development and mental health.<sup>12</sup> The TRAILS target sample was recruited in 2001 from elementary schools in five municipalities in the northern part of the Netherlands.<sup>12,13</sup> Out of all the children approached for enrolment in the study (n=3145), 6.7% were excluded because of mental or physical incapability or language problems. Of the remaining 2935 children, both children and parents of 76.0% (n=2230, mean age=11.09, SD=0.56, 50.8% girls) of them

agreed to participate. Responders and non-responders did not differ with respect to the prevalence of teacher-rated problem behavior, nor in terms of associations between socio-demographic variables and mental health outcomes.<sup>13</sup>

Written informed consent was given by 2139 (96%) parents to retrieve their child's file from the PCH. Out of these, 84.9% could be traced (n=1816 PCH files, mean age=11.06, SD=0.54, 50.9% girls). Children with and without a PCH file differed with statistical significance for prevalence of parent-rated behavior problems (14.4% for the retrieved vs. 20.0% for the non-retrieved,  $p<0.05$ ) but did not differ with statistical significance with respect to the prevalence of parent-rated emotional problems (16.6% vs. 18.2%, respectively). This study was approved by the national ethical medical committee.

### *Measures*

Information on predictors had previously been collected by community physicians and nurses (PCH professionals) as part of the routine procedure of PCH. The assessments included a general physical examination, standardized screening procedures and a semi-structured interview with parents concerning health status and physical, emotional and behavioral developmental problems, all of which were documented in the PCH file. An assessment generally takes approximately 10 to 15 minutes. As potential predictors, we selected prenatal and perinatal factors, early childhood behaviors and socio-demographic variables from the PCH file.

#### Prenatal and perinatal variables

The prenatal and perinatal variables in the PCH files concerned maternal smoking during pregnancy and low birth weight (registered in grams) as provided by the obstetrician or midwife. Maternal smoking was assessed as: "Did the mother smoke during pregnancy?" dichotomized as always/never. Low birth weight was operationalized as < 2500 grams, which is a standard clinical cut-off.<sup>14</sup>

#### Early childhood problems

Early childhood problems entailed PCH-registered behavioral features at age four (mean age=3.88 years, SD=0.15), from which we distinguished "sleeping, eating and enuresis problems" and "emotional and behavior problems." During PCH visits, the PCH professional inquired into these problems with questions such as: "How is your child doing in terms of eating?", "How is your child doing in terms of sleeping?" and "How is your child doing in terms of toilet-training?" Descriptions of these behaviors were categorized as "yes" in case of problems, and "no" or "missing." "Emotional and behavior problems" were collected from two open questions in the PCH files, namely, "How is the child's behavior?" and "How is the child's social behavior?" about which parents could provide one or more descriptions such as "overactive," "shy," "anxious," "social" or "aggressive" (see Table 1). Eight PCH professionals

independently categorized the PCH-registered descriptions – emotional, behavioral, attention hyperactivity problems or positive social behavior – in terms of “yes,” “no” or “not applicable.” A PCH item could not be placed in more than one category by the PCH professionals. PCH professionals shared a very high consensus about the classification of the descriptions. The PCH descriptions were dichotomized as a “yes” if any of these were present and as a “no” if none were present.

### Socio-demographic variables

The socio-demographic variables were the highest educational level of the father and highest educational level of the mother. We distinguished three groups: low (lower tracks of secondary education or less education), middle (higher tracks of secondary education) and high (university degree or more) educational levels, respectively.

### Behavioral and emotional problems

Behavioral and emotional problems at age 10-12 were assessed using the parent-completed Child Behavior Checklist (CBCL) for ages 4-18, an internationally validated questionnaire for child emotional and behavioral problems.<sup>15,16</sup> In the current study we used two broadband scales: externalizing and internalizing problems. Externalizing problems consist of the aggressive behavior and delinquent behavior syndrome scales. Internalizing problems consist of the anxious/depressed, somatic complaints and withdrawn/depressed syndrome scales. Cases were allocated to a normal score or a clinical (elevated) score, using the age and gender-specific 90th percentiles of the Dutch normative sample.<sup>15,16</sup>

### *Analyses*

An average of 8.8% (ranging from 1.2 to 20.3%) of the values of the potential predictors was missing. Missing data on potential predictors were labeled as a separate “unknown” category in the analysis. This was done to explore whether the missing values were missing at random in the PCH files, or not. For the CBCL outcome measures, the number of missing data was quite low, ranging from 0 through 31, with a median of 3.0. Missing data on the CBCL were imputed with individual means by the corrected item mean imputation (CIM) using SPSS version 14. Analyses were restricted to those for whom PCH data as well as parent-reported psychosocial problems were available (n=1692).

First, descriptive statistics were calculated for general characteristics, developmental factors and for the outcome measures. We needed two data sets for our derivation and cross-validation analyses, with both sets large enough for sufficient statistical power. Since a minimum of 100 events and 100 nonevents is recommended for external validation samples,<sup>17</sup> and Peduzzi<sup>18</sup> states that ideally there should be at least 10 cases per candidate predictor, we randomly divided the total sample into two unequal subsamples. The derivation sample (approximately two thirds of the children, n=1058) was used to build a

**Table 1.** Description of behavior of children by PCH professionals divided into four categories by PCH professionals

| Behavioral problems   | Emotional problems   | Attention hyperactivity problems   | Positive behavior   |
|---|--|--|---|
| Aggressive<br>Argues a lot<br>Argumentative<br>Bold<br>Bites others<br>Behavioral problems<br>Defiant<br>Demands attention in a negative way<br>Disobedient<br>Throws toys<br>Gets "beside him/herself"<br>Harassing<br>Headstrong<br>Hits others<br>Impatient<br>Impertinent<br>Imposing<br>Kicks others<br>Manipulative<br>Moody<br>Nagging<br>Oppositional<br>Overly present<br>Provocative<br>Quickly becomes angry<br>Rebellious<br>Stubborn<br>Temper tantrums<br>Whining | Anxious<br>Clings to mother<br>Cries easily<br>Easily frightened<br>Fear of failure<br>Fear of abandonment<br>Insecure<br>Introvert<br>Nervous<br>Over-sensitive<br>Over-submissive<br>Panics easily<br>Quiet<br>Separation anxiety<br>Silent<br>Shy<br>Timid<br>Worried | Boisterous<br>Concentration problems<br>Difficulty concentrating during play<br>Distracted/hyperactive<br>Dreamy<br>Easily bored<br>Impulsive<br>Jumps from one thing to another<br>Noisy<br>Pushes the limits<br>Reacts to everything and everyone<br>Restless<br>Sees no danger<br>Talks excessively<br>Turbulent<br>Very active<br>Volatile<br>Wild<br>Short attention span | Affectionate<br>Attentive<br>Cheerful<br>Confident<br>Cooperative<br>Cool, composed<br>Cuddly<br>Curious<br>Cute<br>Eager to learn<br>Easy<br>Enthusiastic<br>Flexible<br>Focused<br>Helpful<br>Independent<br>Interested<br>Kind<br>Lively<br>Looks after others<br>Nice<br>Open<br>Patient<br>Picks up on things easily<br>Polite<br>Rich imagination<br>Social<br>Sociable<br>Spontaneous<br>Sweet |

predictive model. The validation sample (n=634) was used for evaluation of the validity of the model. Statistical analyses were performed using SPSS version 14.

Second, to examine the influence of early development on the clinical scores of the broadband scales of the CBCL, logistic regression analyses were performed. Based on the results of the univariate analyses, we considered variables associated with the outcomes at  $p < 0.2$  to be candidates for multiple logistic regression analyses for both outcome measures. The variables were entered into a backward stepwise logistic regression procedure, generating a subset of independent predictors for different scales of the CBCL. Interaction terms were also tested as candidate variables in logistic regression; however, none of these terms fulfilled the entering criteria.

Third, the accuracy of the logistic model (the combined set of predictors from the multivariate analyses) in discriminating children with and without clinical CBCL scores in the derivation set was evaluated by calculating the Area Under the receiver operating characteristic Curve (AUC). The AUC is a measure of the diagnostic power of a test that summarizes the likelihood of a dichotomized outcome (i.e., a clinical CBCL score) at various cut-offs of a test, in this case a prediction. The AUC can range from 0.50 (no discrimination) to 1.0 (perfect discrimination). Values of 0.50 to 0.60 are considered poor, 0.61 to 0.70 as moderate, 0.71 to 0.80 as good, and 0.81 to 0.90 as excellent.<sup>19,20</sup> Furthermore, by relating them to the predicted probability from the logistic model, sensitivity and specificity for the outcome measures were calculated for a number of cut-off points.

## Results

The descriptive statistics for general characteristics, predictor variables and outcome measures are presented in Table 2. There were no statistically significant differences between the derivation and validation sets.

Table 3 gives the crude and multivariate odds ratios and 95% confidence intervals on predictors of externalizing and internalizing clinical scores on the CBCL. Within the derivation set, behavioral problems, attention hyperactivity problems, enuresis (all at age 4), low level of education of the father, and being male were identified as significant independent determinants of clinical externalizing problems on the CBCL (OR between 1.6 and 2.3) in the multivariate logistic regression model. Level of education of the father and eating problems did not contribute to the model as independent predictors. For clinical internalizing problems on the CBCL, sleep problems (at age 4), maternal smoking during pregnancy, being male, and unknown status of enuresis were determinants (OR between 1.6 and 3.0). The label "unknown" on the different factors was predictive for later externalizing and internalizing problems (OR between 1.6 and 2.4).

The AUC for externalizing problems was 0.68 (95% CI 0.64-0.73) for the derivation set (Figure 1A). When applied to the validation set, the model discriminated between children with a clinical score and those with no clinical score on the CBCL with an AUC of 0.66 (95% CI

0.59-0.72). In terms of specificity and sensitivity this means that at 90% specificity the corresponding sensitivity was 27% (see Table 4). For internalizing problems on the CBCL, the AUC was 0.63 (95% CI 0.59-0.68) for the derivation set and 0.54 (95% CI 0.47-0.60) for the validation set (Figure 1B). With a specificity of 90%, sensitivity was 16%.

**Table 2.** General characteristics of the derivation set and the validation set

| <b>Variables</b>                         | <b>Derivation set<br/>(n = 1058)</b> | <b>Validation set<br/>(n = 634)</b> |
|--|--------------------------------------|-------------------------------------|
| Age at TRAILS T1 (Mean, SD)              | 11.06 (0.54)                         | 11.06 (0.52)                        |
| Boys (n, %)                              | 505 (47.7)                           | 318 (50.2)                          |
| Low education of mother (n, %)           | 367 (34.7)                           | 228 (36.0)                          |
| Low education of father (n, %)           | 301 (28.4)                           | 170 (26.8)                          |
| Maternal smoking during pregnancy (n, %) | 142 (13.4)                           | 84 (13.2)                           |
| Low birth weight (n, %)                  | 39 (3.7)                             | 27 (4.3)                            |
| Sleep problems (n, %)                    | 31 (2.9)                             | 18 (2.8)                            |
| Problems with eating (n, %)              | 206 (19.5)                           | 125 (19.7)                          |
| Enuresis (n, %)                          | 180 (17.0)                           | 130 (20.5)                          |
| Behavioral problems (n, %)               | 55 (5.2)                             | 31 (4.9)                            |
| Emotional problems (n, %)                | 46 (4.3)                             | 26 (4.1)                            |
| Attention hyperactivity problems (n, %)  | 105 (9.9)                            | 78 (12.3)                           |
| Positive social behavior (n, %)          | 299 (28.3)                           | 152 (24.0)                          |
| <b>Outcome measures</b>                  |                                      |                                     |
| Externalizing problems (n, %)            | 160 (15.1)                           | 85 (13.4)                           |
| Internalizing problems (n, %)            | 190 (18.0)                           | 110 (17.4)                          |

**Table 3.** Associations of early developmental features with clinical scores on externalizing and internalizing problems: odds ratios and 95% confidence intervals (CI)

|                                   | Externalizing        |                      | Internalizing        |                      |
|-----------------------------------|----------------------|----------------------|----------------------|----------------------|
|                                   | OR (crude)<br>95% CI | OR (adj*)<br>95% CI  | OR (crude)<br>95% CI | OR (adj)<br>95% CI   |
| Being male                        | <b>2.1 (1.5-3.0)</b> | 2.0 (1.4-2.8)        | <b>2.0 (1.4-2.8)</b> | 2.0 (1.5-2.9)        |
| Maternal smoking during pregnancy | <b>1.8 (1.1-3.1)</b> |                      | <b>1.6 (1.0-2.6)</b> | 1.7 (1.1-2.6)        |
| Low birth weight                  | 0.6 (0.2-1.8)        |                      | 1.0 (0.4-2.2)        |                      |
| Low education of mother           | <b>2.1 (1.3-3.2)</b> |                      | 1.1 (0.8-1.7)        |                      |
| Middle education of mother        | <b>1.2 (0.8-2.0)</b> |                      | 0.9 (0.6-1.4)        |                      |
| Low education of father           | <b>2.1 (1.3-3.3)</b> | 2.0 (1.2-3.2)        | 0.9 (0.6-1.4)        |                      |
| Middle education of father        | <b>1.6 (1.0-2.5)</b> |                      | 1.1 (0.7-1.7)        |                      |
| Sleep problems                    | <b>2.1 (0.9-4.7)</b> |                      | <b>3.0 (1.4-6.2)</b> | 3.0 (1.4-6.3)        |
| Problems with eating              | <b>1.6 (1.1-2.4)</b> |                      | <b>1.3 (0.9-1.9)</b> |                      |
| Enuresis                          | <b>1.9 (1.2-2.8)</b> | 1.6 (1.1-2.5)        | <b>1.0 (0.6-1.6)</b> |                      |
| Positive social behavior          | 1.1 (0.8-1.6)        |                      | <b>0.7 (0.5-1.0)</b> |                      |
| Behavioral problems               | <b>3.0 (1.6-5.3)</b> | 2.3 (1.2-4.2)        | <b>1.9 (1.1-3.6)</b> |                      |
| Emotional problems                | 0.5 (0.2-1.5)        |                      | 1.5 (0.7-2.9)        |                      |
| Attention hyperactivity problems  | <b>2.3 (1.4-3.6)</b> | 2.1 (1.3-3.3)        | 1.3 (0.8-2.2)        |                      |
| <b>Category unknown</b>           | <b>n (%)</b>         |                      |                      |                      |
| Education of mother unknown       | 13 (1.2)             | <b>2.4 (0.6-9.0)</b> | 1.4 (0.4-5.4)        |                      |
| Education of father unknown       | 117(11.1)            | <b>2.3 (1.3-4.1)</b> | 2.4 (1.3-4.3)        | 1.3 (0.8-2.2)        |
| Sleep problems unknown            | 178(16.8)            | 1.2 (0.7-1.7)        | <b>0.9 (0.5-1.4)</b> |                      |
| Problems with eating unknown      | 188(17.8)            | 1.1 (0.7-1.7)        | <b>1.0 (0.6-1.5)</b> |                      |
| Enuresis unknown                  | 217(20.5)            | <b>1.5 (1.0-2.3)</b> | 1.6 (1.0-2.5)        | <b>1.5 (1.0-2.1)</b> |
| Positive social behavior unknown  | 77 (7.3)             | 1.0 (0.5-2.0)        | 0.9 (0.5-1.6)        |                      |
| Behavioral problems unknown       | 77 (7.3)             | <b>1.0 (0.5-1.9)</b> | 1.1 (0.6-1.9)        |                      |
| Emotional problems unknown        | 77 (7.3)             | 0.9 (0.5-1.7)        | 1.0 (0.6-1.8)        |                      |
| Attention hyperactivity unknown   | 77 (7.3)             | <b>1.0 (0.5-2.0)</b> | 1.1 (0.6-1.9)        |                      |

**Criterion** p<0.2 for inclusion in multivariate model

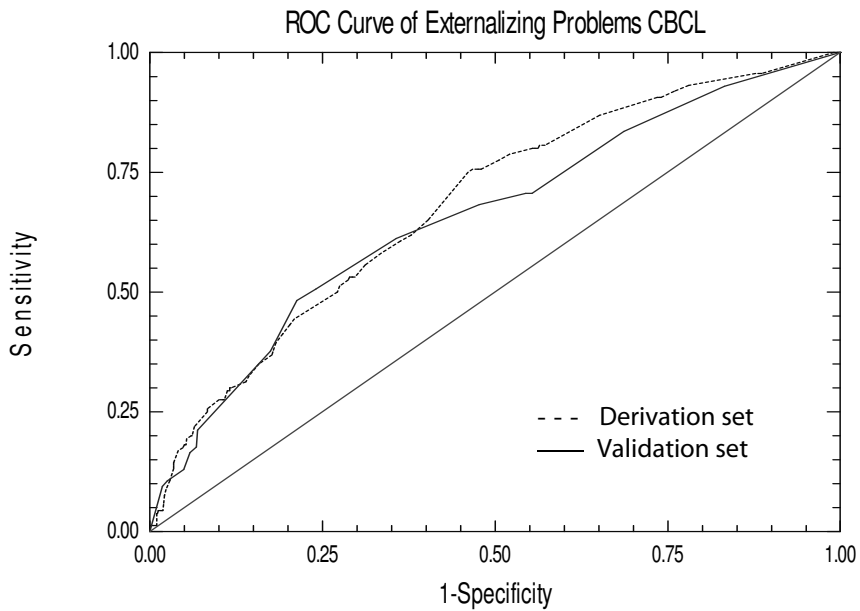
\*adj = adjusted for all other variables which are included in the model

**Table 4.** Specificity, sensitivity, positive predictive value and negative predictive value for externalizing and internalizing problems in the validation set

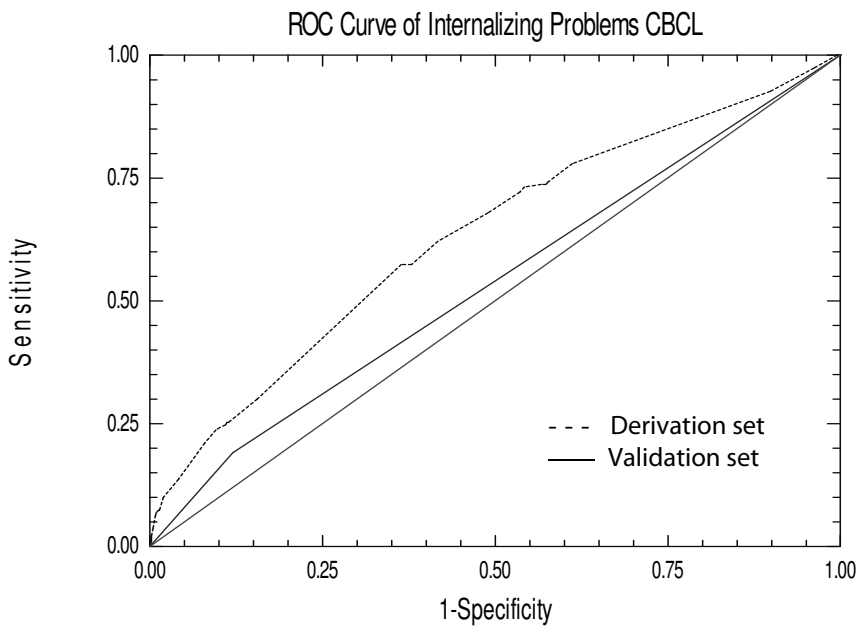
|                      | Sensitivity % | Specificity% | Positive predictive value % | Negative predictive value % |
|----------------------|---------------|--------------|-----------------------------|-----------------------------|
| <b>Externalizing</b> | 95            | 10           | 14.2                        | 94.1                        |
|                      | 25            | 90           | 32.2                        | 88.4                        |
| <b>Internalizing</b> | 91            | 10           | 16.0                        | 98.1                        |
|                      | 15            | 90           | 25.0                        | 83.8                        |



**Figure 1A.** The AUC for a clinical externalizing problem score on the CBCL



**Figure 1B.** The AUC for a clinical internalizing problem score on the CBCL



## Comment

This study is the first to use early developmental data as registered by PCH to predict psychosocial problems in children in a longitudinal community-based sample. We found that the predictive power of PCH-registered early developmental data was rather modest for behavioral problems, with AUC indices being 0.66 (95% CI 0.59-0.72). This means that, PCH-registered early developmental data correctly predict externalizing problems in children at age 11 in 66% of cases. However, for internalizing problems, PCH data are not found to predict emotional problems in preadolescence.

For emotional and behavioral problems at age 11, the predictive power of PCH-registered findings on early development was low to modest. Some caution is needed when interpreting AUC indices, however, because the average AUC for prediction models can vary quite broadly, depending on the research field. For example, in prognostic reproductive medicine (for predicting pregnancy), AUC indices between 0.56 and 0.64 are reported.<sup>21</sup> Furthermore, Diamond<sup>22</sup> has shown in a simulation model that the AUC for a perfectly calibrated model would be 0.83 at best for prognostic studies (versus diagnostic studies). PCH professionals thus identify and register early developmental findings in routine practice that are predictive to some extent.

PCH-registered findings on early development do modestly predict later behavioral problems in preadolescence. This finding confirms previous findings in other studies of early predictors for behavioral problems, which found that externalizing problems<sup>23,24</sup> and attention hyperactivity problems<sup>25</sup> in childhood predicted later psychosocial problems. Other studies found that problems with enuresis in children were associated with behavioral problems.<sup>26,27</sup> Low SES (low education of the parents) and maternal smoking have consistently been shown to increase the risk for psychosocial problems, especially for behavioral problems.<sup>28-31</sup> Our findings show that PCH professionals do indeed identify and register the predictive factors that are found in these previous studies.

Findings on early development as registered by PCH are mostly not predictive for emotional problems in preadolescents. In contrast to our results, Mesman and Koot<sup>32</sup> found that early preschool internalizing problems were predictive for preadolescent internalizing problems. However, they measured early preschool items at age 2-3 years and used questionnaires instead of PCH-registered data. A second explanation for this might simply be that few early childhood features are predictive for later emotional problems.<sup>23,28,32-34</sup> A third possibility is that PCH professionals might not be adequately identifying or registering those factors that are predictive.

Surprisingly, being male is predictive for internalizing problems in our derivation set. The research, however, shows that in this age group similar prevalence rates are found among boys and girls for internalizing problems.<sup>35,36</sup> One explanation may be that, because of the gender-specific cut-off points for the CBCL, gender differences were already taken into account.

Psychosocial problems were more likely if PCH had not registered findings on some aspects of early development, that is, if these data were missing. This implies that these data were probably not missing at random. Several explanations could be given as to why PCH professionals did not always register every item. First, the PCH professional might not have had enough time for the assessments and registration especially in multiple-problem cases (the visits are short, with many competing concerns). Second, certain parents of children with problems may have given unclear answers or refused to answer some questions at all. Whatever the reason, missing PCH-registered data may be considered to be rather predictive for future problems.

The strengths of this study lie in its large sample and its embedding in routine PCH, a program that contacts over 90% of the total population. Moreover, we made use of data registered during the routine health and developmental monitoring that is offered to all Dutch children, and collected and registered according to a highly standardized format. TRAILS has had a high response rate and there was a high percentage of informed consent for retrieving the PCH files. In addition, using multiple predictors is a major strength. Recent overviews have shown that in most prognostic studies, single rather than multiple predictors may be investigated, but that multiple predictors provide better models.<sup>37,38</sup>

Some limitations should be taken into account when interpreting the study results. First, the children may have received effective treatment for their psychosocial problems between the ages of 4 and 11, leading to an underestimation of the predictive power of PCH findings. Second, the fact that our sample had fewer cases with externalizing problems than those without PCH files may also have led to an underestimation. Third, though we consider the CBCL questionnaire as the gold standard, we cannot exclude that it might also be subject to error in terms of the identification of the relevant children. For instance, the sensitivity and specificity of the Dutch version at the cut-off for the clinical range are 0.66 and 0.82, respectively.<sup>16</sup> Fourth, some predictors had a rather low prevalence, which limited the likelihood that they would be included in our predictive model, even if they were very predictive.

For better clinical decision-making in the future, early identification should be further improved. PCH identifies children at risk for psychosocial problems to a certain degree, thus showing its added value, but effort is needed for further improvement. Previous research has shown that the use of validated questionnaires, training of PCH professionals in a structured method for identifying psychosocial problems, and providing more time for the assessment may improve the accuracy of this early identification.<sup>39,40</sup> This study may add to the improvement of the quality of early identification in routine practice by indicating the predictors for behavioral problems that should be monitored.

This study was the first to use early developmental data, as registered by PCH, to predict psychosocial problems and it needs to be confirmed. Further research is needed to find those factors that are early predictors of internalizing problems and to improve the identification of such factors by PCH. Our results show that there is still ample room for improving child and

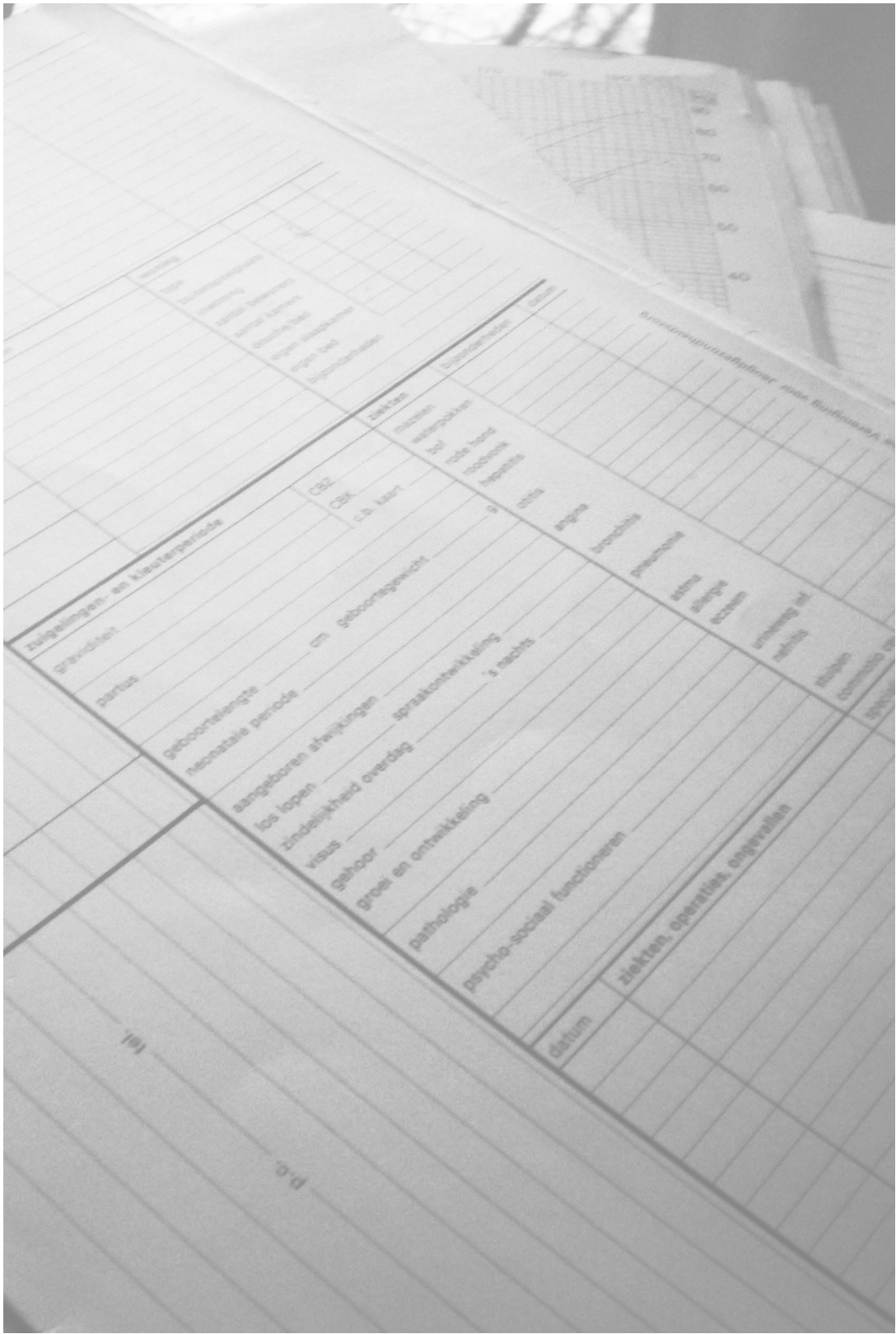
adult health further through better early identification and treatment. The findings on early development as registered in the PCH files are modestly predictive for externalizing problems in preadolescents.

## References

1. Hofstra MB, Van der Ende J, Verhulst FC. Continuity and change of psychopathology from childhood into adulthood: a 14-year follow-up study. *J Am Acad Child Adolesc Psychiatry* 2000 Jul;39(7):850-8.
2. Moffitt TE, Caspi A. Childhood predictors differentiate life-course persistent and adolescence-limited antisocial pathways among males and females. *Dev Psychopathol* 2001;13(2):355-75.
3. Verhulst FC, Van der Ende J. Six-year developmental course of internalizing and externalizing problem behaviors. *J Am Acad Child Adolesc Psychiatry* 1992 Sep;31(5):924-31.
4. Verhulst FC, Van der Ende J. The eight-year stability of problem behavior in an epidemiologic sample. *Pediatr Res* 1995 Oct;38(4):612-7.
5. Keating DP, Hertzman C. *Developmental health and the wealth of nations: Social, Biological, and Educational Dynamics*. New York: Guilford Press; 1999.
6. Kershaw P, Irwin L, Trafford K, Hertzman C. *The British Columbia Atlas of Child Development*. Victoria, BC: Western Geographic Press; 2006.
7. Durlak JA, Wells AM. Evaluation of indicated preventive intervention (secondary prevention) mental health programs for children and adolescents. *Am J Community Psychol* 1998 Oct;26(5):775-802.
8. Nelson G, Westhues A, MacLeod J. A meta-analysis of longitudinal research on pre-school prevention programs for children. *Prevention and Treatment* 2003;6(31):1-32.
9. Durlak JA, Wells AM. Primary prevention mental health programs for children and adolescents: a meta-analytic review. *Am J Community Psychol* 1997 Apr;25(2):115-52.
10. Brugman E, Reijneveld SA, Verhulst FC, Verloove-Vanhorick SP. Identification and management of psychosocial problems by preventive child health care. *Arch Pediatr Adolesc Med* 2001 Apr;155(4):462-9.
11. Glascoe FP. Screening for developmental and behavioral problems. *Ment Retard Dev Disabil Res Rev* 2005;11(3):173-9.
12. Huisman M, Oldehinkel AJ, de Winter AF, et al. Cohort profile: the Dutch 'Tracking Adolescents' Individual Lives' Survey'; TRAILS. *Int J Epidemiol* 2008 Dec;37(6):1227-35.
13. de Winter AF, Oldehinkel AJ, Veenstra R, et al. Evaluation of non-response bias in mental health determinants and outcomes in a large sample of pre-adolescents. *Eur J Epidemiol* 2005;20(2):173-81.
14. Kohn MA, Vosti CL, Lezotte D, Jones RH. Optimal gestational age and birth-weight cutoffs to predict neonatal morbidity. *Med Decis Making* 2000 Oct;20(4):369-76.

15. Achenbach TM, & Rescorla LA. Manual for the Achenbach system empirically based assessment (ASEBA), preschool forms and profiles. Burlington, VT: University of Vermont, Research Center for children, youth and families; 2001.
16. Verhulst FC, Van der Ende J, Koot HM. Manual for the CBCL/4-18 (Handleiding voor de CBCL/4-18). Rotterdam: Erasmus University, Department of Child and Adolescent Psychiatry, Sophia Children's Hospital; 1996.
17. Vergouwe Y, Steyerberg EW, Eijkemans MJ, Habbema JD. Substantial effective sample sizes were required for external validation studies of predictive logistic regression models. *J Clin Epidemiol* 2005 May;58(5):475-83.
18. Peduzzi P, Concato J, Kemper E, Holford TR, Feinstein AR. A simulation study of the number of events per variable in logistic regression analysis. *J Clin Epidemiol* 1996 Dec;49(12):1373-9.
19. Swets JA. Measuring the accuracy of diagnostic systems. *Science* 1988 Jun 3;240(4857):1285-93.
20. Hanley JA, McNeil BJ. The meaning and use of the area under a receiver operating characteristic (ROC) curve. *Radiology* 1982 Apr;143(1):29-36.
21. Coppus SF, van der Veen F, Opmeer BC, Mol BW, Bossuyt PM. Evaluating prediction models in reproductive medicine. *Hum Reprod* 2009 Apr 23.
22. Diamond GA. What price perfection? Calibration and discrimination of clinical prediction models. *J Clin Epidemiol* 1992 Jan;45(1):85-9.
23. Mesman J, Bongers IL, Koot HM. Preschool developmental pathways to preadolescent internalizing and externalizing problems. *J Child Psychol Psychiatry* 2001 Jul;42(5):679-89.
24. Hofstra MB, Van der EJ, Verhulst FC. Child and adolescent problems predict DSM-IV disorders in adulthood: a 14-year follow-up of a Dutch epidemiological sample. *J Am Acad Child Adolesc Psychiatry* 2002 Feb;41(2):182-9.
25. Wahlstedt C, Thorell LB, Bohlin G. ADHD symptoms and executive function impairment: early predictors of later behavioral problems. *Dev Neuropsychol* 2008;33(2):160-78.
26. Baeyens D, Roeyers H, Van de Walle J, Hoebeke P. Behavioural problems and attention-deficit hyperactivity disorder in children with enuresis: a literature review. *Eur J Pediatr* 2005 Nov;164(11):665-72.
27. Van Hoecke E, De Fruyt F, De Clercq B, Hoebeke P, Van de Walle J. Internalizing and externalizing problem behavior in children with nocturnal and diurnal enuresis: a five-factor model perspective. *J Pediatr Psychol* 2006 Jun;31(5):460-8.
28. Ashford J, van Lier PA, Timmermans M, Cuijpers P, Koot HM. Prenatal smoking and internalizing and externalizing problems in children studied from childhood to late adolescence. *J Am Acad Child Adolesc Psychiatry* 2008 Jul;47(7):779-87.
29. Kalff AC, Kroes M, Vles JS, et al. Factors affecting the relation between parental education as well as occupation and problem behaviour in Dutch 5- to 6-year-old children. *Soc Psychiatry Psychiatr Epidemiol* 2001 Jul;36(7):324-31.
30. Shaw DS, Winslow EB, Owens EB, et al. The development of early externalizing problems among children from low-income families: a transformational perspective. *J Abnorm Child Psychol* 1998 Apr;26(2):95-107.

31. Wakschlag LS, Pickett KE, Cook E Jr, Benowitz NL, Leventhal BL. Maternal smoking during pregnancy and severe antisocial behavior in offspring: a review. *Am J Public Health* 2002 Jun;92(6):966-74.
32. Mesman J, Koot HM. Early preschool predictors of preadolescent internalizing and externalizing DSM-IV diagnoses. *J Am Acad Child Adolesc Psychiatry* 2001 Sep;40(9):1029-36.
33. Najman JM, Heron MA, Hayatbakhsh MR, et al. Screening in early childhood for risk of later mental health problems: a longitudinal study. *J Psychiatr Res* 2008 Jul;42(8):694-700.
34. Ong SH, Wickramaratne P, Tang M, Weissman MM. Early childhood sleep and eating problems as predictors of adolescent and adult mood and anxiety disorders. *J Affect Disord* 2006 Nov;96(1-2):1-8.
35. Costello EJ, Pine DS, Hammen C, et al. Development and natural history of mood disorders. *Biol Psychiatry* 2002 Sep 15;52(6):529-42.
36. Weller EB, Kloos A, Kang J, Weller RA. Depression in children and adolescents: does gender make a difference? *Curr Psychiatry Rep* 2006 Apr;8(2):108-14.
37. Burton A, Altman DG. Missing covariate data within cancer prognostic studies: a review of current reporting and proposed guidelines. *Br J Cancer* 2004 Jul 5;91(1):4-8.
38. Riley RD, Abrams KR, Sutton AJ, et al. Reporting of prognostic markers: current problems and development of guidelines for evidence-based practice in the future. *Br J Cancer* 2003 Apr 22;88(8):1191-8.
39. Crone MR, Vogels AG, Hoekstra F, Treffers PD, Reijneveld SA. A comparison of four scoring methods based on the parent-rated Strengths and Difficulties Questionnaire as used in the Dutch preventive child health care system. *BMC Public Health* 2008;8:106.
40. Wiefferink CH, Reijneveld SA, de Wijs J, et al. Screening for psychosocial problems in 5-6-year olds: a randomised controlled trial of routine health assessments. *Patient Educ Couns* 2006 Jan;60(1):57-65.



# 3

## **Trajectories of psychosocial problems in adolescents predicted by findings from early well-child assessments**

M. Jaspers  
A.F. de Winter  
M. Huisman  
F.C. Verhulst  
J. Ormel  
R.E. Stewart  
S.A. Reijneveld

*Submitted*



## Abstract

### *Purpose*

Research results on trajectories of emotional and behavioral problems are rather heterogeneous. To describe trajectories of emotional and behavioral problems in adolescents and to identify early indicators of these trajectories out of data from routine well-child assessments, at ages 0-4 years.

### *Methods*

Data from three assessment waves of adolescents (n=1816) of the Tracking Adolescents' Individual Lives Survey (TRAILS) were used (ages 11-17). Information on early indicators (ages 0-4 years) came from the records of the well-child services. Trajectories of emotional and behavioral problems were based on the parent-reported Child Behavior Checklist (CBCL) and the adolescent-reported Youth Self Report (YSR), filled out at ages 11, 14 and 17. Multinomial logistic regression was used to examine the predictive value of these early indicators on trajectories.

### *Results*

For boys and girls we found four trajectories for each outcome, one with high problem levels, and three with middle high, middle low, and low levels. For emotional problems, the type of trajectory was predicted by parental educational level and parental divorce or single parents, for both genders. Moreover, for boys sleep problems were predictive and for girls language problems (odds ratios between 1.53-7.42). For behavioral problems, the trajectories' type was predicted by maternal smoking during pregnancy, parental educational level, and parental divorce or single parents, for both genders. Moreover, for boys early behavioral problems and attention hyperactivity problems were predictive (odds ratios between 1.64-5.43).

### *Conclusion*

Trajectories of emotional and behavioral problems during adolescence are rather stable and can be predicted by a parsimonious set of data from early well-child assessments.

## Introduction

Emotional and behavioral problems are very prevalent during childhood and adolescence. Patterns vary across ages, though the underlying aspects are rather stable, which limits the value of studies at a single point in time<sup>1,2</sup>. Therefore, studying the trajectories of emotional and behavioral problems has been recommended.<sup>3</sup> So far, trajectory studies have looked at the disorder level<sup>2,4-6</sup> and not at the broad range of emotional and behavioral problems, whereas indicated prevention mostly targets at children with increased problem levels.<sup>7</sup>

Evidence on trajectories of emotional and behavioral problems is rather heterogeneous with some studies showing only slight to moderate variation in problem levels<sup>2,8</sup>, while others showed rather big variation over time.<sup>2,4,9</sup> Evidence on gender differences lacks, but these are likely to occur. First, prevalence rates differ by gender, depending on the type of problems.<sup>10-12</sup> Second, girls have been shown to develop relatively more emotional problems during adolescence than boys.<sup>5,6,10</sup>

Well-child care, or preventive child health care, aims to identify children at risk for various problems, including emotional and behavioral ones, especially the more severe problem behavior. In particular preschool age has been shown to be very important for children's further development and functioning.<sup>13,14</sup> However, evidence on early indicators that discriminate between different trajectories is scarce, with previous studies measuring an outcome at a single time point,<sup>15-18</sup> focusing on disorders, and/or assessing parental and peer relationships as predictors.<sup>8,19-21</sup>

Community-based well-child services are uniquely positioned for the early identification of children at risk for psychosocial problems. In the Netherlands, well-child professionals provide health and developmental monitoring to the entire Dutch population from birth until young adulthood.<sup>22</sup> Evidence lacks on the degree to which their findings are predictive for trajectories of emotional and behavioral problems in adolescents. The aim of the present study is to describe these trajectories of emotional and behavioral problems in adolescents and to identify early indicators of these trajectories out of data from routine well-child assessments.

## Methods

### *Sample*

The TRacking Adolescents' Individual Lives Survey (TRAILS) is a prospective cohort study of Dutch preadolescents and adolescents.<sup>23,24</sup> The present study used data from the first (n=2230, mean age=11.09, SD=0.56), second (n=2149, mean age=13.55, SD=0.54), and third wave (n=1819, mean age=16.26, SD=0.73). Parents of 2139 children (96%) gave written informed consent to retrieve data from the well-child records. Out of these, 84.9% could be traced (n=1816 well-child files). Children with and without a well-child file differed as to the prevalence of parent-rated behavioral problems (14.4% for the retrieved vs. 20.0% for the

non-retrieved,  $p < .05$ ) but did not differ statistically regarding parent-rated emotional problems (16.6% vs. 18.2%, respectively,  $p > .05$ ) at T1. The TRAILS study was approved by the Dutch National Medical Ethics Committee.

### *Emotional and behavioral problems: outcomes*

Emotional and behavioral problems were assessed using the adolescent-reported Youth Self-Report (YSR) and the parent-reported Child Behavior Checklist (CBCL) at each wave. The validity of both instruments has been documented extensively.<sup>25,26</sup> They consist of 120 questions about the previous six months, each coded as: 0= not true; 1= somewhat/sometimes true; and 2= very/often true. 'Emotional problems' consists of the anxious/depressed, somatic complaints, and withdrawn/depressed syndrome scales. 'Behavioral problems' consists of the aggressive behavior and delinquent behavior syndrome scales. Multi-informant information is known to be a better predictor of disorder than information from only one informant.<sup>27,28</sup> We therefore computed the average of the raw scores on the YSR and CBCL, giving equal weight to both informants.

### *Early development*

Data on early development were obtained from well-child records, in which information from all well-child visits had been recorded. These visits are provided free of charge; covering about 95% of the population. For ages 0-4 years, on average 12 visits are provided by community physicians and nurses (well-child professionals). The assessments included a general physical examination, standardized screening procedures and a semi-structured interview with parents concerning health status and physical, emotional and behavioral developmental problems, all of which were recorded in the well-child file. An assessment generally takes approximately 10 to 15 minutes. In accordance with the literature, we selected all the potentially relevant factors from the well-child file: prenatal and perinatal factors, early motor and social development, and family characteristics.<sup>15-18,30-32</sup>

### Prenatal and perinatal risks

Maternal smoking and alcohol use were assessed by two questions: "Did the mother smoke during pregnancy?" and "Did the mother use alcohol during pregnancy?"<sup>30</sup> Low birth weight was defined as <2500 grams.<sup>32</sup> Gestational age was registered in weeks. These questions were part of the PCH files, but were also part of the T1 interview in TRAILS (when a child was 11 years old). If the answer was missing for the well-child file then we enriched the data with the data from TRAILS. Birth complications, for example, included abruption, preterm rupture, meconium in amniotic fluid, and pre-eclampsia, and they were dichotomized to a "yes" if any of these were present, and to a "no" if there were none.

### Early motor and social development

Early motor and social development, from birth to four years of age, were assessed using four indices. The first was the Van Wiechen Scheme, for one to 15 months of age, which is the Dutch equivalent of the Bayley scales.<sup>31</sup> These indicators were divided into three different subcategories: gross motor skills (16 items), fine motor skills and adaptation (11 items), and communication and social behavior (10 items); each of them was targeted towards children of a predetermined age. The items were summed within these three subcategories and then dichotomized as “yes” if any problems were present, or “no”.

Second, the well-child professional assessed problems in motor and language development at six occasions between ages 18 months to four years. Examples of these developmental problems are: delays in motor skills and speech delay. Findings were then dichotomized to “yes” if any problems were present during one or more of these six occasions, and “no” if otherwise.

Third, from age 18 months to four years, the well-child professional systematically asked parents about sleeping and eating behavior. The responses were dichotomized to “yes” if any of these problems were present during one or more of the six visits, and a “no” if there were none.

The fourth index concerned well-child-registered behavioral features, noted at six assessments between the ages of 18 months to four years. Parents’ disclosures concerning playing, behavior, and social behavior were systematically assessed and recorded by well-child professionals using short descriptions such as “overactive,” “shy,” “anxious,” or “aggressive” (see Chapter 4). These were categorized as behavioral problems, emotional problems, attention hyperactivity problems, social problems in behavior, or positive behavior and were then dichotomized to “yes” if any of these were present during these six occasions, and “no”.

### Family characteristics

Parental educational level, based on the parent with the highest level, was allocated to three levels: low (at the lowest levels of secondary education), medium (higher levels of secondary education), and high (higher vocational or university degree). If both answers were missing for the well-child file we enriched the data with the data from TRAILS. The living situation was classified into two groups: living with both biological parents versus divorced parents, stepparent(s), or single-parent households.

## *Analyses*

### Multiple imputation of missing data

To prevent missing data in our indicators we combined data on several visits and if that was not possible we supplemented missing values by retrospectively collected information at T1 (n=1816 well-child files). At the assessment waves, data were missing for 5.6% at T1 to 34.2%

at T3 for the subscales of the YSR and the CBCL. These were imputed, based on the multivariate normal model,<sup>33,34</sup> as implemented in the NORM software.<sup>35</sup> This procedure minimizes the loss of statistical power, provides correctly estimated standard errors, and preserves the characteristics of the data set as a whole.<sup>36</sup> It is based on the assumption that, given the observed data, missing values are random.<sup>36</sup> However, violations have been shown to have only minor effects,<sup>37</sup> and if any, these were further reduced by using all observed information in a multivariate imputation model in which possible relations between missing values and observed data are modeled.<sup>38</sup>

All missing values were imputed ten times to achieve good efficiency of estimation and sufficient statistical power.<sup>33,36</sup> The imputed datasets were then pooled to build trajectories in which the results (from the mean of the ten datasets) were combined to obtain estimates of parameters and standard errors. These estimates then correctly reflected both sampling variability and the additional uncertainty due to missing data and imputation.

### Statistical analyses

First, we computed trajectories for each adolescent using latent class (LC) regression analyses on the data for all three measurement waves, doing so separately for boys and girls. The trajectories were constructed from the mean of the ten imputed datasets. LC regression analysis enables groups of individuals to be categorized into mutually exclusive classes based on their trajectories, followed by their responses to a single outcome variable over time. Because the outcome variables concerned count data, Poisson regression models were used that allowed overdispersion in a negative binomial distribution.<sup>39</sup> To determine the optimal number of classes, the Bayesian information criterion (BIC) was used (see Appendix 1).<sup>40</sup> Using the BIC criterion, this yielded four categories which we labeled as a high trajectory of adolescents with problem levels in the clinical range, and a middle high, middle low, and a low trajectory.

Next, we used multinomial logistic regression (MNL) analysis to assess the relationship between early developmental indicators and trajectories, again separately for boys and girls. A MNL model with four outcomes is roughly equivalent to running three binary logistic regressions, except that all parameters are estimated simultaneously, which enables the predictive power of independent variables to be assessed across all outcome levels.<sup>41</sup> These analyses were performed in two steps. First, we assessed the crude effect of each variable on the outcomes separately. We had chosen these variables based on the available evidence on which variables might be predictive, and on whether data on these variables were recorded in routine PCH. All variables with an association at  $p < .20$  were used in the second step. In this second step, we constructed a final model using backward regression with  $p < .05$  as criterion regarding the contribution of each variable. The statistical analyses were performed using Latent GOLD<sup>39</sup> and SPSS version 16.

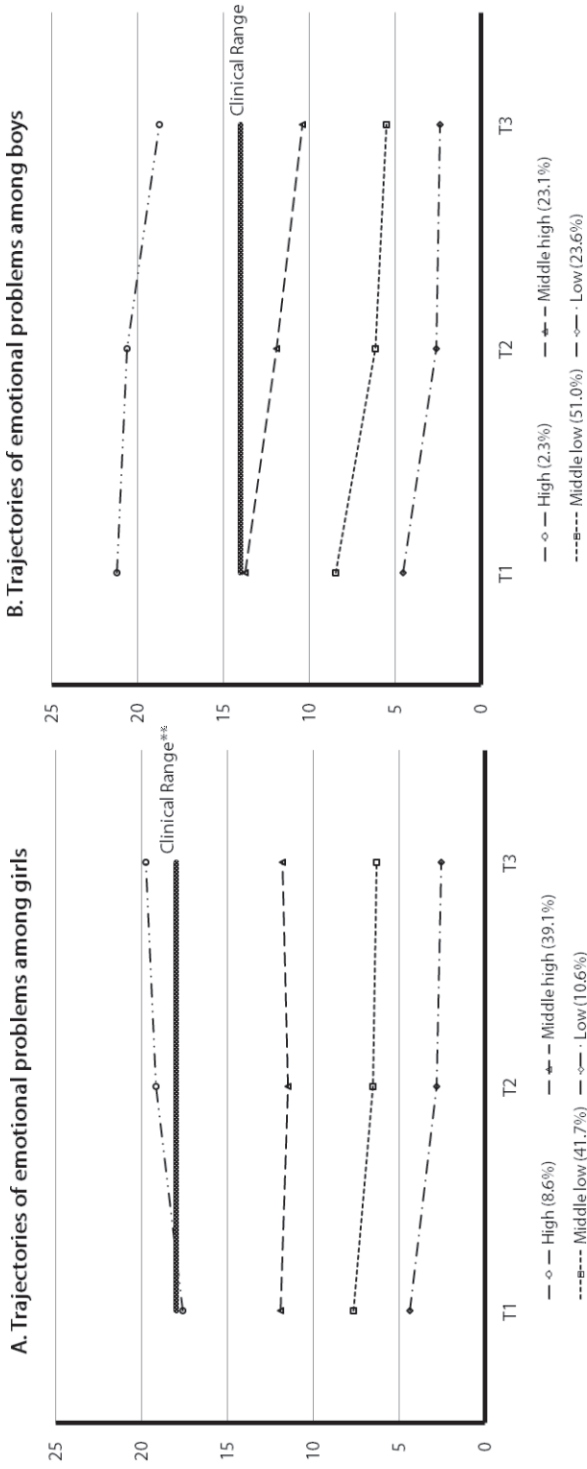
## Results

Figure 1 shows the trajectories of emotional and behavioral problems for girls and boys. Of the 932 girls, 80 (8.6%) were in the trajectory of clinical emotional problems, while 20 of the 884 boys (2.3%) were in this group. In the clinical behavioral group, there were 39 girls (4.2%) and 76 boys (8.6%) (see Figure 1).

Table 1 shows crude and mutually adjusted odds ratios (OR) for the relation between well-child predictors and the four groups of trajectories, for emotional and for behavioral trajectories, in both girls and boys during adolescence. For the group of trajectories of emotional problems in girls, the significant predictors were language and speech problems, having divorced or single parents, and parents with a low educational level (odds ratios, ORs, between 2.72-7.42). Estimates of the associations of language and speech problems with this group of trajectories were rather inaccurate, indicated by fairly wide confidence intervals and unstable estimates. Therefore, we repeated the analyses without this predictor. When doing that, early emotional problems were included as predictor in the model. For the group of trajectories of emotional problems in boys the identified predictors were maternal smoking during pregnancy, early sleep problems, and having parents with a low or medium educational level (ORs between 1.53-5.43), while maternal alcohol use during pregnancy was a protective predictor in the emotional model (OR 0.63).

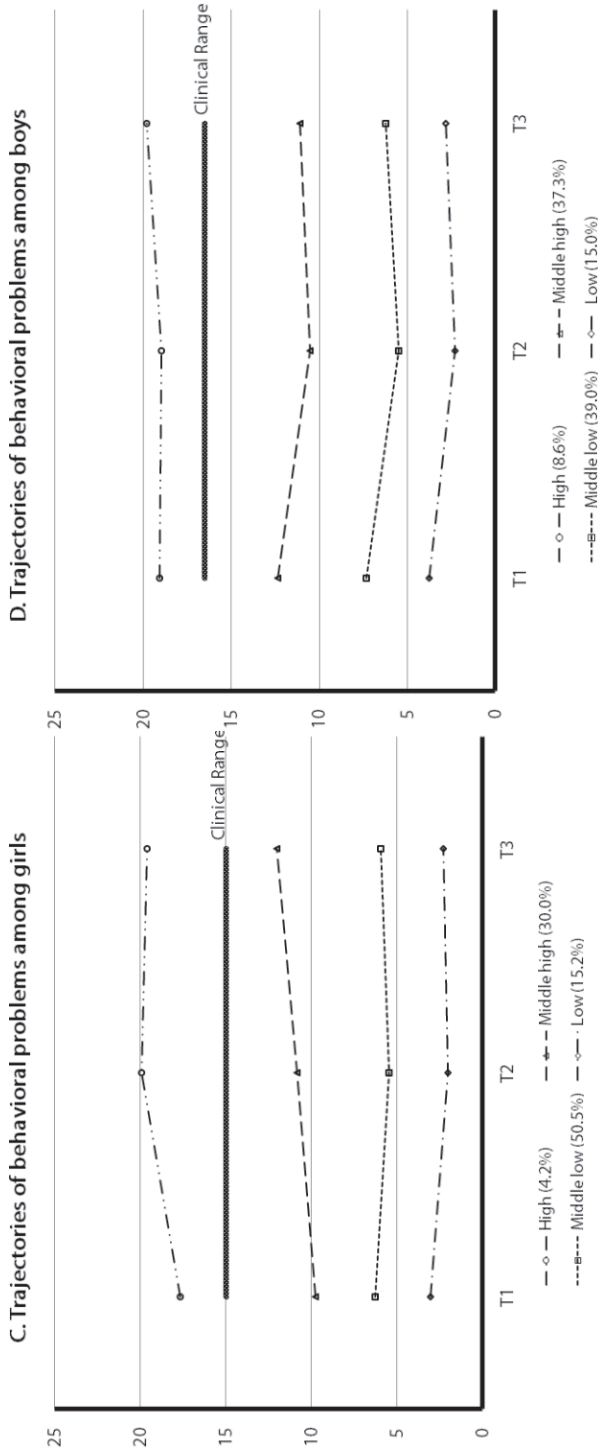
Predictors for the group of trajectories of behavioral problems in girls were maternal smoking during pregnancy, having divorced or otherwise single parents, and having parents with a low or medium educational level (ORs between 1.69-5.41), while gross motor problems was a protective predictor (OR 0.44). Attention hyperactivity problems did not contribute to the model. For the group of trajectories for behavioral problems in boys, maternal smoking during pregnancy, early behavioral problems, attention hyperactivity problems, the absence of any positive reported behavior, a low level of parental education, and having divorced or otherwise single parents were predictors (ORs between 1.59-4.25).

**Figure 1A-D.** Trajectories of emotional and behavioral problems among girls and boys.\*



\*Due to rounding, numbers do not add up to 100% everywhere.

\*\*Clinical Range is the average of the CBCL and the YSR clinical ranges.<sup>25,26</sup>





**Table 1.** Multinomial logistic regression on level of emotional and behavioral problems for adolescents: Odds ratios, OR (and 95% confidence intervals, CI)

| Table 1A. Emotional problems for girls    |                            |                                     |                                    |                            |                         |
|---|----------------------------|-------------------------------------|------------------------------------|----------------------------|-------------------------|
| Variable                                  | High problems<br>80 (8.6%) | Middle high problems<br>364 (39.1%) | Middle low problems<br>389 (41.7%) | Low problems<br>99 (10.6%) | Reference<br>group      |
|   | OR (crude)<br>95% CI       | OR (adj*)<br>95% CI                 | OR (crude)<br>95% CI               | OR (adj*)<br>95% CI        |                         |
| <i>Prenatal and perinatal factors</i>     |                            |                                     |                                    |                            |                         |
| Maternal alcohol use during pregnancy     | 1.23 (0.62-2.49)           |                                     | 0.88 (0.51-1.53)                   |                            | 0.90 (0.53-1.55)        |
| Maternal smoking during pregnancy         | 1.30 (0.69-2.44)           |                                     | 1.25 (0.77-2.02)                   |                            | 1.03 (0.63-1.67)        |
| Low birth weight (< 2500 grams)           | 0.48 (0.09-2.55)           |                                     | 1.45 (0.54-3.88)                   |                            | 1.35 (0.50-3.60)        |
| Birth complication                        | 0.97 (0.49-1.94)           |                                     | 0.89 (0.53-1.51)                   |                            | 0.81 (0.48-1.36)        |
| <i>Early motor and social development</i> |                            |                                     |                                    |                            |                         |
| Gross motor skills delay (age 1-15 mos.)  | 0.72 (0.36-1.44)           |                                     | <b>0.58 (0.35-0.97)</b>            |                            | <b>0.56 (0.35-0.98)</b> |
| Fine motor skills delay                   | 0.82 (0.22-3.00)           |                                     | 0.85 (0.33-2.20)                   |                            | 1.20 (0.48-2.99)        |
| Communication delay                       | 2.28 (0.64-8.08)           |                                     | 1.31 (0.44-3.94)                   |                            | 1.56 (0.53-4.61)        |
| Motor problems (age 1.5 - 4 yrs.)         | 3.93 (0.77-20.0)           |                                     | 3.27 (0.76-14.1)                   |                            | 1.41 (0.31-6.47)        |
| Language and speech problems              | <b>6.93 (1.47-32.61)</b>   | <b>7.42 (1.56-35.31)</b>            | 2.67 (0.61-11.67)                  | 2.78 (0.63-12.21)          | 3.05 (0.71-13.15)       |
| Sleep problems                            | 1.27 (0.66-2.45)           |                                     | 0.82 (0.49-1.38)                   |                            | 0.97 (0.58-1.61)        |
| Problems with eating                      | 0.91 (0.50-1.64)           |                                     | 1.36 (0.87-2.13)                   |                            | 1.18 (0.76-1.84)        |
| Behavioral problems                       | 1.40 (0.76-2.58)           |                                     | 1.10 (0.68-1.76)                   |                            | 1.03 (0.64-1.65)        |
| Emotional problems                        | <b>2.06 (1.02-4.20)</b>    |                                     | 0.93 (0.52-1.69)                   |                            | 1.11 (0.62-1.99)        |
| Social problems in behavior               | 0.82 (0.22-3.00)           |                                     | 1.09 (0.43-2.76)                   |                            | 0.71 (0.27-1.85)        |
| Attention hyperactivity problems          | 0.86 (0.45-1.62)           |                                     | 0.88 (0.55-1.41)                   |                            | 0.85 (0.53-1.36)        |
| No positive behavior reported             | 1.44 (0.79-2.63)           |                                     | 1.11 (0.79-1.75)                   |                            | 1.25 (0.79-1.96)        |
| <i>Family characteristics</i>             |                            |                                     |                                    |                            |                         |
| Low educational level of parents          | <b>2.60 (1.01-6.73)</b>    | <b>2.47 (1.03-5.91)</b>             | 1.26 (0.64-2.50)                   | 1.42 (0.74-2.73)           | 1.78 (0.92-3.44)        |
| Middle educational level of parents       | <b>2.79 (1.31-5.95)</b>    | <b>2.27 (1.11-4.62)</b>             | 1.37 (0.82-2.29)                   | 1.26 (0.77-2.07)           | 1.11 (0.67-1.81)        |
| Divorced parents or one parent            | <b>3.17 (1.39-7.21)</b>    | <b>3.04 (1.32-7.00)</b>             | <b>3.05 (1.53-6.12)</b>            | <b>2.73 (1.35-5.51)</b>    | <b>2.06 (1.02-4.15)</b> |

**Criterion** p<.20 for inclusion in multivariate model

\* adj = adjusted for all other variables which are included in the multivariate model

Table 1B. Emotional problems for boys

| Variable                                  | High problems<br>20 (2.3%) |                          | Middle high problems<br>204 (23.1%) |                         | Middle low problems<br>451 (51.0%) |                         | Low problems<br>209 (23.6%)<br>Reference<br>group |
|---|----------------------------|--------------------------|-------------------------------------|-------------------------|------------------------------------|-------------------------|---|
|   | OR (crude)<br>95% CI       | OR (adj*)<br>95% CI      | OR (crude)<br>95% CI                | OR (adj*)<br>95% CI     | OR (crude)<br>95% CI               | OR (adj*)<br>95% CI     |   |
| <i>Prenatal and perinatal factors</i>     |                            |                          |                                     |                         |                                    |                         |   |
| Maternal alcohol use during pregnancy     | 0.48 (0.14-1.71)           | 0.47 (0.13-1.74)         | 0.86 (0.55-1.35)                    | 0.96 (0.60-1.53)        | <b>0.55 (0.37-0.82)</b>            | <b>0.63 (0.42-0.95)</b> | 1   |
| Maternal smoking during pregnancy         | 1.33 (0.49-3.64)           | 1.23 (0.40-3.72)         | <b>2.04 (1.34-3.11)</b>             | <b>1.82 (1.17-2.81)</b> | 1.34 (0.92-1.95)                   | 1.25 (0.85-1.84)        | 1   |
| Low birth weight (< 2500 grams)           | 1.78 (0.20-15.57)          |                          | 2.30 (0.86-6.18)                    |                         | 1.16 (0.45-3.04)                   |                         | 1   |
| Birth complication                        | 2.02 (0.76-5.37)           |                          | 0.97 (0.61-1.56)                    |                         | 1.20 (0.80-1.78)                   |                         | 1   |
| <i>Early motor and social development</i> |                            |                          |                                     |                         |                                    |                         |   |
| Gross motor skills delay (age 1-15 mos.)  | 0.99 (0.32-3.13)           |                          | 0.93 (0.57-1.51)                    |                         | 1.08 (0.72-1.62)                   |                         | 1   |
| Fine motor skills delay                   | 2.46 (0.64-9.40)           |                          | 1.12 (0.53-2.39)                    |                         | 1.25 (0.66-2.36)                   |                         | 1   |
| Communication delay                       | 1.11 (0.24 (5.16)          |                          | 0.69 (0.33-1.44)                    |                         | 1.08 (0.62-1.90)                   |                         | 1   |
| Motor problems (age 1.5 - 4 yrs.)         | -                          |                          | 2.55 (0.88-7.37)                    |                         | 1.40 (0.50-3.92)                   |                         | 1   |
| Language and speech problems              | 0.86 (0.11-7.01)           |                          | 1.78 (0.85-3.75)                    |                         | 1.25 (0.63-2.49)                   |                         | 1   |
| Sleep problems                            | <b>4.86 (1.89-12.49)</b>   | <b>5.43 (2.05-14.40)</b> | <b>1.62 (1.03-2.55)</b>             | <b>1.64 (1.03-2.60)</b> | 1.44 (0.97-2.15)                   | 1.35 (0.90-2.04)        | 1   |
| Problems with eating                      | 1.49 (0.59-3.73)           |                          | <b>1.74 (1.18-2.57)</b>             |                         | <b>1.55 (1.11-2.16)</b>            |                         | 1   |
| Behavioral problems                       | 1.86 (0.74-4.67)           |                          | 1.46 (0.99-2.16)                    |                         | 1.03 (0.74-1.44)                   |                         | 1   |
| Emotional problems                        | 1.10 (0.30-3.97)           |                          | 1.11 (0.64-1.92)                    |                         | 1.34 (0.84-2.12)                   |                         | 1   |
| Social problems in behavior               | 1.34 (0.29-6.29)           |                          | 1.10 (0.54-2.23)                    |                         | 1.30 (0.72-2.37)                   |                         | 1   |
| Attention hyperactivity problems          | 0.66 (0.25-1.80)           |                          | 1.32 (0.90-1.96)                    |                         | 1.22 (0.88-1.71)                   |                         | 1   |
| No positive behavior reported             | <b>3.42 (1.26-9.21)</b>    |                          | 1.35 (0.91-1.99)                    |                         | 1.26 (0.90-1.76)                   |                         | 1   |
| <i>Family characteristics</i>             |                            |                          |                                     |                         |                                    |                         |   |
| Low educational level of parents          | 0.50 (0.10-2.40)           | 0.74 (0.19-2.52)         | 1.43 (0.82-2.50)                    | 1.49 (0.86-2.58)        | <b>1.94 (1.21-3.10)</b>            | <b>1.70 (1.07-2.69)</b> | 1   |
| Middle educational level of parents       | 0.54 (0.16-1.79)           | 0.57 (0.18-1.80)         | <b>1.65 (1.04-2.62)</b>             | <b>1.63 (1.02-2.59)</b> | <b>1.75 (1.18-2.59)</b>            | <b>1.53 (1.04-2.27)</b> | 1   |
| Divorced parents or one parent            | 2.35 (0.79-6.99)           |                          | <b>2.11 (1.25-3.56)</b>             |                         | <b>1.71 (1.06-2.74)</b>            |                         | 1   |

**Criterion** p<.20 for inclusion in multivariate model

\*adj = adjusted for all other variables which are included in the multivariate model

**Table 1C. Behavioral problems for girls**

| Variable                                  | High problems<br>39 (4.2%) |                          | Middle high problems<br>280 (30.0%) |                         | Middle low problems<br>471 (50.5%) |                         | Low problems<br>142 (15.2%)<br>Reference<br>group |
|---|----------------------------|--------------------------|-------------------------------------|-------------------------|------------------------------------|-------------------------|---|
|   | OR (crude)<br>95% CI       | OR (adj*)<br>95% CI      | OR (crude)<br>95% CI                | OR (adj*)<br>95% CI     | OR (crude)<br>95% CI               | OR (adj*)<br>95% CI     |   |
| <i>Prenatal and perinatal factors</i>     |                            |                          |                                     |                         |                                    |                         |   |
| Maternal alcohol use during pregnancy     | 0.89 (0.34-2.37)           |                          | 1.26 (0.74-2.13)                    |                         | 1.33 (0.81-2.17)                   |                         | 1   |
| Maternal smoking during pregnancy         | <b>2.35 (1.13-4.87)</b>    | 1.56 (0.73-3.35)         | <b>1.94 (1.25-3.01)</b>             | <b>1.69 (1.06-2.70)</b> | 0.99 (0.65-1.51)                   | 0.94 (0.60-1.46)        | 1   |
| Low birth weight (< 2500 grams)           | 0.71 (0.15-3.40)           |                          | 0.70 (0.30-1.61)                    |                         | 1.00 (0.48-2.07)                   |                         | 1   |
| Birth complication                        | 0.81 (0.31-2.14)           |                          | 1.27 (0.76-2.11)                    |                         | 1.36-0.85-2.19)                    |                         | 1   |
| <i>Early motor and social development</i> |                            |                          |                                     |                         |                                    |                         |   |
| Gross motor skills delay (age 1-15 mos.)  | 0.42 (0.16-1.07)           | 0.43 (0.17-1.13)         | <b>0.43 (0.26-0.70)</b>             | <b>0.44 (0.27-0.73)</b> | <b>0.51 (0.34-0.79)</b>            | <b>0.51 (0.33-0.79)</b> | 1   |
| Fine motor skills delay                   | 0.31 (0.04-2.51)           |                          | 0.97 (0.45-2.06)                    |                         | 0.64 (0.31-1.34)                   |                         | 1   |
| Communication delay                       | 0.91 (0.18-4.45)           |                          | 0.69 (0.30-1.74)                    |                         | 1.26 (0.57-2.80)                   |                         | 1   |
| Motor problems (age 1.5 - 4 yrs.)         | 3.94 (0.94-16.56)          |                          | 1.68 (0.54-5.25)                    |                         | 1.61 (0.54-4.77)                   |                         | 1   |
| Language and speech problems              | 2.20 (0.61-7.96)           |                          | 1.17 (0.47-2.91)                    |                         | 1.17 (0.50-2.75)                   |                         | 1   |
| Sleep problems                            | 2.09 (0.97-4.51)           |                          | 1.42 (0.88-2.29)                    |                         | 1.05 (0.66-1.65)                   |                         | 1   |
| Problems with eating                      | 1.09 (0.54-2.22)           |                          | 1.27 (0.85-1.91)                    |                         | 1.34 (0.92-1.95)                   |                         | 1   |
| Behavioral problems                       | 1.59 (0.76-3.35)           |                          | 1.42 (0.91-2.20)                    |                         | 1.34 (0.89-2.02)                   |                         | 1   |
| Emotional problems                        | 1.10 (0.46-2.66)           |                          | 0.84 (0.50-1.42)                    |                         | 1.03 (0.64-1.67)                   |                         | 1   |
| Social problems in behavior               | 0.91 (0.18-4.45)           |                          | 1.36 (0.59-3.15)                    |                         | 0.74 (0.32-1.73)                   |                         | 1   |
| Attention hyperactivity problems          | <b>2.13 (1.01-4.73)</b>    |                          | 1.50 (0.95-2.36)                    |                         | 1.31 (0.85-2.01)                   |                         | 1   |
| No positive behavior reported             | 1.79 (0.88-2.66)           |                          | 1.20 (0.80-1.82)                    |                         | 0.99 (0.68-1.46)                   |                         | 1   |
| <i>Family characteristics</i>             |                            |                          |                                     |                         |                                    |                         |   |
| Low educational level of parents          | <b>5.50 (1.59-19.03)</b>   | <b>5.41 (1.76-16.64)</b> | 1.19 (0.65-2.20)                    | 1.44 (0.81-2.55)        | 1.10 (0.63-1.90)                   | 1.33 (0.78-2.24)        | 1   |
| Middle educational level of parents       | <b>4.55 (1.41-14.62)</b>   | <b>3.90 (1.33-11.45)</b> | <b>1.80 (1.09-2.97)</b>             | <b>1.82 (1.13-2.94)</b> | 1.29 (0.81-2.04)                   | 1.38 (0.89-2.13)        | 1   |
| Divorced parents or one parent            | <b>3.62 (1.68-7.78)</b>    | <b>3.17 (1.43-7.03)</b>  | <b>1.71 (1.03-2.84)</b>             | 1.57 (0.91-2.68)        | 0.96 (0.58-1.57)                   | 0.97 (0.58-1.63)        | 1   |

**Criterion** p<.20 for inclusion in multivariate model

\* adj = adjusted for all other variables which are included in the multivariate model

Table 1D. Behavioral problems for boys

| Variable                                  | High problems<br>76 (8.6%) |                         | Middle high problems<br>330 (37.3%) |                         | Middle low problems<br>345 (39.0%) |                     | Low problems<br>133 (15.0%) |
|---|----------------------------|-------------------------|-------------------------------------|-------------------------|------------------------------------|---------------------|-----------------------------|
|   | OR (crude)<br>95% CI       | OR (adj*)<br>95% CI     | OR (crude)<br>95% CI                | OR (adj*)<br>95% CI     | OR (crude)<br>95% CI               | OR (adj*)<br>95% CI | Reference<br>group          |
| <i>Prenatal and perinatal factors</i>     |                            |                         |                                     |                         |                                    |                     |                             |
| Maternal alcohol use during pregnancy     | 0.73 (0.33-1.62)           |                         | 1.48 (0.88-2.48)                    |                         | 1.28 (0.76-2.16)                   |                     | 1                           |
| Maternal smoking during pregnancy         | <b>4.34 (2.25-8.37)</b>    | <b>2.76 (1.37-5.59)</b> | <b>3.02 (1.79-5.12)</b>             | <b>2.63 (1.53-4.52)</b> | <b>2.51 (1.50-4.25)</b>            | 2.36 (1.38-4.04)    | 1                           |
| Low birth weight (< 2500 grams)           | 0.87 (0.21-3.58)           |                         | 1.22 (0.47-3.15)                    |                         | 0.50 (0.17-1.45)                   |                     | 1                           |
| Birth complication                        | 0.78 (0.40-1.50)           |                         | 0.83 (0.53-1.32)                    |                         | 0.70 (0.44-1.11)                   |                     | 1                           |
| <i>Early motor and social development</i> |                            |                         |                                     |                         |                                    |                     |                             |
| Gross motor skills delay (age 1-15 mos.)  | 0.87 (0.43-1.80)           |                         | 0.93 (0.56-1.53)                    |                         | 1.10 (0.67-1.80)                   |                     | 1                           |
| Fine motor skills delay                   | 0.86 (0.28-2.62)           |                         | 1.14 (0.54-2.42)                    |                         | 0.99 (0.47-2.12)                   |                     | 1                           |
| Communication delay                       | 1.01 (0.38-2.70)           |                         | 1.12 (0.56-2.24)                    |                         | 0.82 (0.40-1.67)                   |                     | 1                           |
| Motor problems (age 1.5 - 4 yrs.)         | 0.28 (0.33-2.39)           |                         | 0.66 (0.23-1.86)                    |                         | 0.96 (0.37-2.54)                   |                     | 1                           |
| Language and speech problems              | 0.97 (0.31-3.01)           |                         | 1.14 (0.51-2.49)                    |                         | 1.12 (0.51-2.46)                   |                     | 1                           |
| Sleep problems                            | 1.47 (0.76-2.86)           |                         | 1.50 (0.91-2.45)                    |                         | 1.63 (1.00-2.66)                   |                     | 1                           |
| Problems with eating                      | 1.14 (0.65-2.01)           |                         | 1.38 (0.92-2.07)                    |                         | 1.36 (0.91-2.03)                   |                     | 1                           |
| Behavioral problems                       | <b>2.54 (1.42-4.55)</b>    | <b>2.06 (1.10-3.86)</b> | <b>1.87 (1.23-2.86)</b>             | <b>1.80 (1.16-2.80)</b> | 1.48 (0.97-2.26)                   | 1.46 (0.94-2.25)    | 1                           |
| Emotional problems                        | 0.64 (0.28-1.47)           |                         | 0.94 (0.55-1.60)                    |                         | 0.95 (0.56-1.61)                   |                     | 1                           |
| Social problems in behavior               | 0.86 (0.31-2.41)           |                         | 0.97 (0.48-1.97)                    |                         | 1.03 (0.51-2.07)                   |                     | 1                           |
| Attention hyperactivity problems          | <b>2.10 (1.18-3.71)</b>    | <b>2.06 (1.10-3.86)</b> | 1.31 (0.87-1.97)                    | 1.26 (0.81-1.94)        | 1.09 (0.72-1.64)                   | 1.07 (0.70-1.64)    | 1                           |
| No positive behavior reported             | <b>1.92 (1.09-3.41)</b>    | 1.83 (0.98-3.42)        | <b>1.56 (1.03-2.35)</b>             | <b>1.59 (1.03-2.45)</b> | 1.26 (0.77-1.74)                   | 1.20 (0.78-1.83)    | 1                           |
| <i>Family characteristics</i>             |                            |                         |                                     |                         |                                    |                     |                             |
| Low educational level of parents          | <b>5.51 (2.13-14.25)</b>   | <b>3.97 (1.60-9.83)</b> | 1.55 (0.88-2.73)                    | 1.03 (0.58-1.82)        | 1.16 (0.66-2.03)                   | 1.03 (0.59-1.79)    | 1                           |
| Middle educational level of parents       | <b>4.55 (1.88-11.00)</b>   | <b>3.48 (1.48-8.20)</b> | <b>1.66 (1.03-2.67)</b>             | 1.37 (0.85-2.20)        | 1.32 (0.83-2.10)                   | 1.24 (0.78-1.97)    | 1                           |
| Divorced parents or one parent            | <b>6.47 (2.99-14.02)</b>   | <b>4.25 (1.10-3.86)</b> | <b>3.10 (1.58-6.05)</b>             | <b>2.58 (1.16-2.80)</b> | <b>2.10 (1.07-4.16)</b>            | 1.85 (0.92-3.70)    | 1                           |

Criterion  $p < .20$  for inclusion in multivariate model

\* adj = adjusted for all other variables which are included in the multivariate model

## Discussion

This study is the first to assess early indicators for trajectories of emotional and behavioral problems in adolescents, based on data from routine well-child assessments in a large longitudinal community-based sample. We identified groups of four trajectories, similarly for both genders and for emotional and behavioral problems. Each group comprised a high trajectory of clinical problems, and a middle high, middle low, and low trajectory. All trajectories were relatively stable across ages; the continuity of these problems was very high. Parsimonious sets of early childhood indicators from well-child assessments predicted each of these groups of trajectories. All sets comprised low and medium parental educational levels, and having divorced or otherwise single parents, for both genders. For trajectories of emotional problems, sleep problems were a unique predictor in boys and language problems in girls. Groups of trajectories of behavioral problems were predicted by maternal smoking during pregnancy for both genders. In addition, in boys early behavioral problems and attention hyperactivity problems were predictive.

We found that trajectories were rather stable, with only slight to moderate increases or decreases in problem levels. This is in line with the findings of Dekovic and colleagues<sup>8</sup> regarding emotional problems. Letcher and colleagues<sup>9</sup> found more variability in trajectories of emotional problems, but they mostly measured the anxiety dimension and not the whole spectrum of emotional problems. Regarding behavioral problems, Nagin and Tremblay<sup>4</sup> found four trajectories for physical aggression, opposition, and hyperactivity among boys. There was a chronic problem trajectory, and a middle high and middle low trajectory, both of which desisted over time, and a no problem trajectory.

Based on our findings, one might conclude that community-based assessments at age 11 already provide most of the information needed to identify groups with higher rates of problems. However, caution is needed, since developmental trajectories groups summarize the average behavioral trend at the group level. Not all individuals' behavioral trajectories will exactly match the group average.<sup>42</sup> Moreover, trajectories on broad groups of problems such as emotional and behavioral problems might not show much variety, while the composing symptoms might do so.

We found gender differences in the prevalence of these two broadband problems: girls experienced more emotional problems and boys experienced more behavioral problems, as has been found in many other studies.<sup>8,9,11,12,19</sup> Moreover, though overall relatively stable, problems increased by approximately 10% between ages 11 to 17 for girls in the clinical trajectory of emotional problems (from an average of 17.7 to 22.2), while there was a decrease for boys in this trajectory.

The predictors that we found for our trajectories of emotional and behavioral problems are partly in line with previous studies that measured predictors at the same time as the trajectories<sup>4,9</sup> and/or focused on parental and peer relationships.<sup>8,19-21</sup> In line with Letcher, we found that toddler emotional problems (including shyness) were predictive for a high

emotional trajectory; however, this was only predictive after removing the factor of language problems from our analyses. We did not replicate the finding of Letcher and colleagues<sup>9</sup> that early behavioral problems were predictive for high rates of adolescent emotional problems. Surprisingly, we also did not replicate the findings that early behavioral and attention hyperactivity problems were predictive for adolescent behavioral problems in girls.<sup>43,44</sup>

Our findings confirm the impact of early social disadvantage on adolescent emotional and behavioral problems, whereas previous findings were mixed.<sup>9,45</sup> We found that having a parent with a low and a medium educational level was predictive for groups of trajectories in both boys and girls, with a high trajectory of behavioral problems and for girls with a high trajectory of emotional problems. Previously, we developed and validated a prediction model for emotional and behavioral problems in preadolescence (T1 data).<sup>29</sup> There, we partially found the same predictors (as in this study), mainly regarding behavioral problems. Maternal smoking during pregnancy, low and medium parental educational level, and having divorced parents or a single parent were predictive for both genders with high trajectories of behavioral problems.

### *Strengths and limitations*

Major strengths of our study concern its prospective nature, spanning many years from birth onwards, its high response rate, and its embedding in routine community-based well-child care. Moreover, we used a broad range of indicators, whereas most previous studies only used subsets of indicators, emotional and behavioral problems were identified based on both child and parent ratings, thus reducing measurement error.

Our study also has some limitations which may have led to underestimation of the predictive power of the well-child findings. First, children may have received effective treatment for their psychosocial problems between the ages of 4 and 11 in early intervention programs. Well-child professionals have been shown to undertake action in 85% of the cases in which they identify psychosocial problems, including an intended referral for further diagnostics and treatment in 20%.<sup>22,46</sup> This may have led to some reduction of problems in adolescence, thus lowering the predictive power of early well-child findings.

Second, some highly predictive early-risk indicators may not have been identified as indicators due to their low prevalence. Third, we didn't control for parental psychopathology. Some indicators, such as smoking during pregnancy and low SES, might be associated with genetically determined higher levels of behavioral problems on the part of the parents<sup>47</sup> implying that causal inferences should be made cautiously. Fourth, the CBCL and YSR questionnaires may also be subject to error in terms of the identification of relevant children, which would decrease the predictive power of indicators. For instance, for the CBCL the sensitivity and specificity of the Dutch version, in terms of the cut-off for clinical range, are 0.66 and 0.82, respectively.<sup>26</sup>

Our findings have several implications for well-child services. First, they support the importance of prevention of smoking during pregnancy.<sup>30</sup> Second, they show the value of

early childhood monitoring to identify children at risk for trajectories of high rates of emotional and behavioral problems. Third, given the continuity of emotional and behavioral problems, they also show the importance of continued monitoring during adolescence.

This study is the first to assess the predictive power of early well-child findings on adolescent trajectories of emotional and behavioral problems, implying that its results need to be confirmed. This should also comprise trajectories of co-occurring emotional and behavioral problems, given the frequent occurrence of these.<sup>48</sup>

In conclusion, trajectories of emotional and behavioral problems during adolescence are remarkably stable and can be predicted by a parsimonious set of data from early well-child assessments. The well-child setting may play an important role in prevention by monitoring children at risk for developing these stable problems, by administering diagnostic instruments to further qualify their symptoms, and by providing early treatment if needed.

## References

1. Kraemer HC, Yesavage JA, Taylor JL, et al. How can we learn about developmental processes from cross-sectional studies, or can we? *Am J Psychiatr.* 2000; 157(2):163-171.
2. Bongers IL, Koot HM, van der Ende J, et al. Developmental trajectories of behavioral behaviors in childhood and adolescence. *Child Dev.* 2004; 75(5):1523-1537.
3. Costello EJ, Angold AC. Developmental epidemiology: A framework for developmental psychopathology. In: A.J.Sameroff, M.Lewis, eds. *Handbook of developmental psychopathology.* New York: Kluwer Academic/Plenum. 2000: 57-73.
4. Nagin D, Tremblay RE. Trajectories of boys' physical aggression, opposition, and hyperactivity on the path to physically violent and nonviolent juvenile delinquency. *Child Dev.* 1999; 70(5):1181-1196.
5. Hankin BL. Development of Sex Differences in Depressive and Co-Occurring Anxious Symptoms During Adolescence: Descriptive Trajectories and Potential Explanations in a Multiwave Prospective Study. *J Clinic Child Adolesc Psychol.* 2009; 38(4):460-472.
6. Olinio TM, Klein DN, Lewinsohn PM, et al. Latent trajectory classes of depressive and anxiety disorders from adolescence to adulthood: descriptions of classes and associations with risk factors. *Comp Psychiatr.* 2010; 51(3):224-235.
7. Durlak JA, Wells AM. Primary prevention mental health programs for children and adolescents: a meta-analytic review. *Am J Community Psychol* 1997; 25(2):115-52.
8. Dekovic M, Wissink IB, Meijer AM. The role of family and peer relations in adolescent antisocial behaviour: comparison of four ethnic groups. *J Adolesc.* 2004; 27(5):497-514.
9. Letcher P, Smart D, Sanson A, et al. Psychosocial Precursors and Correlates of Differing Emotional Trajectories from 3 to 15 Years. *Social Dev.* 2009; 18(3):618-646.
10. Costello EJ, Mustillo S, Erkanli A, et al. Prevalence and development of psychiatric disorders in childhood and adolescence. *Arch Gen Psychiatry.* 2003;60(8):837-44.

11. Leadbeater BJ, Kuperminc GP, Blatt SJ, Hertzog C. A multivariate model of gender differences in adolescents' emotional and behavioral problems. *Dev Psychol.* 1999; 35(5):1268-1282.
12. Zahn-Waxler C, Klimes-Dougan B, Slattery MJ. Emotional problems of childhood and adolescence: Prospects, pitfalls, and progress in understanding the development of anxiety and depression. *Dev Psychopath.* 2000; 12(3):443-466.
13. Keating DP, Hertzman C. *Developmental health and the wealth of nations: Social, Biological, and Educational Dynamics.* New York: Guilford Press, 1999.
14. Kershaw P, Irwin L, Trafford K, Hertzman C. *The British Columbia Atlas of Child Development.* Victoria, BC: Western Geographic Press, 2006.
15. Glascoe FP. Screening for developmental and behavioral problems. *Ment Retard Dev Disabil Res Rev.* 2005; 11(3):173-179.
16. Mesman J, Koot HM. Early preschool predictors of preadolescent emotional and behavioral DSM-IV diagnoses. *J Am Acad Child Adolesc Psychiatr.* 2001; 40(9):1029-1036.
17. Najman JM, Heron MA, Hayatbakhsh MR, et al. Screening in early childhood for risk of later mental health problems: a longitudinal study. *J Psychiatr Res.* 2008; 42(8):694-700.
18. Ong SH, Wickramaratne P, Tang M, et al. Early childhood sleep and eating problems as predictors of adolescent and adult mood and anxiety disorders. *J Affect Disord.* 2006; 96(1-2):1-8.
19. Montague M, Cavendish W, Enders C, et al. Interpersonal Relationships and the Development of Behavior Problems in Adolescents in Urban Schools: A Longitudinal Study. *J Youth Adolesc.* 2010; 39(6):646-657.
20. Galambos NL, Barker ET, Almeida DM. Parents do matter: Trajectories of change in behavioral and emotional problems in early adolescence. *Child Dev.* 2003; 74(2):578-594.
21. Scaramella LV, Conger RD, Simons RL. Parental protective influences and gender-specific increases in adolescent emotional and behavioral problems. *J Res on Adolesc.* 1999; 9(2):111-141.
22. Brugman E, Reijneveld SA, Verhulst FC, et al. Identification and management of psychosocial problems by preventive child health care. *Arch Pediatr Adolesc Med.* 2001; 155(4):462-469.
23. de Winter AF, Oldehinkel AJ, Veenstra R, et al. Evaluation of non-response bias in mental health determinants and outcomes in a large sample of pre-adolescents. *Eur J Epidemiol.* 2005; 20(2):173-181.
24. Huisman M, Oldehinkel AJ, de Winter AF, et al. Cohort profile: the Dutch 'Tracking Adolescents' Individual Lives' Survey'; TRAILS. *Int J Epidemiol.* 2008; 37(6):1227-1235.
25. Achenbach TM, & Rescorla LA. *Manual for the Achenbach system empirically based assessment (ASEBA), preschool forms and profiles.* Burlington, VT: University of Vermont, Research Center for children, youth and families, 2001.
26. Verhulst FC, Van der Ende J, Koot HM. *Manual for the CBCL/4-18 (Handleiding voor de CBCL/4-18).* Rotterdam: Erasmus University, Department of Child and Adolescent Psychiatry, Sophia Children's Hospital, 1996.



27. Achenbach TM, McConaughy SH, Howell CT. Child/adolescent behavioral and emotional problems: implications of cross-informant correlations for situational specificity. *Psychol Bull.* 1987; 101(2):213-232.
28. Verhulst FC, Van der Ende J. Agreement between parents' reports and adolescents' self-reports of problem behavior. *J Child Psychol Psychiatr.* 1992; 33(6):1011-1023.
29. Jaspers M, de Winter AF, de Meer G, et al. Early Findings of Preventive Child Healthcare Professionals Predict Psychosocial Problems in Preadolescence: The TRAILS Study. *J Pediatr.* 2010; 157(2):316-321.
30. Ashford J, van Lier PA, Timmermans M, et al. Prenatal smoking and emotional and behavioral problems in children studied from childhood to late adolescence. *J Am Acad Child Adolesc Psychiatr.* 2008; 47(7):779-787.
31. Jacobusse G, Van Buuren S., Verkerk PH. An interval scale for development of children aged 0-2 years. *Stat Med.* 2006; 25(13):2272-2283.
32. Kohn MA, Vosti CL, Lezotte D, et al. Optimal gestational age and birth-weight cutoffs to predict neonatal morbidity. *Med Decis Making.* 2000; 20(4):369-376.
33. Rubin DB. Multiple imputation for nonresponse in surveys. New York: Willey, 1987.
34. Schafer JL. Analysis of incomplete multivariate data. London: Chapman & Hall, 1997.
35. NORM: Multiple imputation of incomplete multivariate data under a normal model. Version 3. 2000.
36. Graham JW. Missing data analysis: making it work in the real world. *Annu Rev Psychol.* 2009;(60):577-605.
37. Collins LM, Schafer JL, Kam C-M. A comparison of inclusive and restrictive strategies in modern missing data procedures. *Psychol Methods.* 2001; 6:330-351.
38. Schafer JL. Multiple imputation in multivariate problems when the imputation and analysis models differ. *Statistica Neerlandica.* 2003;(57):19-35.
39. Vermunt J.K., Magidson J. *Latent GOLD 4.0 User's Guide.* B. Belmont, Massachusetts: Statistical Innovations Inc, 2005.
40. Magidson J, Vermunt J.K. Latent Class Models. In: Kaplan D., ed. *The Sage handbook of quantitative methodology for the social sciences.* Thousand Oaks: Sage Publications Inc, 2004: 175-198.
41. Long JS, Cheng S. Regression models for categorical outcomes. In: Hardy M, Bryman A, eds. *Handbook of data analysis.* London: Sage publications Ltd, 2004: 259-284.
42. Tremblay RE, Nagin DS, Seguin JR, et al. Physical aggression during early childhood: trajectories and predictors. *Can Child Adolesc Psychiatr Rev.* 2005; 14(1):3-9.
43. Leve LD, Kim HK, Pears KC. Childhood temperament and family environment as predictors of emotional and behavioral trajectories from ages 5 to 17. *J Abnorm Child Psychol.* 2005; 33(5):505-520.
44. Loeber R, Pardini DA, Hipwell A, et al. Are There Stable Factors in Preadolescent Girls' Behavioral Behaviors? *J Abnorm Child Psychol.* 2009; 37(6):777-791.
45. Strohschein L. Parental divorce and child mental health trajectories. *J Marri Fam.* 2005; 67(5):1286-1300.

46. Reijneveld SA, Brugman E, Verhulst FC, et al. Identification and management of psychosocial problems among toddlers in Dutch preventive child health care. *Arch Pediatr Adolesc Med.* 2004; 158(8):811-817.
47. Buschgens CJM, Swinkels SHN, van Aken MAG, et al. Behavioral behaviors in preadolescents: familial risk to behavioral behaviors, prenatal and perinatal risks, and their interactions. *Eur Child Adolesc Psychiatr.* 2009; 18(2):65-74.
48. Pesenti-Gritti P, Spatola CAM, Fagnani C, et al. The co-occurrence between emotional and behavioral behaviors. *Eur Child Adolesc Psychiatr.* 2008; 17(2):82-92.

#### Appendix 1. Fit statistics for LCA models

| Group  | Class | Solution   | Number of parameters | Log-likelihood | Bayes information criterion* |
|--------|-------|------------|----------------------|----------------|------------------------------|
| Female | 3     |            | 14                   | -9946.74       | 19991.93                     |
|        | 4     | Emotional  | 19                   | -9916.77       | <b>19967.14</b>              |
|        | 5     |            | 24                   | -9908.55       | 19985.87                     |
| Male   | 3     |            | 14                   | -8986.64       | 18071.29                     |
|        | 4     | Emotional  | 19                   | -8949.81       | <b>18032.64</b>              |
|        | 5     |            | 24                   | -8943.32       | 18054.67                     |
| Female | 3     |            | 14                   | -9372.08       | 18842.59                     |
|        | 4     | Behavioral | 19                   | -9309.80       | <b>18753.20</b>              |
|        | 5     |            | 24                   | -9302.42       | 18773.59                     |
| Male   | 3     |            | 14                   | -9423.90       | 18945.82                     |
|        | 4     | Behavioral | 19                   | -9392.21       | <b>18917.44</b>              |
|        | 5     |            | 24                   | -9378.94       | 18925.91                     |

\*Best model is indicated in bold



# 4

## **Early childhood assessments of community pediatric professionals predict autism spectrum and attention deficit hyperactivity problems**

M. Jaspers  
A. F. de Winter  
J. K. Buitelaar  
F. C. Verhulst  
S. A. Reijneveld  
C. A. Hartman

*Submitted*

## Abstract

### *Background*

For clinically referred children with Autism Spectrum Disorder (ASD) or Attention Deficit Hyperactivity Disorder (ADHD) several early indicators have been described. However, knowledge is lacking on early markers of less severe variants of ASD and ADHD from the general population. The aim of the present study is to identify early indicators of high risk groups for ASD and ADHD problems based on routine data from community pediatric services between infancy and age four.

### *Methods*

Data are from 1816 participants who take part in Tracking Adolescents' Individual Lives Survey (TRAILS), a longitudinal study. Information on early developmental factors was extracted from charts of routine Preventive Child Healthcare (PCH) visits. To assess ASD and ADHD problems, respectively, we used the Children's Social Behavior Questionnaire (CSBQ) and the Child Behavior Checklist (CBCL), filled out three times between the ages of 11 and 17.

### *Results*

Male gender, low birth weight, low level of education of the mother, social, behavioral, language, psychomotor and eating problems significantly predicted ASD problems (odds ratios (OR) between 1.34-2.41). ADHD problems were also predicted by male gender and low level of education of the mother and by maternal smoking during pregnancy, good gross motor skills in first year, early attention hyperactivity problems, and absence of parent-reported positive behavior (ORs between 1.36-1.74).

### *Conclusions*

Routine data on early childhood from PCH services are predictive for ASD and ADHD problems in adolescents in the general population. The PCH services are a useful setting to identify high risk groups, and to monitor them subsequently.

## Introduction

Autistic spectrum disorders (ASD) and Attention Deficit Hyperactivity Disorder (ADHD) are neurodevelopmental disorders with an onset early in life, with a prevalence of around 1% and 5%, respectively.<sup>1,2</sup> ASD and ADHD often co-exist. Estimates on overlap in children with ASD range from 28% to 53%; ASD problems in children diagnosed with ADHD are also very common, although precise estimates are lacking.<sup>1-7</sup> A recent study showed that a complex longitudinal pattern exists between social-communication and hyperactivity-inattentive traits. The majority of children with persistent hyperactive-inattentive symptoms also showed persistent social-communication deficits but not vice versa.<sup>2</sup> Recently the field has broadened its focus so that it now views ASD and ADHD as constituting the very severe end of continuous distributions in the general population.<sup>8-10</sup> Less severe variants of ASD and ADHD below the threshold for a diagnosis seem common, as shown by both family studies and studies in the general population.<sup>8,9,11,12</sup> We further denote these as ASD and ADHD problems. Individuals with these subthreshold problems have similar but milder impairments in social functioning, communication, and information processing relative to children with a clinical diagnosis.<sup>8,11-14</sup> Thus, even at subthreshold level, problems may be an important burden for the children themselves, their parents, and others in their environment which may be alleviated by treatment.

Research has shown that early identification of ASD and ADHD, if followed by adequate intervention, may improve prognosis.<sup>15-18</sup> It seems important to identify, monitor and, if necessary, intervene in these developmental problems as early as possible. Community pediatric services, such as those in the USA and Europe, are in a unique position for early identification of developmental problems in children. Early indicators are needed to monitor high risk groups (who very likely will develop additional problems or impairments), but there is a dearth of evidence on these in the general population. For clinically referred children with ASD or ADHD, however, several early indicators have been reported in the literature; these concern pre- and perinatal factors,<sup>19-25</sup> early behaviors and emotions,<sup>25-30</sup> motor and speech problems<sup>31-33</sup> and on atypicalities in regulation functions including sleeping and eating.<sup>34-36</sup> The age of observation of these indicators varies, and fluctuates between six months and three-and-a-half years.<sup>18,30</sup>

The aim of the present study is to identify early indicators of high risk groups for ASD and ADHD problems based on routine data from community pediatric services between infancy and age four. The present study is complementary to previous prospective work in that it is the first to focus on the general community by using data from routine Preventive Child Healthcare (PCH) measurements, and from birth up to age four. The presence of ASD and ADHD problems was assessed during (pre)adolescence. Note that previous studies on early indicators were focused on either ASD or ADHD. Given frequent co-occurrence<sup>1,3-5,7</sup> and evidence of overlapping early indicators when the separate literatures on ADHD and ASD are brought together, their simultaneous study may further our insight into which indicators are

unique to these disorders and which might be viewed as generic indicators for both. For the purpose of early detection and treatment, this is highly relevant.

## Methods

The TRacking Adolescents' Individual Lives Survey (TRAILS) is a prospective cohort study among Dutch (pre)adolescents.<sup>37,38</sup> Children with mental or physical incapability were excluded or because of language problems of the parents. The present study involves data from the first ( $n=2230$ , mean age=11.09,  $SD=0.56$ , starting March 2001), second ( $n=2149$ , mean age=13.55,  $SD=0.54$ ) and third wave ( $n=1819$ , mean age=16.26,  $SD=0.73$ ), and also involves data from the PCH files. Parents of 2139 (96%) children gave written informed consent to retrieve their child's file from the PCH at T1. Out of these, 84.9% could be traced ( $n=1816$  PCH files). Children with and without a PCH file differed in parent-rated ASD ( $M=5.45$ ,  $SE=0.13$  for the retrieved and  $M=7.25$ ,  $SE=0.36$  for the non-retrieved,  $p<0.001$ , i.e. higher scores among the non-retrieved) and ADHD problems ( $M=3.83$ ,  $SE=0.08$  vs.  $M=4.41$ ,  $SE=0.19$ , respectively,  $p<0.01$ ) at T1. Both for ASD and ADHD problems, higher scores indicate more symptoms. The TRAILS study was approved by the national ethical committee 'Central Committee on Research involving Human Subjects'.

### *The outcome measures: ASD and ADHD problems*

Parents filled out the Children's Social Behavior Questionnaire (CSBQ) and the Child Behavior Checklist (CBCL) at all three measurement waves. The CSBQ is a validated questionnaire for child social problems typically seen in children with ASD, especially in its milder forms, for ages 4-18.<sup>39</sup> The sum of the subscales of social interest, social understanding, stereotyped behavior, and resistance to change was used, which captures the core symptoms of ASD and consists of 30 items.<sup>40</sup> The CBCL is an internationally validated questionnaire for child emotional and behavioral problems for ages 4-18 and consists of 118 items.<sup>41</sup> From this questionnaire we used the DSM-IV-oriented attention hyperactivity problem scale as outcome measure. This scale consists of seven items.

### *Early indicators*

In the Netherlands, PCH services provide health and developmental monitoring for all Dutch children from birth until age 19; the participation rate is over 90%. The information on indicators had been collected by community physicians and nurses (PCH professionals) as part of the routine procedure of the PCH. These assessments included a general physical examination, standardized screening procedures and an interview with parents concerning health status and developmental (physical, emotional and behavioral) problems, which were all documented in the PCH file. An assessment takes approximately 10 to 15 minutes. In accordance with the literature we selected all potentially relevant predictors: pre- and

perinatal factors, BMI and head circumference growth curves, psychomotor factors, early childhood behaviors, and sociodemographic variables from the PCH file.

### *Pre- and perinatal variables*

Pre- and perinatal variables concerned maternal smoking and alcohol use during pregnancy, low birth weight (registered in grams) and birth defects as provided by the obstetrician or midwife. Maternal smoking and alcohol use were assessed as: "Did the mother smoke during pregnancy?" and "Did the mother use alcohol during pregnancy?" These questions were part of the PCH files, but were also part of the T1 interview in TRAILS (when a child was age 11 years). If either answer was "yes," we defined a score as indicative of smoking or alcohol use, respectively. The obstetrician or midwife could report yes or no, and in case of yes the amount per week or day. Often only yes or no was filled out, so more detailed information on quantity could not be retrieved. Low birth weight was defined as < 2500 grams, which is the standard clinical cut-off point. Birth defects included limb deformities, craniofacial malformations and anomalies in organs, which are often seen in children with a clinical diagnosis of autism.<sup>9</sup> Respondents received a "yes" if any of these were present and a "no" if none were present.

### *BMI and head circumference increase*

BMI at age 2, 3 and 4 years (extracted from weight and height in the PCH files) was categorized into: low BMI, intermediate BMI and high BMI; gender and age-specific cut-offs were used.<sup>42,43</sup> Head circumference increase, from birth until age six months and from age six months until 12 months, was standardized into Mean Z-scores,<sup>44</sup> and then dichotomized into the highest 10% versus the rest.

### *Psychomotor development*

Psychomotor development from birth to age four was assessed by three indices. The first was the Van Wiechen Scheme designed for children aged between one month and 15 months, which is the Dutch equivalent of the Bayley scales.<sup>45</sup> The PCH professional assigns a pass or fail score to each indicator for a given child. Indicators are divided into three different subcategories: gross motor skills (16 items), fine motor skills and adaptation (11 items), and communication and social behavior (10 items); each is targeted at children of a certain age. Items within these three subcategories are summed to provide subscales.

The second index concerned psychomotor development from the age of 18 months until four years old, with six measurements in this period, and was assessed as: "Does the child have any problems with motor skills and/or with speech and language" with both reported by either a "yes" or "no". Motor skills, and speech and language, were each added up, respectively, and then dichotomized to a "yes" if any of these were present during these six occasions, and a "no" if none were present.



The third index concerned neurological problems observed during physical examination of the child, conducted six times between the ages of 18 months and four years old. If on any occasion a problem was present, this index was coded as “yes”, and as “no” if none were present.

### *Early childhood behavior*

Early childhood behavior refers to behavioral features which were the most striking in the child and were recorded between ages 1.5 to 4 years, for which we distinguished “sleeping, eating and emotional and behavioral problems.” During PCH visits, the PCH professional inquired into these problems as: “How is your child doing as far as eating is concerned?” and “How is your child doing as far as sleeping is concerned?” Difficulties such as “has problems falling asleep”, “wakes up and can’t sleep afterwards”, “eats with much problems” or “eats very little” were reported. Descriptions of these behaviors were categorized as “yes,” in case of problems, and “no” or “missing.” The responses to the six times that these behaviors were probed were added up, and then dichotomized to a “yes,” if any of these were present, and a “no,” if none were present. “Emotional and behavioral problems” were collected from three open questions in the PCH files, that is, “How does the child play,” “How is the child’s behavior?” and “How is the child’s social behavior?” The community physician or the nurse could report difficulties here such as “overactive,” “shy,” “anxious” or “aggressive,” but also strengths such as “social” (see Table 1). These PCH-registered descriptions were categorized as social problems in behavior, attention hyperactivity problems, internalizing problems, externalizing problems or absence of parent-reported positive behavior and then dichotomized to a “yes” if any of these were present during these six occasions, and a “no” if none were present.

### *Sociodemographic variables*

Sociodemographic variables refer to the highest educational level of the father and the highest educational level of the mother. We have distinguished two groups here: low (lower tracks of secondary education or less), and middle and high (higher tracks of secondary education, and university degree or more) educational levels, respectively.

### *Statistical analysis*

Prior to analyses, both outcome measures (CSBQ and CBCL) were dichotomized. To determine the optimal cut-off point for dichotomization for both questionnaires, we plotted the cumulative score distribution of decile scores (x-axis) versus raw scores (y-axis). All graphs showed steep increases in problem behavior with a consistent kink at the 80<sup>th</sup> percentile. From that point onwards children began to have substantially more problems. For the CSBQ, the kink at the 80<sup>th</sup> percentile was at 9 for all three measurements; for the ADHD

**Table 1.** Description of behavior of children by PCH professionals divided into five categories

| Social problems in behavior  | Attention hyperactivity problems  | Emotional problems   | Behavioral problems   | Positive behavior   |
|--|---|--|---|---|
| Cannot be made enthusiastic about things<br>Cannot stand change<br>Child with a "manual"<br>Difficulties getting used to new situations<br>Difficulty getting used to others<br>Does not like many things happening simultaneously<br>Does not respond to initiatives by others<br>Easily manipulated<br>Head banging<br>Hits him/herself<br>Immature<br>Inappropriate play<br>Needs very strict routines<br>Peculiar child<br>Resists new things<br>Social interaction does not extend beyond caretakers<br>Sometimes hard to connect with<br>Withdrawn | Boisterous<br>Concentration problems<br>Difficulty concentrating during play<br>Distracted / hyperactive<br>Dreamy<br>Easily bored<br>Impulsive<br>Jumps from one thing to another<br>Noisy<br>Pushes the limits<br>Reacts to everything and everyone<br>Restless<br>Sees no danger<br>Short attention span<br>Talks excessively<br>Turbulent<br>Very active<br>Volatile<br>Wild<br>Withdrawn | Anxious<br>Clings to mother<br>Cries easily<br>Easily frightened<br>Fear of abandonment<br>Fear of failure<br>Insecure<br>Introvert<br>Nervous<br>Over-sensitive<br>Over-submissive<br>Panics easily<br>Quiet<br>Separation anxiety<br>Shy<br>Silent<br>Timid<br>Worried | Aggressive<br>Argues a lot<br>Argumentative<br>Behavioral problems<br>Bites others<br>Bold<br>Defiant<br>Demands attention in a negative way<br>Disobedient<br>Flings toys<br>Gets "beside him/herself"<br>Harassing<br>Headstrong<br>Hits others<br>Impatient<br>Impertinent<br>Imposing<br>Kicks others<br>Manipulative<br>Moody<br>Nagging<br>Oppositional<br>Overly present<br>Provocative<br>Quickly becomes angry<br>Rebellious<br>Stubborn<br>Temper tantrums<br>Whining | Affectionate<br>Attentive<br>Cheerful<br>Confident<br>Cool, composed<br>Cooperative<br>Cuddly<br>Curious<br>Cute<br>Eager to learn<br>Easy<br>Enthusiastic<br>Flexible<br>Focused<br>Helpful<br>Independent<br>Interested<br>Kind<br>Lively<br>Looks after others<br>Nice<br>Open<br>Patient<br>Picks up on things easily<br>Polite<br>Rich imagination<br>Sociable<br>Social<br>Spontaneous<br>Sweet<br>Takes the initiative |

scale of the CBCL it was 7. We defined a score above the 80th percentile at least twice (out of three measurements) as indicative of the presence of ASD and ADHD problems.

Subsequently we calculated descriptive statistics for all predictor variables and performed logistic regression analysis to examine the influence of early development on ASD and ADHD behaviors. Based on the results of the univariate analyses, we considered variables associated with the outcomes at  $p < 0.2$  to be candidates for multiple logistic regression analyses. Variables were entered into a backward stepwise logistic regression procedure, generating a subset of independent predictors for the two outcome measures. As a final step, we investigated whether our final multivariate models changed when we brought the presence of ASD problems into the equation for predicting ADHD problems and vice versa; this to determine whether identified indicators were generic or specific to these problems. Statistical analyses were performed using SPSS Windows version 16.

## Results

Out of our overall sample ( $n=1816$ ), 348 adolescents met the ASD criterion and 419 fulfilled the ADHD criterion. One hundred and ninety-six met both ASD and ADHD criteria. Descriptive statistics of predictor variables in the ASD and ADHD groups, as well as in the remainder of the total sample, i.e. those who are not in either the ASD or the ADHD group, are presented in Table 2. The Mean of the CSBQ was 5.5 at T1 ( $SD=5.6$ ), 5.1 at T2 ( $SD=5.8$ ) and 5.0 at T3 ( $SD=5.7$ ). The Mean of the CBCL was 3.8 at T1 ( $SD=3.1$ ), 2.8 at T2 ( $SD=2.7$ ) and 2.5 at T3 ( $SD=2.6$ ).

Table 3 gives the crude and multivariate odds ratios (OR), and the 95% confidence intervals, on the predictors for ASD and ADHD problems on the CSBQ and the CBCL. Male gender, a low level of education of the mother, a low birth weight, language, psychomotor and eating problems, and social problems (all at toddler age) were identified as significant independent determinants of ASD problems on the CSBQ. A low level of education of the father, maternal smoking during pregnancy, head circumference increase (0-6 months), low BMI at age 2, sleep problems and absence of parent-reported positive behavior did not contribute to the model as independent predictors in multivariate analyses. Controlling for ADHD problems in the ASD group left the model virtually unchanged, only a low level of education of the mother dropped below significance levels, with small reductions in OR. The OR for the presence of ADHD problems was substantial (Table 3).

For ADHD problems on the CBCL, male gender, a low level of education of the mother, maternal smoking during pregnancy, gross motor skills (during the first year), attention hyperactivity problems, and absence of parent-reported positive behavior (at toddler age) were determinants. A low level of education of the father, sleep problems, problems with eating and externalizing problems did not contribute to the model as independent predictors in multivariate analyses. Controlling for ASD problems in the ADHD group left the model nearly intact; only maternal smoking during pregnancy and the absence of parent-

reported positive behavior dropped below significance levels, with small reductions in ORs. The OR for the presence of ASD problems was substantial (Table 3).

**Table 2.** Scores on early indicators in Autism Spectrum Disorder (ASD) and Attention Deficit/Hyperactivity Disorder (ADHD) groups and the remainder of the sample

| Indicators from PCH file                                   | ASD group<br>n= 348<br>n (%) | ADHD group<br>n= 419<br>n (%) | Remainder<br>of the sample<br>n= 1245<br>n (%) |
|--|------------------------------|-------------------------------|--|
| Boys   | 215 (61.8%)                  | 253 (60.4%)                   | 543 (43.6%)                                    |
| Low education of mother                                    | 141 (40.5%)                  | 179 (42.7%)                   | 332 (34.2%)                                    |
| Low education of father                                    | 110 (31.6%)                  | 125 (29.8%)                   | 339 (27.2%)                                    |
| Maternal alcohol use during pregnancy                      | 66 (19%)                     | 94 (22.4%)                    | 247 (19.8%)                                    |
| Maternal smoking during pregnancy                          | 124 (35.6%)                  | 158 (37.7%)                   | 365 (29.3%)                                    |
| Low birth weight (< 2500 grams)                            | 26 (7.5%)                    | 24 (5.7%)                     | 60 (4.8%)                                      |
| Birth defects  | 7 (2.0%)                     | 7 (1.7%)                      | 27 (2.2%)                                      |
| Neurological abnormalities (0- 4 yrs.)                     | 15 (4.3%)                    | 25 (6.0%)                     | 63 (5.1%)                                      |
| Head circumference increase (0- 6 mos.)                    | 39 (11.2%)                   | 35 (8.4%)                     | 94 (7.6%)                                      |
| Head circumference increase (6-12 mos.)                    | 27 (7.8%)                    | 25 (6.0%)                     | 76 (6.1%)                                      |
| Low BMI at age 2   | 45 (12.9%)                   | 44 (10.5%)                    | 143 (11.5%)                                    |
| Low BMI at age 3   | 3 (0.9%)                     | 8 (1.91%)                     | 13 (1.0%)                                      |
| Low BMI at age 4   | 2 (0.6%)                     | 1 (0.2%)                      | 15 (1.2%)                                      |
| Van Wiechen Scheme (VWS): gross motor skills (1-15 mos.)   | 72 (20.7%)                   | 59 (14.1%)                    | 261 (21.0%)                                    |
| VWS: fine motor skills and adaptation (1-15 mos.)          | 29 (8.4%)                    | 26 (6.2%)                     | 83 (6.7%)                                      |
| VWS: communication and social behavior (1-15 mos.)         | 30 (8.6%)                    | 36 (8.6%)                     | 81 (6.5%)                                      |
| Language difficulties (1.5- 4 yrs.)                        | 32 (9.2%)                    | 30 (7.2%)                     | 74 (5.9%)                                      |
| Psychomotor difficulties (1.5- 4 yrs.)                     | 25 (7.2%)                    | 19 (4.5%)                     | 44 (3.5%)                                      |
| Sleep problems (1.5- 4 yrs.)                               | 105 (30.2%)                  | 126 (30.1%)                   | 287 (23.1%)                                    |
| Problems with eating (1.5- 4 yrs.)                         | 196 (56.3%)                  | 232 (55.4%)                   | 604 (48.5%)                                    |
| Social problems in behavior (1.5- 4 yrs.)                  | 38 (10.9%)                   | 35 (8.4%)                     | 79 (6.3%)                                      |
| Attention hyperactivity problems (1.5- 4 yrs.)             | 133 (38.2%)                  | 203 (48.4%)                   | 421 (33.8%)                                    |
| Externalizing problems (1.5- 4 yrs.)                       | 146 (42.0%)                  | 190 (45.3%)                   | 446 (35.8%)                                    |
| Internalizing problems (1.5- 4 yrs.)                       | 66 (19.0%)                   | 64 (15.3%)                    | 217 (17.4%)                                    |
| Absence of parent-reported positive behavior (1.5- 4 yrs.) | 176 (50.6%)                  | 206 (49.2%)                   | 507 (40.7%)                                    |

**Table 3.** Associations of Preventive Child Healthcare indicators with ASD and ADHD problems: odds ratios and 95% confidence intervals (CI)

|  | ASD group (n=348)    |                                 | ADHD group (n=419)   |                                 |
|--|----------------------|---------------------------------|----------------------|---------------------------------|
|  | OR (crude)<br>95% CI | OR (adj) <sup>a</sup><br>95% CI | OR (crude)<br>95% CI | OR (adj) <sup>a</sup><br>95% CI |
| Boys   | 1.71 (1.39-2.11)     | 1.87 (1.43-2.45)                | 1.63 (1.27-2.17)     | 1.74 (1.38-2.19)                |
| Low education of mother                      | 1.65 (1.28-2.13)     | 1.45 (1.12-2.11)                | 1.40 (0.96-2.03)     | 1.52 (1.15-2.01)                |
| Low education of father                      | 0.96 (0.74-1.24)     |                                 |                      | 1.59 (1.25-2.02)                |
| Maternal alcohol use during pregnancy        | 1.24 (1.01-1.54)     |                                 |                      | 1.60 (1.30-1.96)                |
| Maternal smoking during pregnancy            | 1.67 (1.05-2.67)     | 1.93 (1.14-3.27)                | 1.95 (1.10-3.48)     | 1.36 (1.07-1.73)                |
| Low birth weight                             | 0.97 (0.42-2.24)     |                                 |                      | 1.10 (0.86-1.40)                |
| Birth defects                                | 0.78 (0.45-1.38)     |                                 |                      | 1.13 (0.70-1.82)                |
| Neurological abnormalities                   | 1.50 (1.04-2.26)     |                                 |                      | 0.75 (0.33-1.72)                |
| Head circumference increase (0-6 mos.)       | 1.38 (0.88-2.12)     |                                 |                      | 1.22 (0.76-1.96)                |
| Head circumference increase (6-12 mos.)      | 1.54 (1.10-2.20)     |                                 |                      | 0.91 (0.61-1.35)                |
| Low BMI at age 2                             | 1.07 (1.01-1.14)     |                                 |                      | 1.07 (0.50-2.31)                |
| Low BMI at age 3                             | 0.66 (0.13-3.48)     |                                 |                      | 1.03 (0.74-1.44)                |
| Low BMI at age 4                             | 0.94 (0.70-1.25)     |                                 |                      | 2.59 (0.94-7.13)                |
| Van Wiechen Scheme gross motor skills        | 1.30 (0.85-2.01)     |                                 |                      | 0.24 (0.03-2.05)                |
| VWS fine motor skills                        | 1.27 (0.83-1.94)     |                                 |                      | 0.73 (0.61-0.88)                |
| VWS communication                            | 1.61 (1.05-2.46)     | 1.75 (1.09-2.81)                | 1.71 (1.02-2.87)     | 0.88 (0.56-1.38)                |
| Language difficulties                        | 2.22 (1.35-3.65)     | 2.41 (1.38-4.17)                | 2.60 (1.42-4.76)     | 1.28 (0.86-1.91)                |
| (Psycho)motor difficulties                   | 1.37 (1.06-1.78)     |                                 |                      | 1.15 (0.75-1.77)                |
| Sleep problems                               | 1.33 (1.05-1.69)     | 1.34 (1.02-1.73)                | 1.28 (1.02-2.87)     | 1.16 (0.68-1.99)                |
| Problems with eating                         | 1.84 (1.23-2.73)     | 1.65 (1.04-2.60)                | 1.73 (1.06-2.84)     | 1.31 (1.05-1.63)                |
| Social problems in behavior                  | 1.10 (0.86-1.40)     |                                 |                      | 1.38 (1.08-1.76)                |
| Attention hyperactivity problems             | 1.22 (0.96-1.55)     |                                 |                      | 1.25 (0.83-1.88)                |
| Externalizing problems                       | 1.16 (0.86-1.56)     |                                 |                      | 1.95 (1.56-2.43)                |
| Internalizing problems                       | 1.43 (1.13-1.81)     |                                 |                      | 1.47 (1.18-1.84)                |
| Absence of parent-reported positive behavior |                      |                                 | 1.24 (0.93-1.65)     | 0.82 (0.61-1.11)                |
| ADHD or ASD problems in adolescence          |                      |                                 | 6.48 (4.85-8.66)     | 1.36 (1.09-1.70)                |
|  |                      |                                 |                      | 0.60 (0.42-0.87)                |
|  |                      |                                 |                      | 6.85 (5.10-9.20)                |

**Criterion** p<0.2 for inclusion in multiple logistic regression model

<sup>a</sup>adj = adjusted for all other variables which are included in the multiple logistic regression model

<sup>b</sup>adj = adjusted for all other variables which are included in the multiple logistic regression model including ADHD problems in ASD groups and vice versa

## Discussion

This study was the first to use early childhood findings as registered by community pediatric services to predict ASD and ADHD problems in adolescents in a large longitudinal community-based sample. We identified several early childhood indicators predictive of ASD and ADHD problems. Male gender and low level of education of the mother were generic indicators, while a low birth weight, social behavioral problems, language, and psychomotor and eating problems at toddler age were specific for ASD problems, and maternal smoking during pregnancy, gross motor skills during infancy, and attention hyperactivity problems at toddler age, for ADHD problems.

We found two important results that warrant further comment. Both controlling for ADHD problems in the ASD group and controlling for ASD problems for the ADHD group did leave the model virtually unchanged and vice versa, while the OR for the presence of ASD and ADHD problems was substantial. This indicates that neither risk indicators for ASD nor risk indicators for ADHD can be attributed solely to the shared variance between ADHD and ASD, therefore, early developmental risk indicators are to some extent specific for ASD and ADHD.

A second intriguing result was that early attention hyperactivity problems were predictive for later ADHD problems but not for ASD problems, while early social problems in behavior were predictive for later ASD problems but not for ADHD problems. In contrast, during adolescence ADHD is predictive for ASD and vice versa.<sup>2</sup> This finding points to specificity of risk indicators measured very early in development.

Our study adds important information because of our approach to use PCH data regarding the general community which differs from previous studies on early indicators of ASD or ADHD. Previous studies on ASD focused on clinically-referred and selective high-risk children, such as siblings of children with ASD.<sup>29,32,34</sup> Previous studies about early indicators of ADHD are scarce, and none of them was based on prospectively collected data to a younger age than 2 years.<sup>25,33</sup> The prospective and community-based nature of our study thus adds important information to what was already known.

Importantly, none of these studies used data from the PCH services, even though these services routinely follow the physical (diseases and growth) and psychosocial development of all children from birth on, in addition to screening for different disorders. Moreover, PCH services collect and register data according to a highly standardized format, including a number of objective parameters (e.g., birth weight, BMI, head circumference), therefore providing an outstanding setting for studying risk indicators in unbiased samples.

Given our focus on the general community, it is important to note that we identified largely the same early indicators as have been reported for referred and selected high risk ASD and ADHD samples, i.e. pre- and perinatal factors,<sup>25</sup> early behavioral signs associated with ASD including impairments or delay in social-communicative development,<sup>26,29</sup> early behavioral signs such as hyperactive-impulsive and inattentive temperamental features,<sup>25,27</sup>

motor, language and speech development,<sup>31-33</sup> atypicalities in regulation functions related to eating<sup>36</sup> and family adversity.<sup>46</sup> This suggests that findings from selected samples may be generalized to community-based samples and vice versa, and emphasizes how useful the PCH setting can be for identifying and monitoring both subthreshold and clinical ASD and ADHD.

The major strength of our study is the uniqueness of its design: its prospective nature, spanning many years from birth on, and its embedding in a routine PCH setting. Another strength is that we studied ASD and ADHD problems in tandem, therefore the first to report on generic and specific early childhood indicators. A further strength is our use of multiple indicators of varying types, as previous ASD or ADHD studies only used subsets of indicators. Recent overviews have shown that in most prognostic studies single rather than multiple indicators are investigated, but that multiple indicators provide better models.<sup>47,48</sup> A final strength of this study is that the identification of ASD and ADHD problems was based on three ratings, each two-and-a-half years apart, thus reducing measurement error. Also, TRAILS constitutes a large sample with a high response rate, and we retrieved PCH files for the large majority of the participants.

Our study also has limitations, but insofar as these may have affected our results, they will all lead to underestimation of the predictive power of the PCH findings. First, children may have received effective treatment for their developmental problems between the ages of 4 and 11. Second, children in our sample had a lower mean score on ASD and ADHD problems than the remainder of the sample for whom PCH files could not be retrieved, and also, as a result of the design of TRAILS, there were no cases of ASD with severe mental retardation in our study, while ASD problems are common in these children.<sup>49,50</sup> A related third issue is that some highly predictive early risk indicators are low prevalent and thus were not identified as indicators due to their low prevalence. This may, for instance, concern birth defects. Moreover, for some early risk indicators we lacked detailed information, for example, we knew if the mother smoked during pregnancy but not the daily dose of cigarettes. A final limitation may be that we did not use semi-structured interviews. Previous studies, in particular where ASD is concerned, used (semi-)structured interviews which are less susceptible to measurement error and interpretational bias. However, a gold standard interview such as the Autism Diagnostic Interview is designed to pick up on only the severe cases within ASD and is of no use in the general population. Note that part of the measurement error was removed by repeated measurement of ASD and ADHD problems.

In conclusion, the community pediatric services are a useful setting for both research on early predictors of ASD and ADHD problems in unbiased samples and for the early detection of children at risk in routine care. From early childhood PCH-registered routine data of a large community based sample we identified largely the same early indicators of ASD and ADHD problems as have been reported for clinically referred ASD and ADHD samples. This shows that routine PCH can identify children at risk of both sub-threshold and clinical ASD and ADHD in early childhood. The community pediatric services may also play an important role

in close monitoring of children identified in such a way, by administering in depth diagnostic instruments to further qualify their symptoms, and by providing early treatment if needed. Notwithstanding relatively modest differences, this may have a rather huge public health impact as these services cover the full population of children.

## References

1. Rommelse N. N., Geurts H. M., Franke B., Buitelaar J. K., Hartman C. A. (2011). A review on cognitive and brain endophenotypes that may be common in autism spectrum disorder and attention-deficit/hyperactivity disorder and facilitate the search for pleiotropic genes. *Neurosci Biobehav Rev.* [Epub ahead of print].
2. St Pourcain, B., Mandy, W.P., Heron, J., Golding, J., Smith, G.D. & Skuse, D.H. (2011) Links between co-occurring social-communication and hyperactive-inattentive trait trajectories. *J Am Acad Child Adolesc Psychiatry* 50, 892-902.
3. Hattori, J., Ogino, T., Abiru, K., Nakano, K., Oka, M. & Ohtsuka, Y. (2006). Are pervasive developmental disorders and attention-deficit/hyperactivity disorder distinct disorders? *Brain Dev.* 28, 371-374.
4. Nijmeijer, J. S., rias-Vasquez, A., Rommelse, N. N., Altink, M. E., Anney, R. J., Asherson, P., Banaschewski, T., Buschgens, C. J., Fliers, E. A., Gill, M., Minderaa, R. B., Poustka, L., Sergeant, J. A., Buitelaar, J. K., Franke, B., Ebstein, R. P., Miranda, A., Mulas, F., Oades, R. D., Roeyers, H., Rothenberger, A., Sonuga-Barke, E. J., Steinhausen, H. C., Faraone, S. V., Hartman, C. A. & Hoekstra, P. J. (2010). Identifying Loci for the Overlap Between Attention-Deficit/Hyperactivity Disorder and Autism Spectrum Disorder Using a Genome-wide QTL Linkage Approach. *J Am Acad Child Adolesc Psychiatry* 49, 675-685.
5. Reiersen, A. M., Constantino, J. N., Volk, H. E. & Todd, R. D. (2007). Autistic traits in a population-based ADHD twin sample. *J. Child Psychol. Psychiatry* 48, 464-472.
6. Ronald, A., Edelson, L. R., Asherson, P. & Saudino, K. J. (2010). Exploring the relationship between autistic-like traits and ADHD behaviors in early childhood: findings from a community twin study of 2-year-olds. *J Abnorm. Child Psychol.* 38, 185-196.
7. Simonoff, E., Pickles, A., Charman, T., Chandler, S., Loucas, T. & Baird, G. (2008). Psychiatric disorders in children with autism spectrum disorders: prevalence, comorbidity, and associated factors in a population-derived sample. *J. Am. Acad. Child Adolesc. Psychiatry* 47, 921-929.
8. Constantino, J. N. & Todd, R. D. (2005). Intergenerational transmission of subthreshold autistic traits in the general population. *Biol. Psychiatry* 57, 655-660.
9. Levy, F., Hay, D. A., McStephen, M., Wood, C. & Waldman, I. (1997). Attention-deficit hyperactivity disorder: a category or a continuum? Genetic analysis of a large-scale twin study. *J. Am. Acad. Child Adolesc. Psychiatry* 36, 737-744.
10. Stilp, R. L. H., Gernsbacher, M. A., Schweigert, E. K., Arneson, C. L. & Goldsmith, H. H. (2010). Genetic Variance for autism screening items in an unselected sample of toddler-age twins. *J Am Acad Child Adolesc Psychiatry* 49, 267-276.



11. Losh, M., Adolphs, R., Poe, M. D., Couture, S., Penn, D., Baranek, G. T. & Piven, J. (2009). Neuropsychological profile of autism and the broad autism phenotype. *Arch. Gen. Psychiatry* 66, 518-526.
12. Thapar, A., Harrington, R. & McGuffin, P. (2001). Examining the comorbidity of ADHD-related behaviours and conduct problems using a twin study design. *Br. J. Psychiatry* 179, 224-229.
13. Hartman, C.A., Brunnekreef, J.A., De Sonneville, L.M.J., Buitelaar, J.K., Ormel, J., Minderaa, R.B., Hoekstra, P.J., Althaus, M. (2011). Deficient cognitive processing in children with autism spectrum problems from the general population. The TRAILS study. Submitted.
14. Piven, J. (2002). Genetics of Personality: The Example of the Broad Autism Phenotype. In *Molecular Genetics and the Human Personality*, (ed. J. Benjamin, R. P. Ebstein and R. H. Belmaker), pp. 43-62. American Psychiatric Publishing: Washington, D.C.
15. Rogers, S. J. & Vismara, L. A. (2008). Evidence-based comprehensive treatments for early autism. *Journal of Clinical Child and Adolescent Psychology* 37, 8-38.
16. Salmeron, P. A. (2009). Childhood and adolescent attention-deficit hyperactivity disorder: Diagnosis, clinical practice guidelines, and social implications. *Journal of the American Academy of Nurse Practitioners* 21, 488-497.
17. Yirmiya, N. & Charman, T. (2010). The prodrome of autism: early behavioral and biological signs, regression, peri- and post-natal development and genetics. *J Child Psychol. Psychiatry* 51, 432-458.
18. Zwaigenbaum, L., Bryson, S., Lord, C., Rogers, S., Carter, A., Carver, L., Chawarska, K., Constantino, J., Dawson, G., Dobkins, K., Fein, D., Iverson, J., Klin, A., Landa, R., Messinger, D., Ozonoff, S., Sigman, M., Stone, W., Tager-Flusberg, H. & Yirmiya, N. (2009). Clinical assessment and management of toddlers with suspected autism spectrum disorder: insights from studies of high-risk infants. *Pediatrics* 123, 1383-1391.
19. Arnoudse-Moens, C. S., Weisglas-Kuperus, N., van Goudoever, J. B. & Oosterlaan, J. (2009). Meta-analysis of neurobehavioral outcomes in very preterm and/or very low birth weight children. *Pediatrics* 124, 717-728.
20. Courchesne, E. (2004). Brain development in autism: early overgrowth followed by premature arrest of growth. *Ment. Retard. Dev. Disabil. Res. Rev.* 10, 106-111.
21. Kolevzon, A., Gross, R. & Reichenberg, A. (2007). Prenatal and perinatal risk factors for autism: a review and integration of findings. *Arch. Pediatr. Adolesc. Med.* 161, 326-333.
22. Mouridsen, S. E., Rich, B. & Isager, T. (2008). Body mass index in male and female children with pervasive developmental disorders. *Pediatr. Int.* 50, 569-571.
23. Ploeger, A., Raijmakers, M. E., van der Maas, H. L. & Galis, F. (2010). The association between autism and errors in early embryogenesis: what is the causal mechanism? *Biol. Psychiatry* 67, 602-607.
24. Schendel, D. E., Autry, A., Wines, R. & Moore, C. (2009). The co-occurrence of autism and birth defects: prevalence and risk in a population-based cohort. *Dev. Med. Child Neurol.*
25. Smidts, D. P. & Oosterlaan, J. (2007). How common are symptoms of ADHD in typically developing preschoolers? A study on prevalence rates and prenatal/demographic risk factors. *Cortex* 43, 710-717.

26. Hartley, S. L., Sikora, D. M. & McCoy, R. (2008). Prevalence and risk factors of maladaptive behaviour in young children with Autistic Disorder. *J. Intellect. Disabil. Res.* 52, 819-829.
27. Hirshfeld-Becker, D. R., Biederman, J., Faraone, S. V., Violette, H., Wrightsman, J. & Rosenbaum, J. F. (2002). Temperamental correlates of disruptive behavior disorders in young children: preliminary findings. *Biol. Psychiatry* 51, 563-574.
28. Loe, I. M. & Feldman, H. M. (2007). Academic and educational outcomes of children with ADHD. *J. Pediatr. Psychol.* 32, 643-654.
29. Ozonoff, S., Iosif, A., Baguio, F., Cook, I. C., Hill, M. M., Hutman, T., Rogers, S. J., Rozga, A. & Sangha, S. (2010). A prospective study of the emergence of early behavioral signs of autism. *J Am Acad Child Adolesc Psychiatry* 49, 256-266.
30. Zwaigenbaum, L., Bryson, S., Rogers, T., Roberts, W., Brian, J. & Szatmari, P. (2005). Behavioral manifestations of autism in the first year of life. *Int. J. Dev. Neurosci.* 23, 143-152.
31. Hagberg, B. S., Miniscalco, C. & Gillberg, C. (2010). Clinic attenders with autism or attention-deficit/hyperactivity disorder: cognitive profile at school age and its relationship to preschool indicators of language delay. *Res. Dev. Disabil.* 31, 1-8.
32. Landa, R. & Garrett-Mayer, E. (2006). Development in infants with autism spectrum disorders: a prospective study. *J. Child Psychol. Psychiatry* 47, 629-638.
33. Loe, I. M., Balestrino, M. D., Phelps, R. A., Kurs-Lasky, M., Chaves-Gnecco, D., Paradise, J. L. & Feldman, H. M. (2008). Early histories of school-aged children with attention-deficit/hyperactivity disorder. *Child Dev.* 79, 1853-1868.
34. Goodlin-Jones, B. L., Tang, K., Liu, J. & Anders, T. F. (2008). Sleep patterns in preschool-age children with autism, developmental delay, and typical development. *J. Am. Acad. Child Adolesc. Psychiatry* 47, 930-938.
35. Sung, V., Hiscock, H., Sciberras, E. & Efron, D. (2008). Sleep problems in children with attention-deficit/hyperactivity disorder: prevalence and the effect on the child and family. *Arch. Pediatr. Adolesc. Med.* 162, 336-342.
36. Werner, E. & Dawson, G. (2005). Validation of the phenomenon of autistic regression using home videotapes. *Arch. Gen. Psychiatry* 62, 889-895.
37. de Winter, A. F., Oldehinkel, A. J., Veenstra, R., Brunnekreef, J. A., Verhulst, F. C. & Ormel, J. (2005). Evaluation of non-response bias in mental health determinants and outcomes in a large sample of pre-adolescents. *Eur. J. Epidemiol.* 20, 173-181.
38. Huisman, M., Oldehinkel, A. J., de Winter, A. F., Minderaa, R. B., de, B. A., Huizink, A. C., Verhulst, F. C. & Ormel, J. (2008). Cohort profile: the Dutch 'Tracking Adolescents' Individual Lives' Survey; TRAILS. *Int. J. Epidemiol.* 37, 1227-1235.
39. Hartman, C. A., Luteijn, E., Serra, M. & Minderaa, R. (2006). Refinement of the Children's Social Behavior Questionnaire (CSBQ): an instrument that describes the diverse problems seen in milder forms of PDD. *J. Autism Dev. Disord.* 36, 325-342.
40. 't Hart-Kerkhoffs, L. A., Jansen, L. M., Doreleijers, T. A., Vermeiren, R., Minderaa, R. B. & Hartman, C. A. (2009). Autism Spectrum Disorder Symptoms in Juvenile Suspects of Sex Offenses. *Journal of Clinical Psychiatry* 70, 266-272.

41. Achenbach, T. M., Dumenci, L. & Rescorla, L. A. (2003). DSM-oriented and empirically based approaches to constructing scales from the same item pools. *J. Clin. Child Adolesc. Psychol.* 32, 328-340.
42. Cole, T. J., Bellizzi, M. C., Flegal, K. M. & Dietz, W. H. (2000). Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ* 320, 1240-1243.
43. Cole, T. J., Flegal, K. M., Nicholls, D. & Jackson, A. A. (2007). Body mass index cut offs to define thinness in children and adolescents: international survey. *BMJ* 335, 194.
44. Courchesne, E., Carper, R. & Akshoomoff, N. (2003). Evidence of brain overgrowth in the first year of life in autism. *JAMA* 290, 337-344.
45. Jacobusse, G., Van Buuren S. & Verkerk, P. H. (2006). An interval scale for development of children aged 0-2 years. *Stat. Med.* 25, 2272-2283.
46. Lara, C., Fayyad, J., de, G. R., Kessler, R. C., guilar-Gaxiola, S., Angermeyer, M., Demytteneare, K., de, G. G., Haro, J. M., Jin, R., Karam, E. G., Lepine, J. P., Mora, M. E., Ormel, J., Posada-Villa, J. & Sampson, N. (2009). Childhood predictors of adult attention-deficit/hyperactivity disorder: results from the World Health Organization World Mental Health Survey Initiative. *Biol. Psychiatry* 65, 46-54.
47. Burton, A. & Altman, D. G. (2004). Missing covariate data within cancer prognostic studies: a review of current reporting and proposed guidelines. *Br. J. Cancer* 91, 4-8.
48. Riley, R. D., Abrams, K. R., Sutton, A. J., Lambert, P. C., Jones, D. R., Heney, D. & Burchill, S. A. (2003). Reporting of prognostic markers: current problems and development of guidelines for evidence-based practice in the future. *Br. J. Cancer* 88, 1191-1198.
49. de Bildt, A., Sytema, S., Ketelaars, C., Kraijer, D., Volkmar, F. & Minderaa, R. (2003). Measuring pervasive developmental disorders in children and adolescents with mental retardation: a comparison of two screening instruments used in a study of the total mentally retarded population from a designated area. *J Autism Dev. Disord.* 33, 595-605.
50. Oeseburg, B., Groothoff, J. W., Dijkstra, G. J., Reijneveld, S. A. & Jansen, D. E. (2010). Pervasive developmental disorder behavior in adolescents with intellectual disability and co-occurring somatic chronic diseases. *Res. Dev. Disabil.* 31, 496-501.



Handwritten medical chart for a child's development, showing various clinical observations and a growth curve in the background.

| Zwangerschap en kraamperiode |  | Geboortegewicht |   | Ligging |        | Ligging |     |
|------------------------------|--|-----------------|---|---------|--------|---------|-----|
| partus                       |  | cm              | g | linker  | rechts | 100     | 110 |
| geboortelengte               |  |                 |   | linker  | rechts | 90      | 100 |
| neonatale periode            |  |                 |   | linker  | rechts | 80      | 90  |
| angeboren afwijkingen        |  |                 |   | linker  | rechts | 70      | 80  |
| los lopen                    |  |                 |   | linker  | rechts | 60      | 70  |
| zindelijkheid overdag        |  |                 |   | linker  | rechts | 50      | 60  |
| visus                        |  |                 |   | linker  | rechts | 40      | 50  |
| gehoor                       |  |                 |   | linker  | rechts | 30      | 40  |
| groei en ontwikkeling        |  |                 |   | linker  | rechts | 20      | 30  |
| pathologie                   |  |                 |   | linker  | rechts | 10      | 20  |
| psycho-sociaal functioneren  |  |                 |   | linker  | rechts | 0       | 10  |

Handwritten notes on the chart include:

- geboortegewicht 3.5 kg
- geboortelengte 48 cm
- neonatale periode
- angeboren afwijkingen
- los lopen
- zindelijkheid overdag
- visus
- gehoor
- groei en ontwikkeling
- pathologie
- psycho-sociaal functioneren
- datum
- ziekten, operaties, ongevallen

The background features a growth curve with a vertical axis labeled 'gewicht' (weight) ranging from 40 to 110. The chart is a grid with columns for different clinical domains and rows for specific observations.

# 5

## **Preventive child healthcare findings on early childhood predict peer-group social status in preadolescence**

M. Jaspers  
A. F. de Winter  
R. Veenstra  
J. Ormel  
F. C. Verhulst  
S. A. Reijneveld

*Submitted*

## Abstract

### *Purpose*

A disputed social status among peers puts children and adolescents at risk for developing a wide range of problems such as being bullied. However, there is a lack of knowledge about which early predictors could be used to identify (young) adolescents at risk for a disputed social status. The aim of this study is to assess whether preventive child health care (PCH) findings on early childhood predict neglected and rejected status in preadolescence in a large longitudinal community-based sample.

### *Methods*

Data came from 898 participants who participate in TRacking Adolescents' Individual Lives Survey (TRAILS), a longitudinal study. Information on early childhood factors was extracted from the charts of routine PCH visits registered between infancy and age four. To assess social status, peer nominations were used at age 10-12.

### *Results*

Multinomial logistic regression showed that children who had a low birth weight, motor problems, sleep problems, and that children from parents with a low educational level (odds ratios (OR) between 1.71 and 2.90) and with less attention hyperactivity problems (ORs 0.43) were more likely to have a neglected status in preadolescence. Boys, children from parents with a low educational level, and children with early externalizing problems were more likely to have a rejected status in preadolescence (ORs between 1.69 and 2.56).

### *Conclusions*

PCH findings on early childhood – on motor and social development – are predictive of a neglected and rejected status in preadolescence. PCH is a good setting to monitor social status of young adolescents.

## Introduction

Having a disputed social status among peers puts children at risk for a wide range of subsequent problems including being bullied,<sup>1-3</sup> mental health problems,<sup>4-7</sup> academic difficulties, or school dropout.<sup>5,6,8,9</sup> As for disputed social status, usually two types are distinguished: rejected and neglected children.<sup>10,11</sup> Both groups score low on peer acceptance. The difference between the two groups is their level of peer rejection. Rejected children are disliked by their peers. Neglected children score low on peer rejection; they are scarcely noticed by their peers. Given the negative consequences of having a neglected or rejected status, it is important to identify which factors precede this disputed social status.

It has been shown that sociodemographic and psychological factors can predict a neglected and rejected status. Evidence shows that belonging to a family with a low socioeconomic status is predictive for a disputed social status.<sup>12,13</sup> Being aggressive,<sup>13,14</sup> hyperactive, less social, and having a poorer academic performance in elementary school are also predictors.<sup>12,13</sup> Other studies focused on the impact of early temperament on a disputed social status in kindergarten and early elementary school.<sup>15-17</sup> Less is known about the potential role of developmental delays such as motor or language problems.<sup>18</sup> Determinants of developmental delay such as a low birth weight may also be associated with a disputed social status; so far, however, no studies have looked into this. Evidence on the joint effect of early risk factors for a disputed social status is limited. The above-mentioned early risk factors are factors that are distinctive and noticed by the social environment, especially among peers.

Identification of children and adolescents at risk for a disputed social status could lead to earlier interventions designed to improve social skills, social acceptance, and self-esteem, and to prevent the negative outcomes associated with having a neglected or rejected status. This can be achieved by measuring a range of potential risk factors from multiple domains and by starting before peer relationships are well established. These factors are routinely assessed in preventive child healthcare (PCH) during well-child visits.

The aim of the present study is to assess whether PCH findings on early childhood predict social status in preadolescence in a large longitudinal community-based sample. This study is the first to use a wide range of early childhood factors found in routine PCH measurements to predict neglect and rejection by peers in such a sample. In the Netherlands, PCH provides health and developmental monitoring to all Dutch children from birth until age 19, and the participation rate is over 90%.<sup>19</sup> Dutch PCH professionals are highly trained and experienced in registering those child and family characteristics that are relevant for current and future development.



## Methods

### *Sample*

The TRacking Adolescents' Individual Lives Survey (TRAILS) is a prospective cohort study among Dutch adolescents beginning at 10-12 years of age that focuses on adolescent psychosocial development and mental health in the general population.<sup>20,21</sup> The TRAILS target sample was recruited in 2001 from elementary schools in five municipalities in the northern part of the Netherlands. Of all the young adolescents approached for enrolment in the study (n=3145), 6.7% were excluded because of mental or physical incapability, or if no Dutch-speaking parent or parent surrogate was available. Seventy-six percent of the remaining 2935 young adolescents (n=2230, mean age=11.1, SD=0.6, 50.8% girls) and their parents agreed to participate. For detailed descriptions of sample selection procedures and non-response analyses, see De Winter et al.<sup>21</sup>

The present study consists of a subsample of 898 of the 2230 TRAILS participants (mean age=11.0, SD=0.51), for whom both information on social status and PCH files were available. Information on social status was supplied by peers. These peer nominations, which were essential to our study, were only assessed in classrooms with at least 10 TRAILS participants. The subsample of 898 young adolescents differed from the other TRAILS participants mainly as to type of education; young adolescents in special education were not included. For a detailed description, see Veenstra et al.<sup>22</sup> All procedures were approved by the Dutch Central Committee on Research Involving Human Subjects ("CCMO").

### *Preventive child health care setting*

The aim of the PCH is prevention and early identification through a semi-structured interview with parents and standardized screening procedures, all of which are documented in the PCH file. An assessment generally takes 10 to 15 minutes. During children's first four years, community physicians and nurses record data on early childhood indicators at each visit as part of the routine procedure of the PCH, with a total number of 12 visits.

### *The outcome measurement: social status*

Social status was assessed with peer nominations at age 10-12. Young adolescents received a list of all classmates and were asked to answer the following questions: "Who do you like?" and "Who do you dislike?". Young adolescents could make an unlimited number of nominations. On the basis of the received like and dislike nominations, two sociometric variables were computed: social preference and social impact. Social preference was calculated by subtracting the standardized dislike score from the standardized like score. Social impact was calculated by adding the standardized like score and the standardized dislike score.<sup>6</sup> For this study, we focused on the adolescents that were classified as: (a) rejected – low on social preference (< -1 SD), and above average on (> 0 SD) dislike and

below average on ( $< 0$  SD) like; or (b) neglected – low on social impact ( $< -1$  SD) and below average on both dislike and like ( $< 0$  SD) versus the other young adolescents (i.e., popular, average, and controversial).<sup>6</sup> The controversial adolescents are included among the popular and average adolescents because they are liked and accepted by part of their group, and hence are not in the same disputed social position.

### *PCH-assessed early childhood indicators*

As potential indicators, we selected PCH-assessed prenatal and perinatal variables, as well as early motor and social development, and family characteristics.

#### Prenatal and perinatal variables

Maternal smoking and alcohol use were assessed as: “Did the mother smoke during pregnancy?” and “Did the mother use alcohol during pregnancy?” If these data were missing from the PCH file, then we imputed data from the T1 interview on this topic.

Low birth weight was defined as  $< 2500$  grams, which is a frequently used clinical cut-off point.<sup>23</sup> Birth defects included limb deformities and craniofacial malformations. Respondents received a “yes” if any of these were present and a “no” if none were present.

#### Early motor and social development

Early motor and social development, from birth to four years of age, was assessed by four indices. The first was the Van Wiechen Scheme, from age one month to 15 months, which is the Dutch equivalent of the Bayley scales.<sup>24</sup> Indicators were divided into three different subcategories, gross motor skills (16 items), fine motor skills and adaptation (11 items), and communication and social behavior (10 items), each targeted at children of a certain age. Items within these three subcategories were summed to provide subscales.

Second, the PCH professional assessed (also based on parental reports) motor and language development, six times from age 18 months to four years, and reported as either “yes” in case of a problem, or “no”. Motor and language skills were each added up, respectively, and then dichotomized to a “yes” if any problems were present during these six occasions, or to a “no”.

Third, from age 18 months to four years, the PCH professional assessed the development of sleeping and eating behavior six times. Descriptions of this behavior were categorized as “yes”, in case of problems, or “no”. The responses to this behavior were added up, and then dichotomized to a “yes”, if any problems were present, and a “no”, if none were present.

Fourth, PCH assessed a number of behavioral features which were recorded on six occasions between the ages of 18 months to four years. These behavioral features were collected from three open questions concerning playing, problem behavior, and social behavior, about which parents could provide one or more descriptions. Descriptions included, for example, overactive, shy, anxious, or aggressive.<sup>25</sup> PCH-registered descriptions

were categorized as externalizing problems, internalizing problems, attention hyperactivity problems, or social problems in behavior, and then dichotomized to a “yes” if any of these were present during these six occasions, and to a “no” if none were present.

### Family characteristics

Maternal age at the birth of the child (mean=29.4, SD=4.5 years) was dichotomized to contrast young mothers (age 20 and younger) with older mothers. We distinguished three groups for educational level of parents: low (at the lowest tracks of secondary education), middle (higher tracks of secondary education), and high (higher vocational or university degree) educational level, respectively. The highest level of education of one of the parents was taken as the educational level of the parents. Structural family characteristics consisted of two groups: living with both biological parents versus divorced parents, stepparent(s), or single-parent households.

### *Statistical analysis*

First, descriptive statistics were calculated for social status and early childhood indicators. Second, to assess the longitudinal relationship between early childhood indicators and current social status, multinomial logistic regression analysis was used. The multinomial logistic model (MNL) can be used to examine the effects of independent variables on multi-category dependent variables, referring in this case to neglected, rejected, and other young adolescents. With three outcomes, the MNL is roughly equivalent to running three binary logistic regressions. In the MNL, all of the logits are estimated simultaneously, which enforces the logical relationship among the parameters and uses the data more efficiently.<sup>26</sup> If the chi-square tests showed statistically significant ( $p < .05$ ) differences among the three groups, then we assessed the crude effect of each variable separately on the outcomes. Next, we assessed the multivariate (mutually adjusted) effects of all variables that attributed univariately with statistical significance ( $p < .05$ ).

## **Results**

Table 1 shows the differences between neglected, rejected, and other adolescents for PCH-registered prenatal and perinatal factors, early motor and social development factors, and family characteristics. Of the 898 adolescents, 13.8% were in the neglected group, and 12.1% were in the rejected group. In comparison with the other adolescents (i.e., average, controversial, and popular adolescents), during early childhood neglected adolescents more often had a low birth weight, motor problems, sleep problems, attention hyperactivity problems, and parents with a lower level of education ( $p < .10$ ). Adolescents in the rejected group were more often boys, had more communication delays (age 1-15 months), and showed more externalizing and attention hyperactivity problems. Furthermore, they had younger mothers, more often mothers who smoked during pregnancy, less often mothers

who used alcohol during pregnancy, parents with a lower level of education, and they came less often from intact families compared to the other adolescents (*P* values all below 0.10).

Table 2 gives multivariate odds ratios (and 95% confidence intervals) for PCH predictors for having a neglected or rejected status at age 11. A low birth weight, early motor problems, early sleep problems, having attention hyperactivity problems, and a low level of parental education were identified as significant independent predictors of a neglected status (ORs between 0.43 and 2.90) in the multinomial logistic regression model. Gender (being a boy) did not contribute to the model as an independent predictor. For a rejected status, being a boy, early externalizing problems, and a low level of parental education were predictors (ORs between 1.69 and 2.56). Maternal smoking and alcohol use during pregnancy, maternal age under 21 at the birth of the child, early communication delays, early attention hyperactivity problems, and family break-up did not significantly contribute to the model as independent predictors.

## Discussion

This study was the first to assess the effects of PCH findings on early childhood in terms of having a disputed social status later on in preadolescence, using a large longitudinal community-based sample. We identified several early childhood indicators that predicted neglect and rejection by peers. Children with a low birth weight, early motor problems, early sleep problems, and children with parents with a low educational level were more likely to have a neglected status; children with early attention hyperactivity problems were less likely to be so. Boys, children with parents with a low educational level, and children with externalizing problems in toddlerhood were more likely to have a rejected status in preadolescence.

Our study shows that PCH findings on sociodemographic, developmental, and psychological aspects are important for predicting a disputed social status in preadolescence. First, having parents with a low educational level is predictive for both being rejected and neglected, which is in line with previous studies which found that a low socioeconomic status of the family predicted rejection.<sup>13,27</sup> These previous studies did not provide information as to its association with a neglected status, however. Second, our study shows that a low parental educational level, a low birth weight, and early motor problems also independently predict a neglected status.

Third, we found in our study that toddlers who showed impulsive, hyperactive, and disruptive behavior had a lower chance of neglect later in life. Cross-sectional studies found that neglected children and adolescents were less aggressive and disruptive.<sup>11</sup> Because of their lack of social behavior, most likely they are less visible in groups, putting them at risk of being ignored by their peers. Surprisingly, having early attention hyperactivity problems is not predictive for a rejected status at age 11, whereas Brendgen and colleagues<sup>12</sup> found that

**Table 1.** Background and developmental features of preadolescents at age 10-12 by social status

| Variable  | Total<br>n (%) | Neglected<br>(13.8%) | Rejected<br>12.1% | Others<br>(74.1%) | p values |
|---|----------------|----------------------|-------------------|-------------------|----------|
| Gender (boy)  | 398 (44.3%)    | 34.7%                | 63.3%             | 43.0%             | ***      |
| <i>Prenatal and perinatal factors</i>               |                |                      |                   |                   |          |
| Maternal alcohol use during pregnancy               | 115 (13.0%)    | 9.9%                 | 5.6%              | 14.9%             | *        |
| Maternal smoking during pregnancy                   | 257 (28.9%)    | 29.3%                | 37.4%             | 27.5%             | *        |
| Low birth weight (< 2500 grams)                     | 39 (4.3%)      | 8.1%                 | 5.5%              | 3.5%              | *        |
| Born premature (<37 weeks)                          | 35 (3.9%)      | 5.6%                 | 4.6%              | 3.5%              |          |
| Birth defects                                       | 17 (1.9%)      | 0.8%                 | 3.7%              | 1.8%              |          |
| <i>Early motor and social development</i>           |                |                      |                   |                   |          |
| Gross motor skills delay (age 1-15 mos.)            | 158 (17.6%)    | 19.4%                | 12.0%             | 18.2%             |          |
| Fine motor skills delay (age 1-15 mos.)             | 60 (6.7%)      | 8.9%                 | 7.4%              | 6.2%              |          |
| Communication delay (age 1-15 mos.)                 | 50 (5.6%)      | 7.3%                 | 7.4%              | 5.0%              | *        |
| Motor problems (age 1.5 - 4 yrs.)                   | 30 (3.3%)      | 7.3%                 | 2.8%              | 2.7%              | *        |
| Language and speech problems (age 1.5 - 4 yrs.)     | 54 (6.0%)      | 7.3%                 | 8.3%              | 5.4%              |          |
| Sleep problems (age 1.5 - 4 yrs.)                   | 211 (23.5%)    | 31.5%                | 19.3%             | 22.7%             | *        |
| Problems with eating (age 1.5 - 4 yrs.)             | 451 (50.2%)    | 46.8%                | 48.6%             | 51.1%             |          |
| Externalizing problems (age 1.5 - 4 yrs.)           | 340 (37.9%)    | 34.7%                | 52.2%             | 35.9%             | **       |
| Internalizing problems (age 1.5 - 4 yrs.)           | 145 (16.1%)    | 22.6%                | 11.9%             | 15.6%             |          |
| Social problems in behavior (age 1.5 - 4 yrs.)      | 56 (6.2%)      | 4.0%                 | 6.4%              | 6.6%              |          |
| Attention hyperactivity problems (age 1.5 - 4 yrs.) | 324 (36.1%)    | 21.8%                | 48.6%             | 36.7%             | ***      |
| <i>Family characteristics</i>                       |                |                      |                   |                   |          |
| Low educational level of parents                    | 198 (22.0%)    | 28.7%                | 32.7%             | 19.5 %            | *        |
| Structural family characteristics                   | 167 (18.6%)    | 15.3%                | 26.6%             | 17.9%             | *        |
| Mother under age 21 at birth child                  | 28 (3.1%)      | 5.0%                 | 6.9%              | 2.3%              | *        |

n= 898, \*\*\* p<.001, \*\* p<.01, \* p<.10 (two-tailed) chi-square tests

**Table 2.** Univariate and multivariate multinomial logistic regression on social status for preadolescents at age 10-12: Odds ratios, OR (and 95% confidence intervals, CI)

| Variable  | Neglected<br>(13.8%)    |                         | Rejected<br>(12.1%)     |                         | Others<br>(74.1%) |
|---|-------------------------|-------------------------|-------------------------|-------------------------|-------------------|
|   | OR (crude)<br>95% CI    | OR (adj*)<br>95% CI     | OR (crude)<br>95% CI    | OR (adj*)<br>95% CI     |                   |
| Gender (boy)  | 0.70 (0.47-1.05)        | 0.80 (0.53-1.21)        | <b>2.29 (1.50-3.47)</b> | <b>2.05 (1.32-3.17)</b> | 1                 |
| Maternal alcohol use during pregnancy               | 0.56 (0.29-1.08)        | -                       | <b>0.34 (0.14-0.79)</b> | -                       | 1                 |
| Maternal smoking during pregnancy                   | 1.09 (0.72-1.67)        | -                       | <b>1.58 (1.03-2.42)</b> | -                       | 1                 |
| Low birth weight (< 2500 grams)                     | <b>2.45 (1.14-5.28)</b> | <b>2.59 (1.16-5.75)</b> | 1.63 (0.65-4.09)        | 1.83 (0.66-5.06)        | 1                 |
| Communication delay (age 1-15 mos.)                 | 1.50 (0.70-3.22)        | -                       | 1.53 (0.69-3.41)        | -                       | 1                 |
| Motor problems (age 1.5 - 4 yrs.)                   | <b>2.81 (1.23-6.42)</b> | <b>2.90 (1.24-6.77)</b> | 1.02 (0.30-3.51)        | 1.19 (0.33-4.23)        | 1                 |
| Sleep problems (age 1.5 - 4 yrs.)                   | <b>1.56 (1.03-2.39)</b> | <b>1.71 (1.09-2.68)</b> | 0.81 (0.49-1.35)        | 0.67 (0.39-1.15)        | 1                 |
| Attention hyperactivity problems (age 1.5 - 4 yrs.) | <b>0.48 (0.31-0.76)</b> | <b>0.43 (0.26-0.69)</b> | <b>1.63 (1.09-2.45)</b> | 1.43 (0.93-2.20)        | 1                 |
| Externalizing problems (age 1.5 - 4 yrs.)           | 0.95 (0.63-1.42)        | 0.95 (0.62-1.45)        | <b>2.03 (1.35-3.05)</b> | <b>1.69 (1.10-2.62)</b> | 1                 |
| Low educational level of parents                    | <b>1.99 (1.19-3.33)</b> | <b>2.14 (1.26-3.62)</b> | <b>2.71 (1.55-4.73)</b> | <b>2.56 (1.45-4.52)</b> | 1                 |
| Structural family characteristics                   | 0.83 (0.49-1.41)        | -                       | <b>1.66 (1.04-2.66)</b> | -                       | 1                 |
| Mother under age 21 at birth child                  | 2.22 (0.85-5.85)        | -                       | <b>3.12 (1.24-7.85)</b> | -                       | 1                 |

\* adj = adjusted for all other variables which are included in the multivariate model

children with a disputed social status were more hyperactive from kindergarten through age 12.

Furthermore, PCH-identified early internalizing problems were not predictive of either social status, not even in our univariate analyses. This is surprising given that many studies have shown that socially withdrawn children are often rejected by their peers.<sup>28</sup> Either poor early identification of internalizing problems<sup>29</sup> or discontinuity in this type of problem might explain this; further research on this is needed.

### *Strengths and limitations*

The strengths of this study lie in its large sample and its embedding in routine PCH, a program that reaches over 90% of the total Dutch population. Moreover, we made use of data registered during the routine health and developmental monitoring that is offered to all Dutch children, and which is collected and registered according to a highly standardized format.

Some limitations should be taken into account when interpreting the findings. First, peer information was only available for a subset of the TRAILS population; adolescents in special education were not included in the subset, and in our subsample behavioral problems occurred less frequently than in the remaining group. However, it may be inferred that the predictive power of early PCH findings for this group is even better. Second, children may have received effective treatment for their developmental and behavioral problems between the ages of 4 and 11, leading to an underestimation of the predictive power of PCH findings. A related issue is that some highly predictive risk factors may not have been included in our models because, due to their low prevalence, they did not show multivariate or other effects. This may, for instance, be the case for birth defects. Finally, there might be some information bias, for example, regarding alcohol use. PCH risk factors were assessed in the early 1990s and the validity of these risk factors is high. However, regarding alcohol use during pregnancy, at the time clear guidelines did not yet exist about drinking alcohol during pregnancy.<sup>30</sup>

### *Implications*

We are the first to study multiple early childhood predictors – from PCH files – of neglected and rejected young adolescents who were assessed with peer nominations, in a longitudinal design. PCH professionals could closely monitor children and adolescents identified in such a way, and provide early counseling or treatment if needed. There are several effective interventions for acquiring better social skills, and building friendships and self-esteem.<sup>31-33</sup> As our study is the first of its kind, our results are in need of replication by other studies, with larger sample sizes and including the possibility of examining gender differences.

Findings from PCH professionals on early childhood development and social behavior are predictive for a neglected and rejected status in preadolescence from the general population. PCH is a good setting to monitor the social status of children and adolescents.

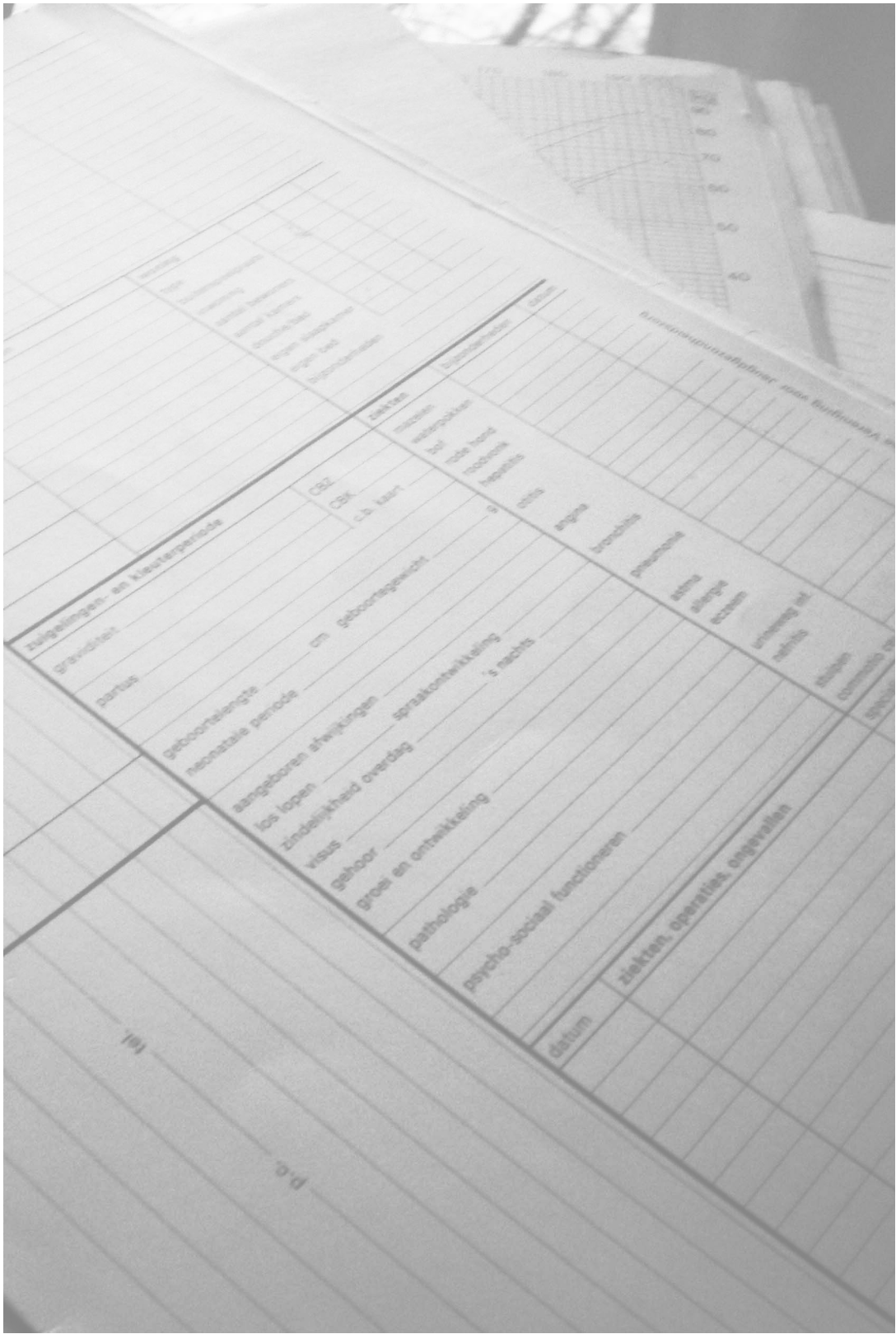
## References

1. Juvonen J, Graham S, Schuster MA, Bullying among young adolescents: The strong, the weak, and the troubled. *Pediatr.* 2003; 112(6):1231-1237.
2. Scholte RHJ, Engels RCME, Overbeek G, et al., Stability in bullying and victimization and its association with social adjustment in childhood and adolescence. *J Abnorm Child Psychol.* 2007; 35(2):217-228.
3. Wolke D, Woods S, Bloomfield L, et al., Bullying involvement in primary school and common health problems. *Arch Dis Childh.* 2001; 85(3):197-201.
4. Almquist Y, Peer status in school and adult disease risk: a 30-year follow-up study of disease-specific morbidity in a Stockholm cohort. *J Epidemiol Com Health.* 2009; 63(12):1028-1034.
5. Rubin KH, Bukowski WM, Parker J, Peer interactions, relationships, and groups. In: Damon W, Lerner R, eds. *Handbook of child psychology.* Hoboken NY: Wiley, 2006: 571-645.
6. Kupersmidt JB, Coie JD, Preadolescent peer status, aggression, and school adjustment as predictors of externalizing problems in adolescence. *Child Dev.* 1990; 61(5):1350-1362.
7. Oldehinkel AJ, Rosmalen JGM, Veenstra R, et al., Being admired or being liked: Classroom social status and depressive problems in early adolescent girls and boys. *J Abnorm Child Psychol.* 2007; 35(3):417-427.
8. Zettergren P, School adjustment in adolescence for previously rejected, average and popular children. *Brit J Educ Psychol.* 2003; 73:207-221.
9. Buhs ES, Ladd GW, Peer rejection as an antecedent of young children's school adjustment: An examination of mediating processes. *Dev Psychol.* 2001; 37(4):550-560.
10. Coie JD, Coppotelli H, Dodge KA, Dimensions and Types of Social-Status - A Cross-Age Perspective. *Dev Psychol.* 1982; 18(4):557-570.
11. Newcomb AF, Bukowski WM, Pattee L, Childrens Peer Relations - A Metaanalytic Review of Popular, Rejected, Neglected, Controversial, and Average Sociometric Status. *Psychol Bull.* 1993; 113(1):99-128.
12. Brendgen M, Vitaro F, Bukowski WM, et al., Developmental profiles of peer social preference over the course of elementary school: Associations with trajectories of externalizing and internalizing behavior. *Dev Psychol.* 2001; 37(3):308-320.
13. Pettit GS, Clawson MA, Dodge KA, et al., Stability and change in peer-rejected status: The role of child behavior, parenting, and family ecology. *Merrill-Palmer Quarterly-Journal of Developmental Psychology.* 1996; 42(2):267-294.
14. Lansford JE, Killeya-Jones LA, Miller S, et al., Early Adolescents' Social Standing in Peer Groups: Behavioral Correlates of Stability and Change. *J Youth Adolesc.* 2009; 38(8):1084-1095.



15. Hart CH, Yang CM, Nelson LJ, et al., Peer acceptance in early childhood and subtypes of socially withdrawn behaviour in China, Russia, and the United States. *Inter J Behav Dev.* 2000; 24(1):73-81.
16. Rubin KH, Burgess KB, Dwyer KM, et al., Predicting preschoolers' externalizing behaviors from toddler temperament, conflict, and maternal negativity. *Dev Psychol.* 2003; 39(1):164-176.
17. Gazelle H, Ladd GW, Anxious solitude and peer exclusion: A diathesis-stress model of internalizing trajectories in childhood. *Child Dev.* 2003; 74(1):257-278.
18. Kanioglou A, Tsoarbatzoudis H, Barkoukis V, Socialization and behavioral problems of elementary school pupils with developmental coordination disorder. *Percept Motor Skills.* 2005; 101(1):163-173.
19. Brugman E, Reijneveld SA, Verhulst FC, et al., Identification and management of psychosocial problems by preventive child health care. *Arch Pediatr Adolesc Med.* 2001; 155(4):462-469.
20. Huisman M, Oldehinkel AJ, de Winter AF, et al., Cohort profile: the Dutch 'Tracking Adolescents' Individual Lives' Survey'; TRAILS. *Int J Epidemiol.* 2008; 37(6):1227-1235.
21. de Winter AF, Oldehinkel AJ, Veenstra R, et al., Evaluation of non-response bias in mental health determinants and outcomes in a large sample of pre-adolescents. *Eur J Epidemiol.* 2005; 20(2):173-181.
22. Veenstra R, Lindenberg S, Oldehinkel AJ, et al., Bullying and victimization in elementary schools: A comparison of bullies, victims, bully/victims, and uninvolved preadolescents. *Dev Psychol.* 2005; 41(4):672-682.
23. Kohn MA, Vosti CL, Lezotte D, et al., Optimal gestational age and birth-weight cutoffs to predict neonatal morbidity. *Med Decis Making.* 2000; 20(4):369-376.
24. Jacobusse G, Van Buuren S., Verkerk PH, An interval scale for development of children aged 0-2 years. *Stat Med.* 2006; 25(13):2272-2283.
25. Jaspers M, de Winter AF, de Meer G, et al., Early Findings of Preventive Child Healthcare Professionals Predict Psychosocial Problems in Preadolescence: The TRAILS Study. *J Pediatr.* 2010; 157(2):316-321.
26. Long J, Regression models for categorical and limited dependent variables. Thousand Oaks: Sage, 1997.
27. Patterson CJ, Kupersmidt JB, Vaden NA, Income level, gender, ethnicity, and household composition as predictors of children's school-based competence. *Child Dev.* 1990; 61(2):485-494.
28. Saigal S, Doyle LW, An overview of mortality and sequelae of preterm birth from infancy to adulthood. *Lancet.* 2008; 371(9608):261-269.
29. Rubin KH, Bowker J, Kennedy A, Avoiding and withdrawing from the peer group. In: Rubin K, Bukowski W, Laursen B, eds. *Handbook of peer interactions, relationships, and groups.* New York: Guilford, 2009: 303-321.
30. Reijneveld SA, Brugman E, Verhulst FC, et al., Identification and management of psychosocial problems among toddlers in Dutch preventive child health care. *Arch Pediatr Adolesc Med.* 2004; 158(8):811-817.

31. Verkerk PH, Alcohol, pregnancy and child development. Ridderkerk: Ridderprint, 1996.
32. DeRosier ME, Marcus SR, Building friendships and combating bullying: Effectiveness of SSGRIN at one-year follow-up. *J Clin Child Adolesc Psychol.* 2005; 34(1):140-150.
33. Greco LA, Morris TL, Treating childhood shyness and related behavior: Empirically evaluated approaches to promote positive social interactions. *Clinic Child Fam Psychol Rev.* 2001; 4(4):299-318.
34. Kingery JN, Erdley CA, Marshall KC, et al., Peer Experiences of Anxious and Socially Withdrawn Youth: An Integrative Review of the Developmental and Clinical Literature. *Clinic Child Fam Psychol Rev.* 2010; 13(1):91-128.



# 6

## **Validity of parental recall on pregnancy, birth and early childhood behavior**

M. Jaspers  
G. de Meer  
F. Verhulst  
J. Ormel  
S. A. Reijneveld

*Journal of Clinical Epidemiology 2010;63(2):185-191.*

## Abstract

### *Objective*

Evidence on the validity of parental recall of early childhood behavior is lacking. Our aim was to examine the validity of parental recall at child age 10-12 for maternal lifestyle during pregnancy, birth characteristics and early childhood behavior.

### *Study Design and Setting*

The study population comprised 2230 children and their parents. Children were recruited from elementary schools at 10-12 years of age (response: 76.0%). Parents were asked to recall lifestyle during pregnancy, birth characteristics, and childhood behavior at age 4-6. Recalled data were compared with information registered by Preventive Child Healthcare (PCH) from birth onwards.

### *Results*

For birth weight and gestational age, we found no systematic difference between recalled and PCH-registered data; 95% limits of agreement were  $\pm 1.2$  pounds (600 grams) and  $\pm 2.4$  weeks respectively. For maternal alcohol use during pregnancy and early childhood behavior problems, Cohen's kappas were low (0.03-0.11). Compared to PCH registration, parents tended to overreport at age 10-12. In contrast, kappa was high for maternal smoking during pregnancy (kappa: 0.77).

### *Conclusion*

Retrospectively collected information on lifestyle during pregnancy, birth and early childhood behavior is biased, which limits its value in estimating the contribution of early life adversity to health in later life.

## Introduction

The period from conception until school age is considered to be extremely important for children's socio-emotional development.<sup>1-3</sup> It can be a 'window of opportunity'<sup>4</sup> and a 'window of vulnerability', depending on the outcome, and it can offer great opportunities to improve further life by reducing adverse environmental factors and/or empowering positive factors.

Early life factors that are associated with future mental and physical health of the child concern either pregnancy, birth or early childhood.<sup>5-14</sup> Pregnancy factors are for example maternal smoking, alcohol use, drug abuse, medication and disease during pregnancy. These have been shown to be risk factors for the development of psychopathology,<sup>5,7-9,11</sup> growth retardation, respiratory problems, cardiovascular disease and other health problems.<sup>6,13</sup> Similarly, birth factors such as low birth weight and premature birth can lead to a number of health problems.<sup>8,13</sup> Early childhood factors are for example toddler sleep problems,<sup>10,14</sup> early eating problems<sup>15,16</sup> and preschool problems with social behavior,<sup>2</sup> which are predictors for later mental health problems.

Ideally, the effects of early life factors should be studied in follow-up studies in which information on these early life factors is collected from various sources (e.g. parents and professional assessment) in the period from conception to school age, follow-up extends to adolescent or even adult age, and attrition and loss-to-follow-up rates are low. However, most studies rely on retrospective data collection, which may introduce information bias. This may concern recall bias due to differences in validity of subject recall, marked by an over- or underreport of information. Or it may for instance be rumination bias, which occurs when people with a disease tend to think harder about their prior exposures than healthy people, causing them to systematically remember exposure differently.<sup>17</sup> This distorts the measurement of the association between exposure and disease. The magnitude and direction of this distortion are difficult to predict.

Many previous studies on early risk factors for adverse future mental health relied on retrospectively collected data and included a limited number of risk factors. The validity of data collected retrospectively needs to be examined before using them to estimate relationships with health or developmental outcomes. Regarding early life factors, previous studies found good recall for maternal smoking during pregnancy,<sup>18-20</sup> for gestational age<sup>20-22</sup> and for birth weight,<sup>19,20,23-26</sup> but not for alcohol use during pregnancy.<sup>18,19</sup> However, most of these studies covered a limited period of time and did not consider a combination of variables. So far, no studies are available on the validity of parental recall of early childhood behavior and neither of pre- and perinatal factors.

The aim of the current study is to examine the validity and precision of recall of maternal lifestyle during pregnancy, birth characteristics and early childhood behavior in a community based sample. For this purpose we compared data on prenatal and early life characteristics

collected at child age 10-12 with data registered by Preventive Child Healthcare (PCH) from birth onwards.

## Methods

### *Study population and procedure*

The TRacking Adolescents' Individual Lives Survey (TRAILS) is a prospective cohort study among Dutch 10-12 year old children aiming at adolescent psychosocial development and mental health. The TRAILS target sample was recruited in 2001 from elementary schools in five municipalities in the northern part of the Netherlands.<sup>27,28</sup> Of all children approached for enrolment in the study (n=3145) 6.7% were excluded because of mental or physical incapacities or language problems. Of the remaining 2935 children, 76.0% (n=2230, mean age=11.09, SD=0.56, 50.8% girls) both child and parent agreed to participate. Responders and non-responders did not differ with respect to the prevalence of teacher-rated problem behavior nor regarding associations between socio-demographic variables and mental health outcomes.<sup>27</sup> Data collection occurred by parent completed questionnaire and a home-visit by trained interviewers. Furthermore, participants were asked for permission to retrieve the child's file from Preventive Child Healthcare (PCH). The PCH provides health and developmental monitoring to all Dutch children from birth until age 19, and participation rate is over 90%.<sup>29,30</sup>

For the current analyses, we used data from the PCH files on maternal lifestyle during pregnancy, birth characteristics and early childhood behavior, and data from the first wave of TRAILS when the child was 10-12 years of age. Data of TRAILS wave 1 were collected by well-trained interviewers during a home-visit, including parent completed questionnaires that comprised the Child Behavior Checklist (CBCL) and sociodemographic variables. Since surveillance protocols differed between the three participating PCH services, numbers for included variables differ considerably.

### *Maternal lifestyle during pregnancy*

Maternal lifestyle during pregnancy concerned smoking and alcohol use. In TRAILS, these were asked for by the following questions: "How much did the mother smoke during pregnancy?" and "How much alcohol did the mother drink during pregnancy?" The answer categories comprised five categories varying from "never" to "more than two packs of cigarettes a day" for smoking, and from "never" to "more than 20 glasses per week" for alcohol use. For the current analyses we compared "never" to the other categories combined (i.e. "ever") for smoking or alcohol use. In the PCH files smoking and alcohol use were assessed as: "Did the mother smoke during pregnancy?" and "Did the mother use alcohol during pregnancy?", respectively, similarly dichotomized as ever/never.

### *Birth characteristics*

Birth characteristics concerned gestational age and birth weight. In TRAILS these were asked by the following questions: "How much did the child weigh at birth?", and "How many weeks did the pregnancy last?", in pounds (500 grams) and weeks, respectively, which present common measures of birth weight and gestational age in the Netherlands. In the PCH files, these data were registered in grams and days, respectively, as provided by the obstetrician or midwife. Aiming at a similar precision of TRAILS and PCH data, PCH data on birth weight were transformed to pounds (500 grams), and those on gestational age were converted to completed weeks.

### *Early childhood behavior*

Early childhood behavior concerned 'sleeping problems', 'eating problems', and 'social behavior problems' at age 4-6. In the TRAILS data collection, parents filled out a questionnaire on the child's behavior when it was in kindergarten (age 4-6). Sleeping and eating problems were considered to have occurred if parents gave a confirmative answer on the following questions: "Didn't ... (name child) want to eat?"; "Did ... (name child) have problems falling asleep?"; "Did ... (name child) have problems sleeping through the night?" Social behavior problems were assessed by the following questions: "In comparison with other children:" "was your child quickly anxious?"; "was your child shy?"; "was your child quick tempered?". Answering categories concerned a 5-point Likert scale (from "much more" to "much less"), and problems were considered to have occurred if parents reported "more" or "much more".

In the PCH files, 'sleeping or eating problems' were assessed by the following predefined questions: "Does the child have any problems eating?", and "Does the child have any sleeping problems?". 'Social behavior problems' was measured based on the information that the PCH professional registered at the following predefined items in the records 'how is the child's behavior?', 'social behavior?', and 'psychosocial functioning?'. For each, the following descriptions could be used: 'quick tempered', 'shy', 'anxious' or 'no problem', the latter being contrasted to the other categories. A social behavior problem was considered to be present only if any of these three items was filled out affirmatively.

### *Child Behavior Checklist*

Behavioral and emotional problems at age 10-12 were assessed by the parent completed Child Behavior Checklist (CBCL) for ages 4-18, an internationally validated questionnaire for child emotional and behavioral problems.<sup>31,32</sup> In the current study we used the Total Problems Score and two broadband scales, Externalizing and Internalizing Problems. The Total Problems score is the sum of all individual item scores (118 items). Internalizing Problems consists of the Anxious/Depressed, the Somatic Complaints and the Withdrawn/Depressed syndrome scales. Externalizing Problems consists of the Aggressive Behavior and Delinquent



Behavior syndrome scales. Cases were allocated to a normal range or a clinical (elevated) range, using the age and gender-specific 90th percentiles of the Dutch normative sample for the scales concerned as cut-off.<sup>32</sup>

### *Statistical analysis*

Statistical analyses were performed using SPSS version 12. For continuous variables, i.e. gestational age and birth weight, the agreement of values from the two sources (PCH registration and TRAILS parental recall) was estimated using the stepwise method described by Bland and Altman.<sup>33,34</sup> First, we evaluated the data for systematic differences between PCH-registered and recalled values. Using a paired t-test, we tested if the mean differences between the two birth weights (PCH-registered versus TRAILS recalled) deviated from 0, to test for systematic deviation. Subsequently, the difference between PCH-registered and recalled values were plotted against their mean value to evaluate a potential relationship of deviation with mean scores. After exclusion of systematic differences, 95% limits of agreement were calculated as the mean differences  $\pm$  2 SD, which mark the precision of the association between the two measures, i.e. random deviation.

Cohen's kappa (agreement adjusted for chance agreement) values were calculated as a measure of concordance between registered (PCH) and recalled (TRAILS) dichotomous variables, i.e. maternal lifestyle during pregnancy and early childhood behavior. Cohen's kappas between 0.40 and 0.75 were considered as moderate to good agreement, above 0.75 as excellent. If kappa was below 0.40 then we also calculated the percentage over- and underreports (where differences were assessed, using McNemar tests where  $p < 0.05$  was considered a significant difference).

Parental recall can be influenced by the occurrence of child behavioral and emotional problems at the moment of recall, so we examined the agreement between PCH registration and TRAILS parental recall for children with and without an elevated CBCL score at the moment of recall. We did this using logistic regression for the outcomes most likely to be affected: maternal lifestyle during pregnancy, birth characteristics and early childhood behavior.

## **Results**

### *Description of sample*

Of the 2230 TRAILS participants, 2139 (96%) parents gave permission to retrieve the child's file from the PCH. Out of these, 88% could be traced ( $n=1879$  files, mean age=11.06, SD=0.54, 50.9% girls). Parent-recalled TRAILS data at age 10-12 differed with statistical significance between children with retrieved PCH data and with non- retrieved data for two out of the nine outcomes assessed. These were parent-reported maternal alcohol use during pregnancy (19% for the retrieved vs. 15% for the others,  $p < 0.05$ ), and problems with eating at child age 4-6 (18% vs. 13%, respectively,  $p < 0.05$ ). A considerable proportion of data missed on some

variables in the retrieved PCH files, further called PCH item non-response, ranging from 64.2% regarding maternal behaviors to 30.4% regarding early child behaviors (Table 2). PCH item non-response rates varied in particular between the five sites of data-collection, each site representing a different PCH service. Regarding maternal smoking and alcohol use, PCH item non-response was 96.9% in one site, compared to 38.8% for the other four sites, ( $p < 0.001$ ). After adjustment for site, PCH item non-response for these maternal behaviors did not vary by sociodemographic factors (all  $p > 0.05$ ). Regarding early child behaviors, PCH item non-response did also not vary by any of these background characteristics.

In the retrieved PCH files 37.3% of the mothers had a low educational level, 35.5% intermediate, and 27.1% had a high educational level. Fathers had a higher educational level on average, i.e. 32.4% low, 32.2 intermediate, and 35.4% high respectively. Of all families, 21.0% ( $n=454$ ) was divorced (at child age 11). 8.7% of the children had no siblings, 48.9% one, 29.5% two, and 12.9% three or more.

### *Birth characteristics*

Table 1 shows mean values for birth weight in pounds and gestational age in weeks for parent-recalled TRAILS values and PCH-registered values shortly after birth. For both outcomes the mean values differed with statistical significance but the actual differences were close to zero and not clinically relevant, i.e. 0.05 pounds (25 g) for birth weight and 0.08 weeks (0.6 days) for gestational age. The statistical significance is likely due to overpowering of the sample size with respect to the estimation of a clinically relevant difference in birth weight and for gestational age.

**Table 1.** Difference between recalled en registered values for birth weight and gestational age

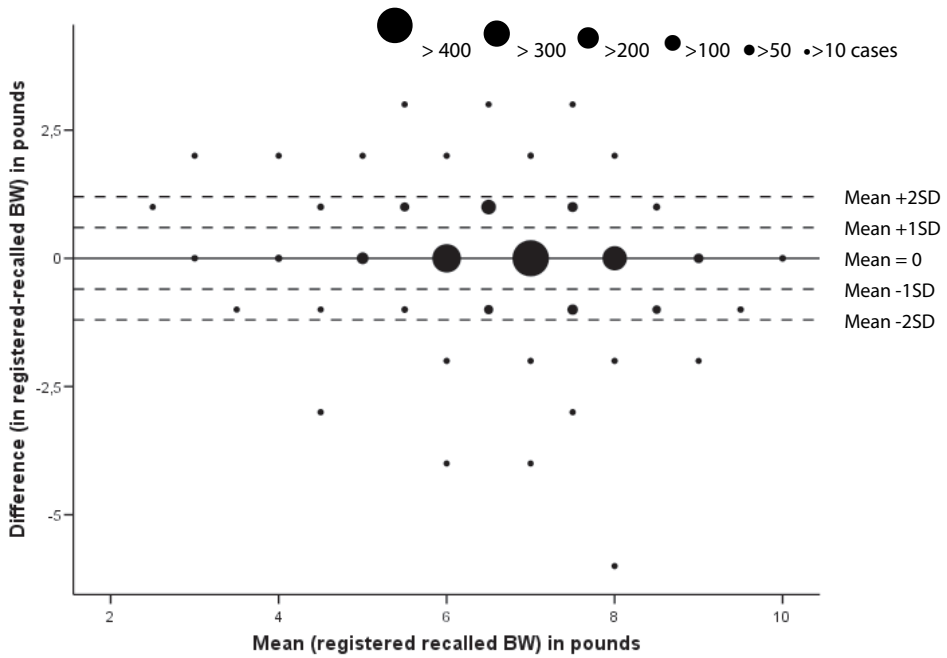
|                            | Birth weight,<br>units of 500 gram (SD)<br>n = 1691 | Gestational age,<br>weeks (SD)<br>n = 1696 |
|----------------------------|---|--|
| Recalled <sup>a</sup>      | 6.8 (1.2)   | 39.7 (1.8)                                 |
| Registered <sup>b</sup>    | 6.9 (1.1)   | 39.7 (1.9)                                 |
| Mean difference (95% C.I.) | +0.05 (0.02; 0.16)                                  | -0.08 (-0.13; -0.04)                       |

<sup>a</sup> retrieved from TRAILS data collected at child age 10-12

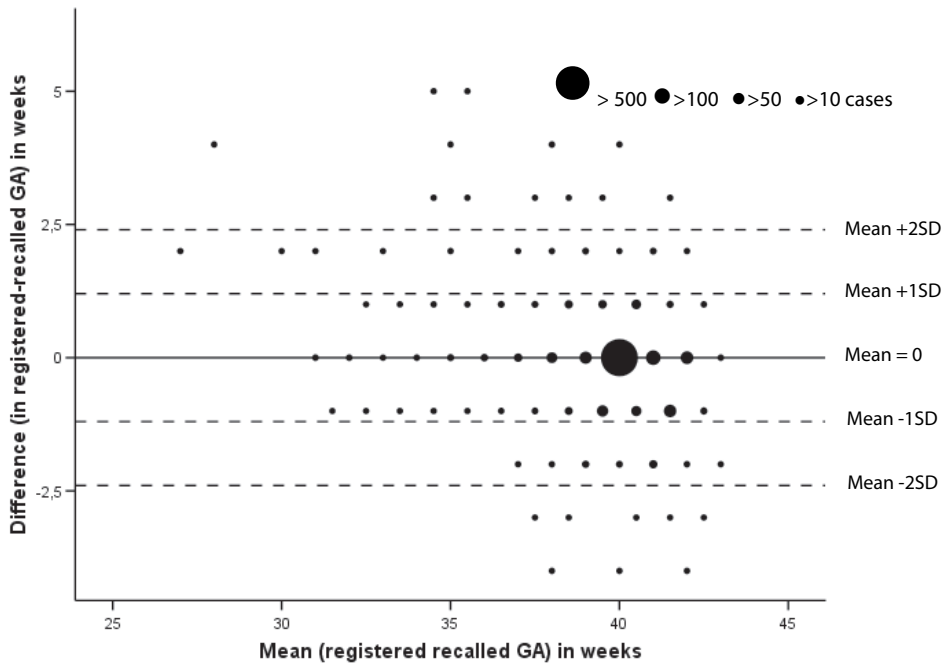
<sup>b</sup> retrieved from the PCH files, recorded at birth

Plots of the differences between recalled and reported values against their mean value (Figures 1A and 1B) showed no relation between the difference and mean values. The 95% limits of agreement of recalled compared to registered values were  $0.0 \pm 1.2$  pounds (600 grams) for birth weight and  $0.0 \pm 2.4$  weeks (17 days) for gestational age, i.e.  $\pm 17.4\%$  and  $\pm 6.0\%$  of the mean values for respectively birth weight and gestational age.

**Figure 1.** Plot of difference between recalled and registered values, against the mean values  
**A.** Birth weight (n=1691), maximum per dot = 446 cases



**B.** Gestational age (n=1696), maximum per dot = 525 cases



### *Maternal lifestyle during pregnancy*

Concordance between recalled (TRAILS) and PCH-registered maternal lifestyle during pregnancy was high for maternal smoking (kappa: 0.77 (95%C.I. 0.71; 0.82)) and low for maternal alcohol use during pregnancy (kappa 0.09 (95%C.I. 0.00; 0.19)) (Table 2). For smoking, rates of underreporting and overreporting were equal (4.7% and 5.6%, McNemar  $p > 0.10$ ), but parents tended to overreport retrospectively at age 10-12 maternal alcohol use during pregnancy: 19.7% overreport compared to 3.7% underreport (McNemar test  $p < 0.001$ ).

### *Early childhood behavior*

Table 2 also shows concordance for eating, sleeping and social behavior (all at child age 4-6). For all studied markers of early childhood behavior, concordance was low, kappa values ranging from 0.03-0.10. Overreport occurred more frequently than underreport for most outcomes (McNemar tests:  $p < 0.001$ ), except for eating problems (McNemar test:  $p > 0.10$ ). We repeated these analyses for severe child behavior problems, if parents reported that their child had "much more problems compared to other children". The proportion of overreport reduced to 2.4%, 2.4% and 2.8% for quick temperedness, anxiety and shyness, respectively. However, kappa values remained low (0.02-0.11).

Parental recall may be related to child emotional or behavioral problems. Therefore, logistic regression analyses were performed on the relationship of (dis)agreement between registered and recalled information and the parent completed Child Behavior Checklist (CBCL). None of the associations between (dis)agreement and dichotomized CBCL scores (clinical vs. normal) was significant, neither for the CBCL Total Problems score, nor for Internalizing or Externalizing Problems (results not shown).

## **Discussion**

In this large community-based sample we studied the validity of parental recall over a 10-12 year period for maternal lifestyle during pregnancy, birth characteristics and early childhood behavior. Results show that parental recall of birth weight and gestational age is valid (no systematic error) but not very precise. For maternal alcohol use during pregnancy, and early child behavior, recall was poor. A good recall was observed only for maternal smoking during pregnancy.

To our knowledge this study is the first to examine validity of parental reports of a number of prenatal and early life factors over a 10-12 year period, using data collected in a community-based setting at both time points. Moreover, this study is the first that studies parental recall of early child behavior characteristics which is considered highly relevant for the development of psychopathology later in life.

For birth weight and gestational age, no systematic difference was observed for recalled and PCH-registered data which confirms previous studies.<sup>19-26</sup> However, when taking into

**Table 2.** Prevalence rates (dis)agreement and kappas for maternal lifestyle during pregnancy and early childhood behavior according recorded and recalled data

|  | %prevalence |        | %agreement |              | %disagreement |             | Kappa<br>(95% C.I.) |
|--|-------------|--------|------------|--------------|---------------|-------------|---------------------|
|  | PCH         | TRAILS | Denial     | Confirmation | Overreport    | Underreport |                     |
| <i>Maternal lifestyle during pregnancy</i> |             |        |            |              |               |             |                     |
| Smoking, n = 708                           | 33.3        | 32.2   | 62.0       | 27.7         | 4.7           | 5.6         | 0.77 (0.71; 0.82)   |
| Alcohol use, n = 679                       | 6.0         | 22.1   | 74.2       | 2.4          | 19.7*         | 3.7*        | 0.08 (0.00; 0.19)   |
| <i>Early child behavior</i>                |             |        |            |              |               |             |                     |
| Sleeping problems, n = 666                 | 3.0         | 18.1   | 80.4       | 1.5          | 16.6*         | 1.5*        | 0.10 (0.00; 0.22)   |
| Eating problems, n = 673                   | 13.4        | 13.1   | 77.1       | 3.6          | 9.5           | 9.8         | 0.15 (0.00; 0.19)   |
| Shyness, n = 1307                          | 3.4         | 23.7   | 74.8       | 1.9          | 21.8*         | 1.5*        | 0.09 (0.01; 0.16)   |
| Anxiety, n = 1308                          | 0.6         | 15.8   | 83.9       | 0.3          | 15.5*         | 0.3*        | 0.03 (0.00; 0.11)   |
| Quick tempered, n = 1309                   | 3.0         | 15.7   | 82.1       | 0.8          | 14.9*         | 2.2*        | 0.03 (0.00; 0.09)   |

\* Significant difference between over- and underreport,  $p < 0.05$  (McNemar tests)

consideration the precision of recall, the use of recalled data adds considerable random error to all findings. For birth weight, the 95% range of recalled values deviated 17.4% from the mean value, and for gestational age 6.0%. Methodologically, these findings also clearly show the merits of the rigorous assessment procedure of agreement as proposed by Bland & Altman.<sup>33,34</sup>

For maternal lifestyle during pregnancy our results are in agreement with previous studies that also observed an acceptable agreement for smoking and a poor one for alcohol use.<sup>18,19</sup> The recall of early child behavior was poor as well. However, the total rate of agreement (confirmation and denial put together, Table 2) for maternal lifestyle during pregnancy and of the child at age 4-6 was high. This counterintuitive finding can largely be explained by the low proportions of confirmations on both occasions (TRAILS and PCH). The kappa statistic has been shown to be sensitive to extremes in prevalence and unbalanced margin totals leading to lower kappa values,<sup>35</sup> but that explains the low kappa value in our study to a very limited degree. The discordance for the child behavior problems can also be caused by the fact that the PCH files did not mention the length of time these problems lasted, while the question at age 11 was focused on the whole kindergarten period. Finally, child behavior problems in this study mostly comprised internalizing behavior, i.e. anxiousness, shyness, and sleep problems. Faraone et al.<sup>36</sup> showed that parental recall of psychopathology of their child after one year was much better for externalizing than for internalizing problems. Our findings show that this holds to an even higher degree if the period of recall is longer.

Alcohol use during pregnancy and early child behavior were reported more frequently in the TRAILS data compared to PCH-registered data. This may be due to either an overreport at age 10-12 or an underreport in the PCH files. A likely source of overreport might be child behavioral and emotional problems at 10-12 years of age. In this population, however, parental recall was unrelated to child emotional or behavioral problems. An underreport in the PCH registration may have occurred for alcohol use during pregnancy. At the time of PCH registration in our study population, the early 1990's, there was no consensus on the effect of non-habitual alcohol use on fetal development. However, kappa values did not change when we focused on more frequent use. In addition, parents may have underreported alcohol use because of the setting and timing of PCH registration. Lifestyle during pregnancy was asked for during the first PCH visit only, which is shortly after birth. The setting and timing may evoke emotions that lead to recall.<sup>37</sup>

Strengths of this study are its large, community-based sample and the preventive health care setting. Moreover, we made use of data registered during routine health and developmental monitoring offered to all Dutch children and collected and registered according to a highly standardized format. We retrieved 88% of the PCH files as expected based upon the 90% participation reported from national data.<sup>30</sup> So there is no or limited bias from parents report. However, information on reasons of non-retrieval was not available.

Our study has some limitations. First, though we consider the PCH data to be most valid, we cannot exclude that these are subject to some bias too. In particular, parent-reported information may have been influenced by the report being to a PCH professional and being registered by that professional. Regarding this, only birth weight and gestational age registered in the PCH files can be considered as true reference values. Second, the low prevalence of some behavior may have resulted in somewhat too low kappa estimates, but the impact of this is rather small. Thirdly, some of the outcomes as studied were only registered in a part of the PCH encounters, which could have introduced bias if occurring in association with child characteristics. However, site appeared to be the only predictor of this non-response and only regarding maternal behaviors. This indicates that the missingness of some items is in particular due to differences between services in their registration policies as at that period each site was served by a different PCH service. Apparently, in that period, services differed in their policies on how to spend the very limited time per encounter (approximately 10-15 minutes), with in most services the registration of past maternal behavior having a much lower priority than current child behavior. Finally, the non-response of 24% in the TRAILS study could have led to selection bias in our findings. However, we found no differences between responders and non-responders in the prevalence of teacher-rated problem behavior nor regarding associations of socio-demographic variables and mental health outcomes, which makes the occurrence of selection bias rather unlikely.

Summarized, we observed a poor parental recall after a 10-12 year period for maternal lifestyle during pregnancy, birth characteristics, and early childhood behavior, which was mostly due to over-reporting at age 10-12. This should be taken into account when asking retrospectively about these events, either by researchers or by clinicians. We conclude that retrospectively collected information of early life adversities is of limited value for estimating the contribution to child (public) health.

## References

1. Cicchetti D, Cohen DJ. Perspectives on developmental psychopathology. New York: Wiley; 1995.
2. Mesman J, Koot HM. Early preschool predictors of preadolescent internalizing and externalizing DSM-IV diagnoses. *J Am Acad Child Adolesc Psychiatry* 2001;40:1029-36.
3. Sroufe LA. Pathways to adaptation and maladaptation: psychopathology as developmental deviation. In: Cicchetti D, Toth SL, Eds. Rochester symposium on developmental psychopathology, Vol 1 developmental psychopathology: an emerging discipline. Hillsdale, NJ: Erlbaum; 1989. 13-40.
4. Barker DJ, Bergmann RL, Ogra PL. Concluding remarks. The Window of Opportunity: Pre-Pregnancy to 24 Months of Age. *Nestle Nutr Workshop Ser Pediatr Program* 2008;61:255-60.
5. Eaton WW, Mortensen PB, Thomsen PH, Frydenberg M. Obstetric complications and risk for severe psychopathology in childhood. *J Autism Dev Disord* 2001;31:279-85.

6. Haberg SE, Stigum H, Nystad W, Nafstad P. Effects of pre- and postnatal exposure to parental smoking on early childhood respiratory health. *Am J Epidemiol* 2007;166:679-86.
7. Hook B, Cederblad M, Berg R. Prenatal and postnatal maternal smoking as risk factors for preschool children's mental health. *Acta Paediatr* 2006;95:671-7.
8. Indredavik MS, Vik T, Heyerdahl S, Kulseng S, Brubakk AM. Psychiatric symptoms in low birth weight adolescents, assessed by screening questionnaires. *Eur Child Adolesc Psychiatry* 2005;14:226-36.
9. Linnet KM, Dalsgaard S, Obel C, Wisborg K, Henriksen TB, Rodriguez A, et al. Maternal lifestyle factors in pregnancy risk of attention deficit hyperactivity disorder and associated behaviors: review of the current evidence. *Am J Psychiatry* 2003;160:1028-40.
10. Mattes E, Kendall GE, Susser ES, McKeague IW, SSR, Stanley FJ, et al. Sleep problems at age 2 as a predictor of mental health from middle childhood to adolescence: the Western Australian Pregnancy Cohort (RAINE) study. *Early Human Development* 2007;vol. 83, afl. 1, pag. S57. Oral presentation.
11. Olsen EM, Skovgaard AM, Weile B, Jorgensen T. Risk factors for failure to thrive in infancy depend on the anthropometric definitions used: the Copenhagen County Child Cohort. *Paediatr Perinat Epidemiol* 2007;21:418-31.
12. Rice F, Jones I, Thapar A. The impact of gestational stress and prenatal growth on emotional problems in offspring: a review. *Acta Psychiatr Scand* 2007;115:171-83.
13. Saigal S, Doyle LW. An overview of mortality and sequelae of preterm birth from infancy to adulthood. *Lancet* 2008;371:261-9.
14. Thunström M. Severe sleep problems in infancy associated with subsequent development of attention-deficit/ hyperactivity disorder at 5.5 years of age. *Acta Paediatrica* 2002;91 (5):584-92.
15. Laucht M, Esser G, Schmidt MH. [Behavioral disorders in infants and young children: a contribution to psychopathology of early childhood]. *Z Kinder Jugendpsychiatr* 1992;20:22-33.
16. McDermott BM, Mamun AA, Najman JM, Williams GM, O'callaghan MJ, Bor W. Preschool children perceived by mothers as irregular eaters: physical and psychosocial predictors from a birth cohort study. *J Dev Behav Pediatr* 2008;29:197-205.
17. Sackett DL. Bias in analytic research. *Journal Chronic Disease* 1979;32:51-63.
18. Delgado-Rodriguez M, Gomez-Olmedo M, Bueno-Cavanillas A, Garcia-Martin M, Galvez-Vargas R. Recall bias in a case-control study of low birth weight. *J Clin Epidemiol* 1995;48:1133-40.
19. Rice F, Lewis A, Harold G, van den BM, Boivin J, Hay DF, et al. Agreement between maternal report and antenatal records for a range of pre and peri-natal factors: the influence of maternal and child characteristics. *Early Hum Dev* 2007;83:497-504.
20. Yawn BP, Suman VJ, Jacobsen SJ. Maternal recall of distant pregnancy events. *J Clin Epidemiol* 1998;51:399-405.
21. McCormick MC, Brooks-Gunn J. Concurrent child health status and maternal recall of events in infancy. *Pediatrics* 1999;104:1176-81.



22. Sou SC, Chen WJ, Hsieh WS, Jeng SF. Severe obstetric complications and birth characteristics in preterm or term delivery were accurately recalled by mothers. *J Clin Epidemiol* 2006;59:429-35.
23. Gofin R, Neumark YD, Adler B. Birthweight recall by mothers of Israeli children. *Public Health* 2000;114:161-3.
24. O'Sullivan JJ, Pearce MS, Parker L. Parental recall of birth weight: how accurate is it? *Arch Dis Child* 2000;82:202-3.
25. Tate AR, Dezateux C, Cole TJ, Davidson L. Factors affecting a mother's recall of her baby's birth weight. *Int J Epidemiol* 2005;34:688-95.
26. Walton KA, Murray LJ, Gallagher AM, Cran GW, Savage MJ, Boreham C. Parental recall of birthweight: a good proxy for recorded birthweight? *Eur J Epidemiol* 2000;16:793-6.
27. de Winter AF, Oldehinkel AJ, Veenstra R, Brunnekreef JA, Verhulst FC, Ormel J. Evaluation of non-response bias in mental health determinants and outcomes in a large sample of pre-adolescents. *Eur J Epidemiol* 2005;20:173-81.
28. Oldehinkel AJ, Hartman CA, de Winter AF, Veenstra R, Ormel J. Temperament profiles associated with internalizing and externalizing problems in preadolescence. *Dev Psychopathol* 2004;16:421-40.
29. Brugman E, Reijneveld SA, Verhulst FC, Verloove-Vanhorick SP. Identification and management of psychosocial problems by preventive child health care. *Arch Pediatr Adolesc Med* 2001;155:462-9.
30. Reijneveld SA, Verloove-Vanhorick SP, Hirasing RA. Preventive Child Healthcare (Jeugdgezondheidszorg). In: Mackenbach JP, van der Maas PJ, Eds. *Volksgesondheid en gezondheidszorg*. Maarsen: Elsevier gezondheidszorg; 2004. 150-60.
31. Achenbach TM, & Rescorla LA. Manual for the Achenbach system empirically based assessment (ASEBA), preschool forms and profiles. Burlington, VT: University of Vermont, Research Center for children, youth and families; 2001.
32. Verhulst FC, Ende Jvd, Koot HM. Manual for the CBCL/4-18 (Handleiding voor de CBCL/4-18). Rotterdam: Erasmus University, Department of Child and Adolescent Psychiatry, Sophia Children's Hospital; 1996.
33. Bland JM, Altman DG. Statistical methods for assessing agreement between two methods of clinical measurement. *Lancet* 1986;1:307-10.
34. Bland JM, Altman DG. Agreement between methods of measurement with multiple observations per individual. *J Biopharm Stat* 2007;17:571-82.
35. Cicchetti DV, Feinstein AR. High agreement but low kappa. II. Resolving the paradoxes. *J Clin Epidemiol* 1990;43:551-8.
36. Faraone SV, Biederman J, Milberger S. How reliable are maternal reports of their children's psychopathology? One-year recall of psychiatric diagnoses of ADHD children. *J Am Acad Child Adolesc Psychiatry* 1995;34:1001-8.
37. Oatley K, Jenkins JM. Functions and effects of emotions in cognition and persuasion. In: Oatley K, Jenkins JM, Eds. *Understanding Emotions*. Cambridge, MA: Blackwell Publishers; 1996. 251-84.





# 7

## General Discussion





## Introduction

The main aim of this thesis was to investigate whether early findings of PCH professionals predict psychosocial problems in adolescents from the general population. Other aims were to investigate early childhood indicators for social status in preadolescence and to examine the validity and precision of recall of maternal lifestyle during pregnancy, birth characteristics and early childhood behavior.

Our aims have been translated into the following research questions:

1. Can we predict which preadolescents are at risk for psychosocial problems with early childhood findings as registered by PCH?
2. Which early risk assessments by professionals are predictive for trajectories of internalizing and externalizing problems in adolescents in a PCH setting?
3. Can we identify early indicators of autism spectrum disorder and attention deficit hyperactivity disorder problems with early childhood findings as registered by PCH?
4. Can we predict which children have a heightened chance of being disliked or ignored by their preadolescent peers with data from the routine PCH?
5. How is the validity of parental recall on pregnancy, birth and early childhood behavior in preadolescence?

In this general discussion a summary of the findings is presented, followed by a discussion of these findings and the methodological considerations, and finally, implications for practice and suggestions for future research are given.

## Main findings

The research question in Chapter 2 was: Can we predict which preadolescents are at risk for psychosocial problems with early childhood findings as registered by PCH? For that we developed and validated -in two data sets- a prediction model for psychosocial problems in preadolescence based on data from routine preventive child healthcare on childhood factors in early life. Early childhood findings were measured during pregnancy and at age 4, while psychosocial problems were measured at age 11. PCH-registered behavioral problems, attention hyperactivity problems, enuresis, level of education of the father, and being male all predicted externalizing problems. Internalizing problems were predicted by maternal smoking during pregnancy, sleep problems and being male. Surprisingly, the absence of certain data was predictive for psychosocial problems. The predictive power of PCH-registered early childhood data was rather modest for behavioral problems, with areas under the curve indices being 0.66 (95% CI 0.59-0.72). This means that PCH-registered early childhood data correctly predicts externalizing problems in children at age 11 in 66% of

cases. However, for internalizing problems, PCH data did not predict emotional problems in preadolescence.

In Chapter 3 we examined which early risk assessments by professionals are predictive for trajectories of internalizing and externalizing problems in adolescents in a PCH setting. In contrast with Chapter 2, early childhood indicators (where applicable) and outcome measures were measured at different moments in time from pregnancy up to age 4 and between the ages of 11 and 17, respectively. Four types of trajectories were identified for both genders and for both types of problems. Per type of trajectory, a high trajectory of adolescents with clinical problems was identified, as well as a middle high, middle low, and low trajectory. All trajectories were relatively stable across ages; the continuity of these problems was very high. Parsimonious sets of early childhood indicators from PCH assessments predicted each of these trajectories. All sets comprised for both genders low and middle parental educational levels, and having divorced or otherwise single parents. For trajectories of internalizing problems, sleep problems were an additional predictor for boys, while language problems were for girls. Trajectories of externalizing problems were additionally predicted by maternal smoking during pregnancy for both genders. Moreover, for boys early behavioral problems and attention hyperactivity problems were predictive.

In Chapter 4 we assessed whether early indicators of ASD and ADHD problems can be identified with early childhood findings as registered by PCH. In this chapter early indicators and ASD and ADHD problems were measured at different moments in time from pregnancy up to age 4 and between the ages of 11 and 17 years, respectively. Several early childhood indicators were identified that predicted ASD and ADHD problems. Male gender and the absence of parent-reported positive behavior at toddler age were generic indicators, while a low birth weight, social behavioral problems, language, and psychomotor and eating problems at toddler age were specific indicators for ASD problems. Low level of education of the mother, maternal smoking during pregnancy, gross motor skills during infancy, and attention hyperactivity problems at toddler age were specific indicators for ADHD problems.

In Chapter 5 we described the prediction of which children (in preadolescence) have a heightened chance of being disliked or ignored by their peers based on routine data from the PCH. Early childhood indicators were measured at different moments, from pregnancy up to age 4. Findings show that several early childhood indicators were predictive for neglect and rejection by peers. Children with a low birth weight, early motor problems, early sleep problems, and children with parents with a low educational level were more likely to have a neglected status; children with early attention hyperactivity problems were less likely to be so. Boys, children with parents with a low educational level, and children with externalizing problems in toddlerhood were more likely to have a rejected status in preadolescence.

Our final research question in Chapter 6 was: How is the validity of parental recall on pregnancy, birth and early childhood behavior in preadolescence? Retrospectively collected information on lifestyle during pregnancy, birth and early childhood behavior (in kindergarten) is sometimes biased, which limits its value in estimating the contribution of

early life adversity to health in later life. Findings show a poor parental recall after a 10-12 year period for maternal alcohol use during pregnancy and early childhood behavior, which was mostly due to over-reporting at age 10-12. In contrast, the recall of maternal smoking during pregnancy was good. For birth weight and gestational age, no systematic difference between recalled and PCH-registered data were found.

## Discussion of the main findings

Much of the effort documented in this thesis was aimed to improve the quality of preventive child healthcare by expanding our knowledge of the predictability of early PCH findings. Regarding this, it indeed has yielded interesting new findings.

Identification of predictors of future psychosocial problems might aid PCH professionals to improve their monitoring of the development of children and might facilitate early treatment or referral of potential vulnerable children. Our findings are also important for the long-term perspective of these children and their chances of developing psychosocial problems. The long-term economic costs of childhood and adolescent psychosocial problems are high; a lifetime cost in lost family income is approximately \$300,000. Large negative effects are found on educational accomplishments and the ability to work and earn as adults.<sup>1</sup>

A parsimonious set of data from early PCH assessments predicts psychosocial problems in (pre)adolescence, but only to a moderate degree. The effect sizes of the predictors are modest. Externalizing, ASD and ADHD problems can be better predicted with early PCH data than internalizing problems. Although several predictors were identified which may facilitate the PCH professionals in their work, our results show the difficulty of accurate prediction of psychosocial problems from early PCH findings. This was shown in different chapters with different approaches. The only modest predictive power of early PCH findings may disappoint. Several considerations should be accounted for to reach a balanced appraisal of them. Below we first take into account the previous studies on the validity of PCH findings, then look at some methodological considerations and finally discuss predictors and effects of missing data in our study.

So far, there have been mainly studies on the short-term prediction of psychosocial problems in a PCH setting, e.g. the studies by Harland et al.<sup>2</sup>, Brugman et al.<sup>3</sup> and Reijneveld et al.<sup>4,5</sup> Harland et al.<sup>2</sup> showed that psychosocial problems as measured by the CBCL are more prevalent among some risk groups such as children whose parents are unemployed or divorced. Reijneveld et al.<sup>6</sup> showed that ethnic minority groups also have a higher chance of developing psychosocial problems. However, we are the first to study long-term prediction of psychosocial problems based on PCH findings. Compared to these previous studies our effect sizes are smaller, i.e. the predictive power of these predictors seems to decrease in time.



How to explain the fact that our effect sizes are smaller? An explanation for this finding is the large variation in the course of the psychosocial problems in children and adolescents<sup>7-11</sup> which makes long-term prediction difficult. During the long period (6-7 years) between our predictors and our (first) outcome measures, life events, at home and at school, and provision of mental health care can effect the occurrence of psychosocial problems, thus diluting the association between predictors and outcomes. If we had measured other determinants of mental health between age 4 and 11, we probably would have measured more precisely and more validly. If we had been able to adjust for these factors, we might have found a stronger prediction (bigger effect sizes) and possibly even more and/or other predictors in our studies. With respect to mental health care previous research does show that PCH professionals take action in 85% of the cases for which they identify psychosocial problems and in 20% they refer for further diagnostics and treatment.<sup>3,5</sup> However, it is important to realize that PCH professionals relatively often identify psychosocial problems in children who do not have a heightened score on the CBCL<sup>3,5</sup> and we do not know if the referral by the PCH actually took place. So previous research does not give us a clear picture of how many children seen by the PCH professionals receive an intervention if psychosocial problems are present.

A second explanation, for the fact that our effect sizes are relatively small, is that the data of the PCH used in this thesis are approximately 20 years old, so we are looking at the performance of the PCH 20 years ago. Would more recent PCH data give a different picture of the performance of the PCH on awareness of early risk factors for psychosocial problems? This seems likely given the number of additional tools,<sup>4,12-14</sup> trainings<sup>15</sup> and guidelines<sup>16-18</sup> provided since then. We do not have a comparison for our data on the entire 20 years period. However, a recent study, on a part of that period (between 1997 and 2003), by Theunissen et al.<sup>19</sup> shows that the quality of problem identification in children by the PCH has not improved in the last years after a series of nation-wide interventions.

Another interesting finding of our studies is the predictive power of some indicators for several outcome measures. It is striking that we identified several predictors which are rather similar for various psychosocial problems and for a disputed social status, e.g. maternal smoking during pregnancy, early behavior problems, early attention hyperactivity problems, a low level of education of parents and divorce of parents. The set of predictors consists of both family factors and child factors, which are important in the prediction. Regarding family factors, the level of education of the parents is predictive for all psychosocial problems. Other family factors are also predictive such as divorce of parents. For the child factors, early behavior of the child is important to predict many psychosocial problems (but not internalizing problems) and a disputed social status.

Data on early development as registered by PCH are mostly not predictive for internalizing problems in (pre)adolescents. An explanation for this might be that few early childhood features are predictive for later internalizing problems. Perhaps having a genetic vulnerability is much more important for developing internalizing problems than these early risk factors. In the methodological consideration some other aspects will be discussed as well.

A second possibility is that PCH professionals might not be adequately identifying or registering those factors that are predictive.

Psychosocial problems were more likely when PCH had not registered findings on some aspects of early development, that is, when these data were missing. Several explanations were given in Chapter 2 as to why PCH professionals did not always register every item. First, the PCH professional might not have had enough time for the assessments and registration especially in multiple-problem cases (the visits are short, with many competing concerns). Second, certain parents of children with problems may have given unclear answers or refused to answer some questions at all. Parental knowledge and attitudes about (mental health) problems and interactions among family members and friends influence decisions to seek help or disclose problems to PCH professionals. Subsequently, the attitudes, knowledge and skills of PCH professionals who are first points of contact when families seek help, determine whether concerns are recognized and receive an appropriate response. Missing data might indicate difficulties met by the PCH professional during the assessment.

## Methodological considerations

In addition to the long period between our predictors and our (first) outcome measures and the non-random missing of data, some other methodological factors may have affected our findings.

First, despite a reasonable power, some early risk indicators were low prevalent and thus might not have been identified as indicators due to their low prevalence. This may, for instance, concern birth defects.

Another methodological consideration is the use of data from routine care. PCH professionals registered data for care purposes and not for research. Consequently, there were many missing data in the PCH files. As we showed in Chapter 2 the missingness of certain data was actually predictive for psychosocial problems. Several explanations were given in Chapter 2 as to why PCH professionals did not always register every item. Because of the missingness of PCH data, we expected this would lead to even smaller effect sizes and to a loss of power. To assess if this was the case, we decided to use a different type of predictor variable(s) in the studies in Chapters 3 to 5, where we used measurements, noted at six assessments between the ages of 18 months to four years. These were then dichotomized to “yes” if any of these were present during these six occasions, or “no”. Because of this, we had almost no missing data. But even with these different constructions of the predictors (in Chapter 2 and 3) we found similar results. Our effect sizes might have been somewhat stronger though if the PCH files would have been more complete.

Third, we partly used grouped problems, for example emotional problems, as outcome measures and not specific disorders such as depression. If one examines the level of disorders possibly different predictors and/or different effect sizes might have been found, as we found in our study for ASD and ADHD problems.

A final methodological consideration concerns the TRAILS sample. The sample was largely representative for the Dutch population that is seen by PCH. However, a very small number of parents (4%) participating in TRAILS did not consent to retrieve their child's PCH file. Also, the percentage of children from ethnic minority groups and of children who were unable to participate in TRAILS due to mental and cognitive abilities in this study is smaller than in the Dutch population as a whole. This could have consequences for the estimation of the predictive power, because there are indications that the PCH is less successful in detecting psychosocial problems of children from ethnic minority groups.<sup>6,20</sup> Therefore, we expect that the small share of ethnic minorities in the TRAILS sample leads to a relative overestimation of the predictive power for the Dutch population as a whole. For children with intellectual disabilities on the other hand, we would expect that their limited share in the TRAILS sample leads to an underestimation of the predictive power for the Dutch population, considering that there usually is an early identification for this group, which makes that these children are monitored more often and files are filled out more complete and rigorously.<sup>21</sup>

## Implications for practice of the Preventive Child Healthcare

The identification of children with psychosocial problems is one of the main tasks of PCH. Now that the Dutch PCH is transitioning to an even more evidence based healthcare service where psychosocial development of children is very important, the focus is shifting more towards high risk groups and more personalized care. Our findings give an insight from PCH data which children are more vulnerable for developing psychosocial problems. PCH may move towards targeting care more at that group.

Our research shows room for improvement of PCH. First, the assessment of early psychosocial problems by PCH might be improved. Because of the modest predictive power of early psychosocial findings for later psychosocial problems, the PCH should employ additional tools when they screen for psychosocial problems. How can PCH improve their detection of psychosocial problems? As previously discussed by Vogels et al.<sup>13</sup> and Theunissen et al.<sup>19</sup>, tools for detecting psychosocial problems, such as short questionnaires, could further improve early detection. Moreover, Vogels et al.<sup>13</sup> found systematic differences between individual PCH professionals, which indicates that detection of children with psychosocial problems based only on a clinical judgment does not meet the requirements of standardization. Further standardization in the methods PCH professionals use for screening is needed. Introducing new PCH guidelines would most likely contribute to this.

Furthermore, PCH professionals should register their findings better for two reasons. The first reason is that we found that the missingness of certain data was predictive for psychosocial problems. The other is that in case a child is seen by another PCH professional, this professional misses possible important information in the file and therefore lacks a more complete picture of the development of the child. We already discussed in the

methodological considerations why PCH professionals did not always register every item. More time for the assessments of children during routine health care assessment may improve the completeness and quality of PCH files. Theunissen et al.<sup>19</sup> suggest the use of a short questionnaire to improve the quality of identification of psychosocial problems by PCH professionals as well as extra training, ongoing coaching by a child mental health specialist and more time for the assessment. They also mention a different type of solution, to replace the current PCH professionals, i.e. doctors and nurses, by other types of professionals, such as psychologists. However, it should be realized that replacing doctors and nurses by psychologists will likely be at the expense of other required skills.

The possible negative effects of identifying a child as having a chance of developing psychosocial problems are not yet clear. Although it seems important to identify, monitor and, if necessary, intervene in these psychosocial problems as early as possible, the PCH (and mental health professionals alike) have to be careful that they don't prematurely treat children who don't need it. Because this can lead to stigmatization and it will have a huge effect on society if -ultimately- the majority of children in the society is defined as having mental health problems. As a society we have to be aware that we cannot detect every mental health problem.

### *Future perspectives*

In the last years several steps forward have been and are being made to reinforce evidence based working in PCH, both by the PCH professionals and researchers. Below are some examples of current studies and initiatives with this objective. At the moment validated questionnaires are being developed for ages 0-4 year to identify psychosocial problems. A current study by Theunissen et al.<sup>19</sup> is evaluating which of four (existing) questionnaires is the best choice to improve evidence based working. Second, Vogels, Jacobusse and Reijneveld<sup>13</sup> assessed whether a short Computerized Adaptive Test (CAT) can overcome the weaknesses of short written questionnaires when identifying children with psychosocial problems. They showed that it is a very promising option for the identification of psychosocial problems in children, as it can lead to an efficient, yet high-quality identification. However, the results of their simulation study need to be replicated in a real-life administration of this CAT. Third, Hielkema et al.<sup>22</sup> describe in their design paper a new family-centered method to identify psychosocial problems in early childhood which is being implemented within Dutch PCH. Its main features are consideration of the child's developmental context and empowerment of parents to enhance the developmental context.

Fourth, The Collaborative Centre on Care for Children and Youth with behavioral and emotional problems (C4Youth) has been set up to strengthen ties between groups involved in research and education and institutions that provide care to children and adolescents with behavioral and emotional problems.<sup>23</sup> More specifically, C4Youth has three objectives: 1) To exchange knowledge between professionals working in organizations and institutions for care, education, training, research and policymaking for children and adolescents (0-23 years)

with behavioral and emotional problems, and their parents/guardians (i.e. clients). 2) To develop a data collection system that allows valid and reliable assessment of (a) which care these clients use for these problems and (b) what their short-term and long-term outcomes are. 3) To obtain evidence on relevant themes to improve this care, specifically regarding (a) the entrance of these clients into care, (b) the types of care that clients actually receive and its relationship with the problems that they have, (c) the communication between clients and professionals during the process of care and its association with outcomes reached, and (d) the short-term questions of various partners of C4Youth, including questions on 'who is where in care for what' from policymakers. Fifth, the Dutch government still has youth health and care as a research priority; the Netherlands Organization for Health Research and Development (ZonMw) was recently asked to develop a new program by the Ministry of Health, Welfare and Sport, with a budget of 21 million euro.<sup>24</sup> Furthermore, there is a continuation of the program 'Guidelines in PCH'.

## Recommendations for future research

Still further research is needed to improve the long-term prediction of psychosocial problems. Future studies could measure several moments between age 4 and age 11, to be able to correct for this period in a longitudinal study (like ours) to achieve an even clearer picture on which early risk factors are predictive of later psychosocial problems. Moreover, future research could examine whether there is a distinct set of early predictors for adolescents with comorbid problems and examine further gender differences in early indicators and predictors.

In order to unravel certain predictors research could examine these predictors more in depth. For example, in the case of single parenthood, is it the environment in which the child grows up that makes this a risk factor for psychosocial problems or is it the missing of a second role model? And if this is better unraveled how such a risk factor can be better identified and in the end be better supported by the PCH. In this way there is much less risk of stigmatization.

Because previous research indicates that children with a disputed social status and no or few friends might be more at risk for later psychosocial problems than children with (more) friends,<sup>25</sup> future research could use a combination of social status and friendship (nominations), this combined probably makes for an even stronger outcome measure of children at risk of a disputed social status and might generate different early predictors or stronger effect sizes.

Many previous studies on early risk factors for adverse future mental health relied on retrospectively collected data and included a limited number of risk factors. In this thesis we show that the reliability of recalled (TRAILS) data on maternal smoking during pregnancy, birth weight and gestational age was good. However, parental recall regarding maternal

alcohol use during pregnancy and early childhood behavior was poor after a 10-12 year period. Future research should take that into account.

## Conclusion

This thesis shows that early findings of PCH professionals predict psychosocial problems in (pre)adolescence, but only to a moderate degree. More research is needed to further improve the long-term predictive value and robustness of early PCH findings, so that it can be better used by PCH professionals in the care they provide to children and adolescents.

## References

1. Smith JP, Smith GC. Long-term economic costs of psychological problems during childhood. *Soc Sci Med* 2010;71:110-5.
2. Harland P, Reijneveld SA, Brugman E, Verloove-Vanhorick SP, Verhulst FC. Family factors and life events as risk factors for behavioural and emotional problems in children. *Eur Child Adolesc Psychiatry* 2002;11:176-84.
3. Brugman E, Reijneveld SA, Verhulst FC, Verloove-Vanhorick SP. Identification and management of psychosocial problems by preventive child health care. *Arch Pediatr Adolesc Med* 2001;155:462-9.
4. Reijneveld SA, Vogels AG, Brugman E, van EJ, Verhulst FC, Verloove-Vanhorick SP. Early detection of psychosocial problems in adolescents: How useful is the dutch short indicative questionnaire (KIVPA)? *Eur J Public Health* 2003;13:152-9.
5. Reijneveld SA, Brugman E, Verhulst FC, Verloove-Vanhorick SP. Identification and management of psychosocial problems among toddlers in dutch preventive child health care. *Arch Pediatr Adolesc Med* 2004;158:811-7.
6. Reijneveld SA, Harland P, Brugman E, Verhulst FC, Verloove-Vanhorick SP. Psychosocial problems among immigrant and non-immigrant children--ethnicity plays a role in their occurrence and identification. *Eur Child Adolesc Psychiatry* 2005;14:145-52.
7. Letcher P, Smart D, Sanson A, Toumbourou JW. Psychosocial precursors and correlates of differing internalizing trajectories from 3 to 15 years. *Social Development* 2009;18:618-46.
8. Leve LD, Kim HK, Pears KC. Childhood temperament and family environment as predictors of internalizing and externalizing trajectories from ages 5 to 17. *J Abnorm Child Psychol* 2005;33:505-20.
9. Bongers IL, Koot HM, van der EJ, Verhulst FC. Developmental trajectories of externalizing behaviors in childhood and adolescence. *Child Dev* 2004;75:1523-37.
10. Bongers IL, Koot HM, van der EJ, Verhulst FC. The normative development of child and adolescent problem behavior. *J Abnorm Psychol* 2003;112:179-92.
11. Nagin D, Tremblay RE. Trajectories of boys' physical aggression, opposition, and hyperactivity on the path to physically violent and nonviolent juvenile delinquency. *Child Dev* 1999;70:1181-96.

12. Reijneveld SA, Vogels AG, Hoekstra F, Crone MR. Use of the pediatric symptom checklist for the detection of psychosocial problems in preventive child healthcare. *BMC Public Health* 2006;6:197.
13. Vogels AG, Jacobusse GW, Reijneveld SA. An accurate and efficient identification of children with psychosocial problems by means of computerized adaptive testing. *BMC Med Res Methodol* 2011;11:111.
14. Crone MR, Vogels AG, Hoekstra F, Treffers PD, Reijneveld SA. A comparison of four scoring methods based on the parent-rated strengths and difficulties questionnaire as used in the dutch preventive child health care system. *BMC Public Health* 2008;8:106.
15. Wiefferink CH, Reijneveld SA, de Wijs J, Swagerman M, Campman D, Paulussen TG. Screening for psychosocial problems in 5-6-year olds: A randomised controlled trial of routine health assessments. *Patient Educ Couns* 2006;60:57-65.
16. Ministerie van VWS. Basistakenpakket jeugdgezondheidszorg. Den Haag: Ministerie van VWS; 2002.
17. Blokland G. Groepsgerichte opvoedingsondersteuning. *Nederlands Tijdschrift Voor Jeugdzorg* 2002;2:97-103.
18. Vogels AGC. Jeugdgezondheidszorg en suïcidaal gedrag onder adolescenten. rapport van de werkgroep JGZ en suïcidepreventie. Leiden: Nederlands Instituut voor Preventieve Gezondheidszorg - TNO; 1986.
19. Theunissen MH, Vogels AG, Reijneveld SA. Early detection of psychosocial problems in children aged 5 to 6 years by preventive child healthcare: Has it improved? *J Pediatr* 2011.
20. Crone MR, Bekkema N, Wiefferink CH, Reijneveld SA. Professional identification of psychosocial problems among children from ethnic minority groups: Room for improvement. *J Pediatr* 2010;156:277,84.e1.
21. Oeseburg B. Prevalence and impact of chronic diseases in adolescents with intellectual disability. S.l.: ; 2010. Proefschrift Rijksuniversiteit Groningen.
22. Hielkema M, de Winter AF, de Meer G, Reijneveld SA. Effectiveness of a family-centered method for the early identification of social-emotional and behavioral problems in children: A quasi experimental study. *BMC Public Health* 2011;11:636.
23. C4Youth; collaborative centre on care for children and youth [Internet] [cited 2011 10/27]. Available from: <http://www.c4youth.nl/>.
24. ZonMW; nieuws: Programma Richtlijnen Jeugdgezondheid maakt voorstel voor vervolg [Internet] [cited 2011 10/27]. Available from: [http://www.zonmw.nl/nl/themas/thema-detail/jeugd/thema-detail/?tx\\_zonmwdata\\_pi3%5Btab%5D=3&tx\\_zonmwdata\\_pi3%5Bnieuwsitem%5D=271&cHash=eeecc480ec4a023257398814f280d90b](http://www.zonmw.nl/nl/themas/thema-detail/jeugd/thema-detail/?tx_zonmwdata_pi3%5Btab%5D=3&tx_zonmwdata_pi3%5Bnieuwsitem%5D=271&cHash=eeecc480ec4a023257398814f280d90b).
25. Rubin KH, Bowker J, Kennedy A. Avoiding and withdrawing from the peer group. In: KH Rubin, WM Bukowski, B. Laursen, editors. *Handbook of peer interactions, relationships, and groups*. New York: Guilford; 2009.







# Summary





This thesis focuses on the prediction of psychosocial problems in adolescents by early findings of Preventive Child Healthcare (PCH) professionals. In addition, it investigates early childhood indicators for social status in preadolescence and examines the validity and accuracy of parental recall of maternal lifestyle during pregnancy, birth characteristics and early childhood behavior. The research described in this thesis is part of the TRacking Adolescents' Individual Lives Survey (TRAILS), a large prospective study in the general population on determinants of mental health and social development during adolescence and young adulthood. With the support of the PCH services in Drenthe, Friesland and Groningen we were able to retrieve these PCH files from their archives.

## Introduction

Chapter 1 introduces what psychosocial problems are and addresses the complexity of early detection of these problems. The PCH services offer an ideal setting for the early detection of psychosocial problems. At the end of this chapter the aim and research questions are formulated and the data collection of the TRAILS study and retrieval of the PCH files is described.

The following questions were answered:

1. Can we predict which preadolescents are at risk for psychosocial problems with early childhood findings as registered by PCH?
2. Which early risk assessments by professionals are predictive for trajectories of internalizing and externalizing problems in adolescents in a PCH setting?
3. Can we identify early indicators of autism spectrum and attention deficit hyperactivity problems with early childhood findings as registered by PCH?
4. Can we predict which children have a heightened chance of being disliked or ignored by their preadolescent peers with data from the routine PCH?
5. How is the validity of parental recall on pregnancy, birth and early childhood behavior at child age 10-12 years?

## Indicators of psychosocial problems

In Chapter 2 we developed and validated -in two data sets- a prediction model for psychosocial problems in preadolescence based on data from routine PCH on childhood factors in early life. Early childhood findings were measured during pregnancy and at age 4, while psychosocial problems were measured at age 11 by parent report (with the CBCL). PCH-registered behavioral problems, attention hyperactivity problems, enuresis, level of education of the father, and being a boy all predicted externalizing problems. Internalizing problems were predicted by maternal smoking during pregnancy, sleep problems and being male. Surprisingly, the absence of certain data was predictive for psychosocial problems. The

model for externalizing problems had a modest discriminatory power (AUC 0.66, 95% confidence interval 0.59-0.72). That means that 66% of the children with externalizing problems were correctly predicted with PCH-registered early childhood data. However, for internalizing problems the AUC was 0.54 (95% confidence interval 0.47-0.60), indicating poor discriminatory power. It was concluded that findings on early development as registered by PCH are modestly predictive for externalizing problems in preadolescents, but only slightly for internalizing problems.

## Trajectories of psychosocial problems

The study described in Chapter 3 examined which early risk assessments by professionals are predictive for trajectories of internalizing and externalizing problems in adolescents in a PCH setting. In contrast with Chapter 2, early childhood indicators (where applicable) and outcome measures were measured at different moments in time from pregnancy up to age 4 and between the ages 11 and 17, respectively. Information on early indicators came from the records of the PCH. Trajectories of internalizing and externalizing problems were based on a combination of the parent-reported Child Behavior Checklist (CBCL) and the adolescent-reported Youth Self Report (YSR). Four types of trajectories were identified for both genders and for both types of problems. Per type of trajectory, a high trajectory of adolescents with clinical problems was identified, as well as a middle high, middle low, and low trajectory. All trajectories were relatively stable across ages; the continuity of these problems was very high. Parsimonious sets of early childhood indicators from PCH assessments predicted each of these trajectories. All sets comprised for both genders low and medium parental educational levels, and having divorced or otherwise single parents. For trajectories of internalizing problems, sleep problems were an additional predictor for boys, while language problems were for girls. Trajectories of externalizing problems were additionally predicted by maternal smoking during pregnancy for both genders. Moreover, for boys early behavioral problems and attention hyperactivity problems were predictive. Therefore, it was concluded that trajectories of internalizing and externalizing problems during adolescence are remarkably stable and can be predicted by a parsimonious set of data from early PCH assessments.

## Indicators of ASD and ADHD problems

In Chapter 4 we assessed whether early indicators of ASD and ADHD problems can be identified with early childhood findings as registered by PCH. In this chapter early indicators and ASD and ADHD problems were measured at different moments in time from pregnancy up to age 4 and between the age of 11 and 17 years, respectively. ASD and ADHD problems were based on the parent-reported Children's Social Behavior Questionnaire (CSBQ) and the Child Behavior Checklist (CBCL), respectively. Several early childhood indicators were identified that predicted ASD and ADHD problems. Male gender and the absence of parent-

reported positive behavior at toddler age were generic indicators, while a low birth weight, social behavioral problems, language, and psychomotor and eating problems at toddler age were specific indicators for ASD problems. Low level of education of the mother, maternal smoking during pregnancy, gross motor skills during infancy, and attention hyperactivity problems at toddler age were specific indicators for ADHD problems. In Chapter 4 we concluded that routine data on early childhood from PCH services are predictive for ASD and ADHD problems in adolescents in the general population. The PCH services are a useful setting to identify high risk groups, and to monitor them subsequently.

## **Indicators for a disputed social status**

Children and adolescents with a disputed social status among peers are at risk for several problems including being bullied. However, evidence on the joint effects of early risk factors for a disputed social status is limited. Therefore, in Chapter 5 we described the prediction of which children (in preadolescence) have a heightened chance of being disliked or ignored by their peers based on data from the routine PCH. Early childhood indicators were measured at different moments, from pregnancy up to age 4. To assess social status, peer nominations were used at age 11. Findings show that several early childhood indicators were predictive for neglect and rejection by peers. Children with a low birth weight, early motor problems, early sleep problems, and children with parents with a low educational level were more likely to have a neglected status; children with early attention hyperactivity problems were less likely to be so. Boys, children with parents with a low educational level, and children with externalizing problems in toddlerhood were more likely to have a rejected status in preadolescence. We concluded that PCH findings on early childhood – on motor and social development – are predictive of a neglected and rejected status in preadolescence. PCH can be a good setting to monitor social status of preadolescents.

## **Validity of parental recall**

The study described in Chapter 6 investigated the validity of parental recall on pregnancy, birth and early childhood behavior at child age 11. Evidence on the validity of parental recall of early childhood behavior is lacking. Findings show a poor parental recall after a 10-12 year period for maternal alcohol use during pregnancy and early childhood behavior, which was mostly due to over-reporting at age 10-12. In contrast, the recall of maternal smoking during pregnancy was good. For birth weight and gestational age, no systematic difference between recalled and PCH-registered data were found. It was concluded that retrospectively collected information on maternal alcohol use during pregnancy and early childhood behavior is sometimes biased, which limits its value in estimating the contribution of early life adversity to health in later life. But the reliability of recalled (TRAILS) data on maternal smoking during pregnancy, birth weight and gestational age was good.

## Discussion and implications

In Chapter 7 the answers on the main research questions of this thesis were summarized. The results were discussed, methodological considerations and recommendations were made, both for PCH practice and research. The results of this thesis show that early findings of PCH professionals predict psychosocial problems in (pre)adolescence, but only to a moderate degree. Externalizing, ASD and ADHD problems can be better predicted with early PCH data than internalizing problems. Although several predictors were identified which may facilitate the PCH professionals in their work, our results show the difficulty of accurate prediction of psychosocial problems from early PCH findings. More research is needed to further improve the long-term predictive value and robustness of early PCH findings, so that it can be better used by PCH professionals in the care they provide to children and adolescents.







# Samenvatting





Dit proefschrift richt zich op het voorspellen van psychosociale problemen – dat wil zeggen emotionele, gedrags-, aandachtstekort / hyperactiviteit en autisme spectrum problemen – bij adolescenten op basis van gegevens over de vroege ontwikkeling zoals vastgelegd door professionals van de Jeugdgezondheidszorg (JGZ). Tevens wordt onderzocht welke indicatoren uit de vroege kindertijd voorspellend zijn voor de sociale status in de preadolescentie en worden de validiteit en nauwkeurigheid vastgesteld van de gegevens die ouders zich herinneren over de leefstijl van de moeder tijdens de zwangerschap, geboortekennmerken en gedrag in de vroege kindertijd. Het in dit proefschrift beschreven onderzoek maakt deel uit van TRacking Adolescents' Individual Lives Survey (TRAILS), een grootschalig prospectief onderzoek onder de algemene bevolking naar determinanten van geestelijke gezondheid en sociale ontwikkeling tijdens de adolescentie en jongvolwassenheid. Met steun van de instellingen voor JGZ in Drenthe, Friesland en Groningen waren we in staat de benodigde gegevens te verzamelen uit JGZ-dossiers in hun archieven.

## Inleiding

In hoofdstuk 1 wordt beschreven wat psychosociale problemen zijn en hoe complex de vroegtijdige onderkenning van deze problemen is. De JGZ biedt een ideale setting voor de vroegtijdige onderkenning van psychosociale problemen. Aan het eind van dit hoofdstuk worden het doel van dit onderzoek en de onderzoeksvragen geformuleerd, de TRAILS-studie en de dataverzameling uit de JGZ-dossiers worden beschreven.

De onderzoeksvragen zijn:

1. Kunnen we op basis van gegevens uit de vroege kindertijd, geregistreerd door de JGZ, voorspellen welke preadolescenten een verhoogd risico lopen op het ontwikkelen van psychosociale problemen?
2. Welke vroege risicofactoren, vastgelegd door JGZ-professionals, voorspellen internaliserende en externaliserende probleemtrajecten bij adolescenten?
3. Kunnen we vroege indicatoren identificeren van autisme spectrum (AS) en aandachtstekort / hyperactiviteit (ADH) problemen met gegevens uit de vroege kindertijd geregistreerd door de JGZ?
4. Kunnen we voorspellen welke kinderen een verhoogde kans lopen om afgewezen of genegeerd te worden door hun preadolescente leeftijdgenoten op basis van JGZ-gegevens uit de vroege kindertijd?
5. Hoe valide is dat wat ouders zich herinneren over zwangerschap, geboorte en gedrag uit de vroege kindertijd van hun kind in de leeftijd van 10 tot 12 jaar?

## Indicatoren van psychosociale problemen

In hoofdstuk 2 beschrijven we de ontwikkeling en validering – in twee datasets – van een predictie model voor psychosociale problemen in de preadolescentie gebaseerd op reguliere JGZ-gegevens over de ontwikkeling in de vroege kindertijd. Gegevens over de vroege kindertijd werden vastgelegd tijdens de zwangerschap en op vierjarige leeftijd, psychosociale problemen werden gemeten op elfjarige leeftijd met behulp van rapportage door de ouders (met de Child Behavior Checklist, CBCL).

Door de JGZ geregistreeerde gedragsproblemen, aandachtstekort / hyperactiviteit problemen, enuresis (incontinentie voor urine), opleidingsniveau van vader, en geslacht (man) voorspelden externaliserende problemen. Internaliserende problemen werden voorspeld door roken van de moeder tijdens de zwangerschap, slaapproblemen op vroege leeftijd en geslacht (man). Opmerkelijk is dat het ontbreken van informatie in het dossier voorspellend was voor psychosociale problemen op de leeftijd van 10-12 jaar.

Het model voor externaliserende problemen heeft een matig onderscheidend vermogen (AUC 0,66; 95% betrouwbaarheidsinterval 0,59-0,72). Dit betekent dat voor 66% van de kinderen met externaliserende problemen de voorspelling correct was met door de JGZ geregistreeerde gegevens over de vroege ontwikkeling. Echter, voor internaliserende problemen was de AUC 0,54 (95% betrouwbaarheidsinterval 0,47-0,60), dit betekent een onvoldoende onderscheidend vermogen.

De conclusie is dat externaliserende problemen in de preadolescentie matig voorspeld worden door de JGZ geregistreeerde gegevens over de vroege ontwikkeling en internaliserende problemen slecht voorspeld worden.

## Trajecten van psychosociale problemen

In hoofdstuk 3 wordt beschreven welke vroege risicofactoren, vastgesteld door JGZ-professionals, trajecten van internaliserende en externaliserende problemen bij adolescenten voorspellen. Anders dan in hoofdstuk 2, werden indicatoren uit de vroege kindertijd (waar van toepassing) en uitkomstmaten gemeten op verschillende momenten in de tijd: achtereenvolgens van zwangerschap tot vierjarige leeftijd en tussen de leeftijd van 11 en 17 jaar. Informatie over vroege indicatoren kwam uit de dossiers van de JGZ. Trajecten van internaliserende en externaliserende problemen werden gebaseerd op een combinatie van gegevens: de door ouders ingevulde CBCL vragenlijst en door adolescenten ingevulde Youth Self Report (YSR) vragenlijst.

Vier typen trajecten werden geïdentificeerd, voor elk van beide geslachten en voor elk van beide typen problemen. Per trajecttype werd zowel een hoog traject van adolescenten met klinische problemen, als een middelhoog, middellaag en laag traject geïdentificeerd. Alle trajecten waren relatief stabiel over leeftijd; de continuïteit van deze problemen was erg hoog. Beperkte sets van indicatoren (uit de vroege kindertijd) van JGZ-gegevens voorspelden elk van deze trajecten. Alle sets bevatten voor beide geslachten de volgende indicatoren:

lage en gemiddelde opleidingsniveaus van de ouders, gescheiden ouders en eenoudergezinnen vanwege andere redenen. Voor trajecten van internaliserende problemen waren slaapproblemen een extra voorspeller voor jongens, voor meisjes waren dit taalproblemen. Trajecten van externaliserende problemen werden voor beide geslachten bovendien voorspeld door roken van de moeder tijdens de zwangerschap. Tevens waren voor jongens vroege gedragsproblemen en aandachtstekort / hyperactiviteit problemen voorspellend.

De conclusie is dan ook dat trajecten van internaliserende en externaliserende problemen tijdens de adolescentie opmerkelijk stabiel zijn en voorspeld kunnen worden door een beperkte set van JGZ-gegevens over de vroege ontwikkeling.

## Indicatoren van AS en ADH problemen

In hoofdstuk 4 stellen we vast welke vroege indicatoren van autisme spectrum en aandachtstekort / hyperactiviteit problemen geïdentificeerd kunnen worden op basis van JGZ-gegevens uit de vroege kindertijd. Vroege indicatoren en AS en ADH problemen zijn op verschillende momenten in de tijd gemeten: achtereenvolgens van zwangerschap tot vierjarige leeftijd en tussen 11 en 17 jaar. AS en ADH problemen werden gemeten met respectievelijk de door ouders ingevulde Children's Social Behavior Questionnaire (CSBQ) en de CBCL vragenlijst.

Verschillende indicatoren voor AS en ADH problemen in de adolescentie werden geïdentificeerd. Geslacht (man) en de afwezigheid van door ouders gerapporteerd positief gedrag op vroege leeftijd waren voorspellers voor beide typen problemen. Een laag geboortegewicht, afwijkend sociaal gedrag, taalproblemen, problemen met eten en psychomotorische problemen op vroege leeftijd waren specifieke indicatoren voor AS problemen. Een laag opleidingsniveau van de moeder, roken tijdens de zwangerschap door de moeder, vertraagde ontwikkeling van de grove motoriek en aandachtstekort / hyperactiviteit problemen op vroege leeftijd waren specifieke indicatoren voor ADH problemen.

De conclusie is dat reguliere JGZ-gegevens over de vroege ontwikkeling voorspellende waarde hebben voor AS en ADH problemen voor adolescenten in de algemene populatie. Instellingen voor JGZ zijn een geschikte setting om hoogrisicogroepen te identificeren, en deze vervolgens te monitoren.

## Indicatoren voor een lage sociale status

Kinderen en adolescenten met een lage sociale status onder leeftijdgenoten lopen het risico verschillende problemen te krijgen, waaronder gepest worden. Het wetenschappelijk bewijs voor de gezamenlijke effecten van vroege risicofactoren op een lage sociale status is echter beperkt. Daarom proberen we in hoofdstuk 5 te voorspellen welke kinderen in de preadolescentie een verhoogde kans lopen om afgewezen of genegeerd te worden door

leeftijdgenoten op basis van regulier door de JGZ verzamelde gegevens over de vroege ontwikkeling. Indicatoren (uit de vroege kindertijd) werden op verschillende momenten gemeten, van de zwangerschap tot vierjarige leeftijd. Sociale status op elfjarige leeftijd werd vastgesteld op basis van beoordelingen van leeftijdgenoten.

De resultaten wijzen uit dat verschillende vroege indicatoren voorspellen of een kind in de preadolescentie wordt genegeerd of afgewezen door leeftijdgenoten. Kinderen met een laag geboortegewicht, problemen als jong kind met de motoriek of met slapen, en kinderen met laagopgeleide ouders liepen meer kans om als preadolescent genegeerd te worden; kinderen met vroege aandachtstekort / hyperactiviteit problemen liepen hierop minder kans. Jongens, kinderen van laagopgeleide ouders, en kinderen met externaliserende problemen in de vroege kindertijd liepen meer kans om te worden afgewezen als preadolescent.

De conclusie is dat JGZ-gegevens over de vroege - motorische en sociale - ontwikkeling de sociale status (negeren en afwijzing door leeftijdgenoten) in de preadolescentie voorspellen. De JGZ kan een goede setting zijn om problemen met de toekomstige sociale status te monitoren.

## De validiteit van herinneringen van de ouders

In de studie beschreven in hoofdstuk 6 onderzochten we de validiteit van herinneringen van de ouders aan de zwangerschap, geboorte en gedrag (op leeftijd 4-6) van hun elfjarige kind. Wetenschappelijke kennis over de validiteit van herinneringen van ouders van gedrag uit de vroege kindertijd is er nog niet.

De resultaten wijzen erop dat ouders zich na een periode van 10 tot 12 jaar slecht kunnen herinneren hoe het gesteld was met alcoholgebruik tijdens de zwangerschap en gedrag uit de vroege kindertijd; er bleek vooral sprake van overrapportage op 10 tot 12-jarige leeftijd van hun kind. Daarentegen herinnerden zij zich goed of er gerookt werd tijdens de zwangerschap. Voor geboortegewicht en zwangerschapsleeftijd werden geen systematische verschillen gevonden tussen wat ouders zich herinnerden en wat de JGZ registreerde.

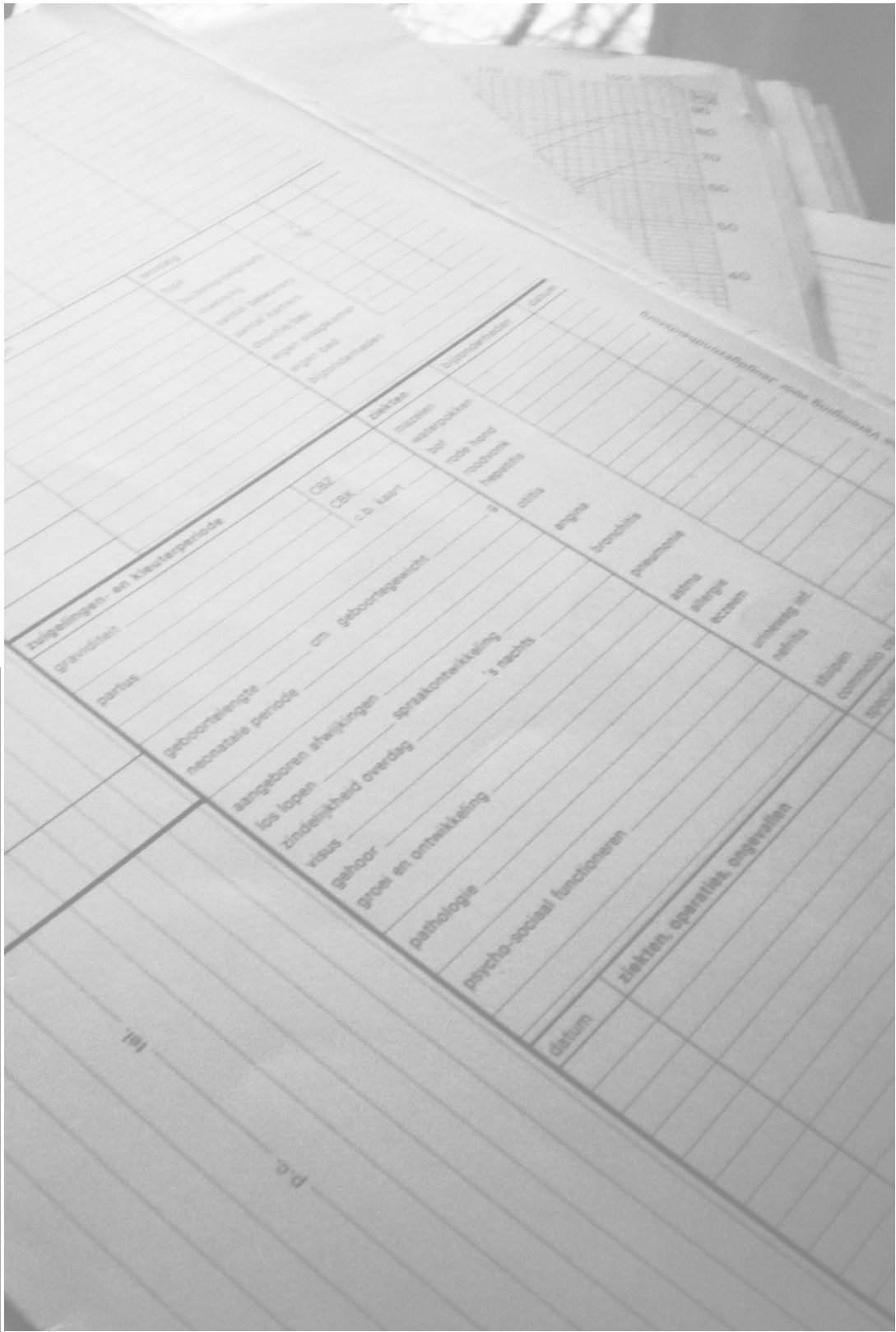
De conclusie is dat retrospectief verzamelde informatie over alcoholgebruik tijdens de zwangerschap en gedrag (op leeftijd 4-6) soms vertekend is, wat de waarde ervan voor het bepalen van de bijdrage van moeilijkheden en problemen (tijdens de kleuterschoolperiode) aan de gezondheid op latere leeftijd beperkt. Daarentegen bleek dat wat ouders zich herinnerden (TRAILS data) van roken tijdens de zwangerschap, geboortegewicht en zwangerschapsleeftijd wel betrouwbaar is.

## Discussie en implicaties

In hoofdstuk 7 worden de antwoorden op de eerdergenoemde onderzoeksvragen van dit proefschrift samengevat. De resultaten worden in de context gezet van eerder onderzoek en methodologie en er worden aanbevelingen geformuleerd, zowel voor de praktijk van de Jeugdgezondheidszorg als voor het wetenschappelijk onderzoek.

De resultaten van dit proefschrift wijzen uit dat vroege bevindingen van JGZ-professionals psychosociale problemen in de (pre)adolescentie voorspellen, maar slechts in beperkte mate. Externaliserende problemen, AS en ADH problemen kunnen beter worden voorspeld op basis van door JZG geregistreerde gegevens dan internaliserende problemen. Hoewel verschillende voorspellers werden geïdentificeerd die het werk van JGZ-professionals kunnen ondersteunen, wijzen onze resultaten uit hoe moeilijk het is psychosociale problemen op latere leeftijd nauwkeurig te voorspellen op basis van door de JGZ geregistreerde gegevens over de vroege ontwikkeling. Meer onderzoek is nodig om de over langere termijn voorspellende waarde en kracht van JGZ-gegevens over de vroege ontwikkeling te verbeteren om JGZ-professionals in hun zorg aan kinderen en adolescenten beter te kunnen ondersteunen.





# Dankwoord





Graag wil ik een aantal mensen bedanken voor hun bijdrage aan de totstandkoming van dit proefschrift en aan de mooie tijd als promovendus. Zonder hen zou het niet hetzelfde zijn geweest.

Allereerst gaat mijn dank uit naar mijn promotor prof. dr. S.A. Reijneveld en copromotor dr. A.F. de Winter. Beste Menno, tijdens mijn onderzoek heb ik enorm veel gehad aan jouw vakkennis en je altijd nuttige en extreem snelle commentaar. Ook wil ik je bedanken voor je strategische inzicht, onder andere bij het publiceren en het vasthouden van de grote lijn. Je hebt me geleerd korter en bondiger te schrijven. Beste Andrea, voordat je mijn copromotor werd, werkten we al samen binnen TRAILS. Jouw deur stond altijd voor me open als dagelijks begeleider, de laatste periode zelfs in het weekend. Onze discussies (dikwijls samen met Menno) brachten vaak nieuwe inzichten. Jouw vermogen om elke keer een stuk met een frisse blik te lezen, waardoor we het steeds scherper en evenwichtiger konden maken, evenals je enthousiasme hebben enorm bijgedragen aan het voltooiën van mijn proefschrift. Dank voor je oprechte betrokkenheid bij mijn onderzoek en de plezierige samenwerking. Mijn dank gaat ook uit naar mijn eerste dagelijks begeleider, dr. G. de Meer. Beste Gea, dank voor je begeleiding tijdens de eerste jaren van mijn onderzoek.

De leden van de beoordelingscommissie, prof. dr. F.J.M. Feron, prof. dr. E.J. Knorth en prof. dr. A.J. Oldehinkel wil ik hartelijk bedanken voor het lezen en beoordelen van mijn proefschrift.

Naast mijn (co)promotoren zijn er ook verschillende coauteurs die ik graag wil bedanken. Catharina Hartman, ik heb veel geleerd van onze samenwerking, ook op het gebied van autisme en ADHD, en enorm genoten van onze hilarische momenten achter de computer. Jouw bevologenheid inspireert me. René Veenstra, dank voor je stoomcursus over sociale status bij jongeren en je grote inspanningen als derde auteur. Hans Ormel, Frank Verhulst en Jan Buitelaar wil ik bedanken voor het meedenken over verschillende studies en voor hun waardevolle commentaar. Roy Stewart, shukran voor al je hulp op het gebied van statistiek en voor alle fijne gesprekken (zelfs op zondag in het UMCG), onder andere over de kunst van dans en reizen. Dank voor alle tijd die je erin hebt gestoken en voor het beantwoorden van mijn vele vragen. Dankzij Roy betrokken we Mark Huisman bij hoofdstuk 4. Mark, bedankt voor de fijne samenwerking en het imputeren van de data. Ik heb bewondering voor jouw kunde en kunst om moeilijke zaken eenvoudig uit te leggen.

Wijlen Willem Lok, bedankt voor het programmeren van het mooie veldwerkprogramma. Al mijn ideeën voor de data-invoer kon jij omzetten in Access. Truus van Ittersum, dank voor het maken van de vele recente literatuurlijsten en voor je hulp als ik vastliep in Reference Manager. Elise Dusseldorp en Stef van Buuren (TNO), dank voor de berekeningen van de D-

scores van het Van Wiechenschema. Het secretariaat sociale geneeskunde, Lida op 't Ende, Gerda Kloosterman en Janneke Vos, bedankt voor jullie ondersteuning.

Dank aan de TRAILS deelnemers die grotendeels door de jaren heen mee zijn blijven doen en het TRAILS team dat alle metingen uitstekend heeft verricht. Alsook de collega's die ik trof bij het TRAILS wetenschappelijk overleg. Ik heb veel geleerd tijdens deze bijeenkomsten. Dank daarvoor Kirstin, Hanneke (Creemers), Eryn, Judith, Harriëtte, Kennedy, Esther, Martin, Arjen, Rianne, Hanneke (Wigman,) Andrea (Prince), Jan Kornelis, Jelle, Catharina, René, Tineke en Hans.

Ook mijn dank aan de drie Noordelijke GGD-en en de andere (toenmalige) JGZ-instellingen voor het openstellen van hun archieven (als er toestemming was van de ouders van de TRAILS deelnemers), in het bijzonder Leo Wanders, Marian Luinstra, Jaap Erik Pijlman, Jan van Beek en Alies van der Neut. Daarbij ook Cathy Bolwijn, Wieke Broekman-de Boer, Ria Brouwer, Marjanne de Graaf, Hedwig Grooten, Marleen Koudenburg en Madelon Vuijk voor het invullen van een vragenlijst en het meelopen met Hedwig op het consultatiebureau in Sauwerd.

Leenke Visser en Else-Liene de Wijn, hartelijk dank voor het helpen bij de dataverzameling van de JGZ-dossiers en de vele gezellige momenten in de trein tussen Groningen, Assen en Leeuwarden.

Al mijn collega's van de 5<sup>e</sup> en de 6<sup>e</sup> verdieping van de Brug wil ik danken voor de prettige werksfeer en de gezelligheid, jullie deuren staan altijd open. In het bijzonder mijn kamergenoten door de jaren heen, Andrea, Annemieke, Edwin, Leenke en Manna. We hebben lief en leed met elkaar gedeeld en wat heb ik veel van jullie geleerd.

Eryn, bedankt voor alle gezellige lunches en etentjes waarbij we allang niet meer alleen over het TRAILS onderzoek sparren. Fijn dat we ondertussen praktisch burens zijn geworden. Jacomijn, Gemma, Lihua en Yvonne, bedankt voor jullie lotgenotencontact en onze relativerende gesprekken als psychologen onder elkaar. Inge en Marike, ik ben blij dat we onze lunches tijdens onze promotieonderzoeken hebben ingeruild voor uitstapjes van hele dagen samen met Andrea. Hoogste tijd om weer wat te plannen. Marike, samen hebben we veel bereikt in de promovendiraad.

Verder wil ik graag mijn collega's bij Academische Zaken bedanken voor de geweldige en warme ontvangst op mijn nieuwe werk en de energie die jullie me geven. Ook wil ik graag de UCW en de commissie Noort bedanken voor hun interesse tijdens de afronding van mijn proefschrift.

Voor en tijdens mijn promotie ontstonden vele vriendschappen in Groningen. Een deel van mijn vrienden is echter uitgeweken naar exotische oorden als Amsterdam, Brussel, Londen Washington D.C. en Zuid-Afrika. Ik wil jullie ontzettend bedanken voor jullie belangstelling en de welkome afleiding. Nu heb ik eindelijk weer tijd om jullie veel meer te zien, en dan niet alleen op Skype.

Andrea, eerst collega, toen kamergenoot en nu vriendin. Wat hebben we veel gelachen tussen al het harde werken door, van Tour de France en EK poules tot dat ene slot van de laptop. Ik vond het bijzonder om je paranimf te zijn en nu draaien we de rollen om.

Anne en Béchir, bedankt voor jullie betrokkenheid en belangstelling. Dat geldt natuurlijk ook voor Anne en Jelle.

Mijn geweldige ouders, Jan en Maria, bedankt voor alle liefde, steun en goede gesprekken. Het onvoorwaardelijke vertrouwen dat jullie altijd in mij gehad hebben, heeft me veel geholpen. Helaas heb ik wel een weddenschap verloren...

Lieve Jelle, mijn kleine broertje dat al lang niet meer klein is. Qua leeftijd lag je net een jaar voor op de TRAILS deelnemers. Ook al ben ik vaak het mikpunt van je grappen, toch geniet ik met volle teugen van je humor. Ik ben heel trots dat je mijn paranimf bent. Word jij de volgende dr. Jaspers?

Lieve Karim:

حبيبي. حياتي معك هي أكثر من ذلك بكثير ملونة. شكرا لدعمك وحبك غير المشروط. لا أستطيع الانتظار لبقية حياتنا.

Nu wordt het tijd om Arabisch te leren...



## Research Institute for Health Research SHARE

This thesis is published within the Research Institute SHARE of the Graduate School of Medical Sciences (embedded in the University Medical Center Groningen / University of Groningen). Further information regarding the institute and its research can be obtained from: [www.rug.nl/share](http://www.rug.nl/share). More recent theses can be found in the list below.

((co-)supervisors are between brackets)

### 2011

**Boersma-Jentink J.** *Risk assessment of antiepileptic drugs in pregnancy*  
(prof LTW de Jong-van den Berg, prof H Dolk)

**Zijlstra W.** *Metal-on-metal total hip arthroplasty; clinical results, metal ions and bone implications*  
(prof SK Bulstra, dr JJAM van Raay, dr I van den Akker-Scheek)

**Zuidersma M.** *Exploring cardiotoxic effects of post-myocardial depression*  
(prof P de Jonge, prof J Ormel)

**Fokkens AS.** *Structured diabetes care in general practice*  
(prof SA Reijneveld, dr PA Wiegersma)

**Lohuizen MT van.** *Student learning behaviours and clerkship outcomes*  
(prof JBM Kuks, prof J Cohen-Schotanus, prof JCC Borleffs)

**Jansen H.** *Determinants of HbA1c in non-diabetic children and adults*  
(prof RP Stolk)

**Reininga IHF.** *Computer-navigated minimally invasive total hip arthroplasty; effectiveness, clinical outcome and gait performance*  
(prof SK Bulstra, prof JW Groothoff, dr M Stevens, dr W Zijlstra)

**Vehof J.** *Personalized pharmacotherapy of psychosis; clinical and pharmacogenetic approaches*  
(prof H Snieder, prof RP Stolk, dr H Burger, dr R Bruggeman)

**Dorrestijn O.** *Shoulder complaints; incidence, prevalence, interventions and outcome*  
(prof RL Diercks, prof K van der Meer, dr M Stevens, dr JC Winters)

**Lonkhuijzen LRCM van.** *Delay in safe motherhood*  
(prof PP van den Berg, prof J van Roosmalen, prof AJJA Scherpbier, dr GG Zeeman)



**Bartels A.** *Auridory hallucinations in childhood*

(prof D Wiersma, prof J van Os, dr JA Jenner)

**Qin L.** *Physical activity and obesity-related metabolic impairments: estimating interaction from an additive model*

(prof RP Stolk, dr ir E Corpeleijn)

**Tomčíková Z.** *Parental divorce and adolescent excessive drinking: role of parent – adolescent relationship and other social and psychosocial factors*

(prof SA Reijneveld, dr JP van Dijk, dr A Madarasova-Geckova)

**Mookhoek EJ.** *Patterns of somatic disease in residential psychiatric patients; surveys of dyspepsia, diabetes and skin disease*

(prof AJM Loonen, prof JRB Brouwers, prof JEJM Hovens)

**Netten JJ van.** *Use of custom-made orthopaedic shoes*

(prof K Postema, prof JHB Geertzen, dr MJA Jannink)

**Koopmans CM.** *Management of gestational hypertension and mild pre-eclampsia at term*

(prof PP van den Berg, prof JG Aarnoudse, prof BWJ Mol, dr MG van Pampus, dr H Groen)

## 2010

**Martirosyan, L.** *Prescribing quality indicators for type 2 diabetes management: development, validation and selection*

(prof FM Haaijer-Ruskamp, dr P Denig, dr J Braspenning)

**Zwerver J.** *Patellar tendinopathy; prevalence, ESWT treatment and evaluation*

(prof RL Diercks, dr I van den Akker-Scheek, dr F Hartgens)

**Heijne-Penninga M.** *Open-book tests assessed: quality learning behaviour, test time and performance*

(prof JBM Kuks, prof J Cohen-Schotanus, prof WHA Hofman)

**Veselská Z.** *Intrapersonal factors, social context and health-related behavior in adolescence*

(prof SA Reijneveld, dr JP van Dijk, dr A Madarasova Geckova)

**Dubayová T.** *Parkinson's disease - psychological determinants of quality of life*

(prof JW Groothoff, dr JP van Dijk, dr I Nagyova, dr Z Gdovinona, dr LJ Middel)

**Sarková M.** *Psychological well-being and self esteem in Slovak adolescents*

(prof WJA van den Heuvel, dr JP van Dijk, dr Z Katreniakova, dr A Madarasova Geckova)

**Oeseburg B.** *Prevalence and impact of chronic disease in adolescents with intellectual disability*  
(prof JW Groothoff, prof SA Reijneveld, dr DEMC Jansen)

**Ittersum MW van.** *Chronic musculoskeletal disorders assessment and intervention*  
(prof JW Groothoff, prof CP van der Schans, dr CP van Wilgen, dr MF Reneman)

**De Smedt RHE** *Patients' perceptions of adverse drug events and their management in heart failure –towards a better understanding of the perspectives of the patients*  
(prof FM Haaijer-Ruskamp, prof T Jaarmsa, prof K van der Meer, dr P. Denig)

**Duyvendak M.** *Pharmaceutical care by clinical pharmacists in patients with musculoskeletal disease*  
(prof JRGB Brouwers, dr M Naunton, dr EN van Roon)

**Bakker MP.** *Stressful life events and adolescents' mental health; The TRAILS study*  
(prof AJ Oldehinkel, prof J Ormel)

**Schokker MC.** *Psychosocial outcomes in diabetes the interplay of intra-and interpersonal factors*  
(prof M Hagedoorn, prof TP Links, prof R Sanderman, prof BHR Wolffenbuttel, dr JC Keers)

**Hoedeman R.** *Severe medically unexplained physical symptoms in a sick-listed occupational health population*  
(prof JW Groothoff, dr B Krol, dr AH Blankenstein)

**Voogd JN de.** *Patients with chronic obstructive pulmonary disease in rehabilitation on psychological profiles, dyspnea and survival*  
(prof R Sanderman, dr JB Wempe)

**Vliet-Ostapchouk JV van.** *Revealing the genetic roots of obesity and type 2 diabetes*  
(prof MH Hofker, prof C Wijmenga)

**Bieleman A.** *Work participation and work capacity in early osteoarthritis of the hip and the knee*  
(prof JW Groothoff, dr FGJ Oosterveld, dr MF Reneman)

**Voorham J.** *Assessing cardiometabolic treatment quality in general practice*  
(prof FM Haaijer-Ruskamp, prof BHR Wolffenbuttel, dr P Denig)

**Meulenbelt HEJ.** *Skin problems of the stump in lower limb amputees*  
(prof JHB Geertzen, prof MF Jonkman, prof PU Dijkstra)

**Connolly MP.** *The economics of assisted reproduction; costs and consequences of fertility treatments*

(prof MJ Postma, prof W Ledger)

**Spanjer J.** *The Disability Assessment Structured Interview; its reliability and validity in work disability assessment*

(prof JW Groothoff, dr B Krol, dr S Brouwer)

**Kooij L.** *Diagnostic testing and screening in reproduction.*

(prof PP van den Berg, prof MJ Heineman, dr Tj Tijmstra)

**Tak LM.** *Dysfunction of stress responsive systems in somatization*

(prof J Ormel, prof JPJ Slaets, dr JGM Rosmalen)

**Vries R de.** *Health-economics of interventions aimed at infectious diseases dynamic modeling inevitable for reliable medical decision making*

(prof MJ Postma, prof LTW de Jong-van den Berg)

**Schorr SG.** *Drug safety in patients with psychotic disorders*

(prof K Taxis, prof JRBJ Brouwers, dr R Bruggeman, dr CJ Slooff)

**For more 2009 and earlier SHARE-theses see our website.**

## Previously published theses on TRAILS data

1. Sondeijker, F.E.P.L. (2006). Neuroendocrine and autonomic risk factors for disruptive behaviors in adolescents. Promotores: Prof. dr. F.C. Verhulst, Prof. dr. J. Ormel. Copromotor: Dr. R.F. Ferdinand
2. Brunnekreef, J.A. (2007). Information processing and problem behavior in preadolescents. Promotores: Prof. dr. J. Ormel, Prof. dr. R.B. Minderaa. Copromotores: Dr. M. Althaus, Dr. ir. L.M.J. de Sonnevile.
3. Dietrich, A. (2007). Autonomic nervous system function and behavioral characteristics in (pre)adolescents from a general population cohort. Promotores: Prof. dr. J. Neeleman, Prof. dr. J. Ormel. Copromotor: Dr. J.G.M. Rosmalen.
4. Greaves-Lord, K. (2007). Roots of Anxiety. The role of cardiovascular regulation and cortisol in the development of anxiety in early adolescence. Promotores: Prof. dr. F.C. Verhulst, Prof. dr. J. Ormel. Copromotor: Dr. A.C. Huizink.
5. Dijkstra, J.K. (2007). Status and affection among (pre)adolescents and their relation with antisocial and prosocial behavior. Promotor: Prof. dr. S. Lindenberg. Copromotor: Dr. R. Veenstra.
6. Amone, K.P. (2009). Examining the link between socio-economic position and mental health in early adolescents. Promotores: Prof. dr. J. Ormel, Prof. dr. A.J. Oldehinkel. Copromotor: Dr. H. Burger.
7. Noordhof, A. (2010). In the absence of a gold standard. Promotores: Prof. dr. J. Ormel, Prof. dr. A.J. Oldehinkel.
8. Sentse, M. (2010). Bridging contexts: the interplay between family, child, and peers in explaining problem behavior in early adolescence. Promotor: Prof. dr. S. Lindenberg. Copromotor: Dr. R. Veenstra.
9. Creemers, H.E. (2010). High Times - The role of temperament and other risk factors in the onset and continuation of cannabis use during adolescence. Promotores: Prof. F.C. Verhulst, Prof. A.C. Huizink
10. Bouma, E.M.C. (2010). The Sensitive Sex - Depressive symptoms in adolescence and the role of gender, genes and physiological stress responses. Promotores: Prof. dr. A.J. Oldehinkel, Prof. dr. J. Ormel. Copromotor: dr. H. Riese.
11. Liem, E.T. (2010). Development of overweight in adolescence. Genes, growth & mood. Promotores: Prof. dr. R.P. Stolk, Prof. dr. P.J.J. Sauer
12. Bakker, M.P. (2010). Stressful life events and adolescents' mental health - The TRAILS study. Promotores: Prof. dr. A.J. Oldehinkel, Prof. dr. J. Ormel

13. Sijtsema, J.J. (2010). Adolescent Aggressive Behavior – Status and stimulation goals in relation to the peer context. Promotor: Prof. dr. S. Lindenberg. Copromotor: Dr. R. Veenstra.
14. Bosch, N.M. (2011). Adolescents in Stress. The ups and downs of the psychophysiological stress response. Promotores: Prof. dr. A.J. Oldehinkel, Prof. dr. J. Ormel. Copromotor: dr. H. Riese.
15. Wigman, J.T.W. (2011). Persistence of the Extended Psychosis Phenotype: linked between Vulnerability and Clinical Need. Promotores: Prof. dr. W.A.M. Vollebergh, Prof. dr. J. van Os.
16. Janssens, K.A.M. (2011). The etiology of functional somatic symptoms in adolescents. A new perspective on lumping an splitting. Promotores: Prof. dr. J.G.M. Rosmalen, Prof. Dr. A.J. Oldehinkel.
17. Ivanova, K.O. (2011). From Parents to Partners: The Impact of Family on Romantic Relationships in Adolescence and Emerging Adulthood. Promotores: Prof. dr. M.C. Mills, Prof. dr. R. Veenstra.