The main aim of this thesis was to investigate the early identification of developmental and behavioral problems in pediatric primary care. We first explored the influence of redistributive policies on the social environment of early child development. Second, we focused on the assessment of communication problems in early childhood and on the identification of emotional and behavioral problems by teachers. At last, the relation between early childhood temperament and nutritional risk factors was investigated. In this chapter the main findings from this thesis are reported and discussed. Additionally, methodological issues and implications for pediatric primary care practice and research will be addressed.

**FINDINGS PER RESEARCH QUESTION**

In this paragraph we summarize our findings per research question.

1. **What is the influence of redistributive policies on early child development services and outcomes?**

   We have investigated country scores on four social determinants of health important in the early years of child development: prenatal care, maternal leave, child health care, and child care and early childhood education. For each of these social determinants we have compared the organization of services and health outcomes in five countries with different redistributive policies, including the Netherlands and Canada. More redistributive policies were associated with better organization of early child health services such as higher maternal leave allowances and more preventive child healthcare visits. Child health outcomes that were associated with generous redistributive policies included lower rates of infant mortality, low birth weight rate and under-five mortality. Importantly, our comparative analysis demonstrated correlation but cannot claim causation.

2. **How well does the Nipissing District Developmental Screen (NDDS) identify communication problems in infants?**

   In this study our primary objective was to assess the validity of the 18-month NDDS using the Infant Toddler Checklist (ITC) as a criterion measure. One or more “no” responses on the 18-month NDDS (i.e., the child does not demonstrate a behavior) indicate a need for further developmental assessment and/or referral. This is known as the “one flag” rule (1+NDDS flag). Previously, a minimum of two “no” responses (“two flag” rule) was recommended for a referral and/or follow-up of the child’s development (2+NDDS flag). Compared with the ITC, the 1+NDDS flag had modest to good sensitivity and poor specificity to identify expressive speech delay and other communication delays. The 2+NDDS flag had low to fair sensitivity and good specificity to identify expressive speech delay and other communication delays.
These results indicated that the NDDS does not have adequate psychometric characteristics to validly identify children with a range of communication delays.

3. **What is the reliability and validity of the teacher version of the Strengths and Difficulties Questionnaire (SDQ-T)?**

We evaluated the reliability of the SDQ-T and its validity using the Teacher’s Report Form (TRF) as a gold standard. Internal consistencies of the SDQ-T Total Difficulties Score, and the Hyperactivity/Inattention and Prosocial behavior domain scores were very good. Good concurrent validity was demonstrated by strong correlations of all subscales of the SDQ-T with the corresponding scales of the TRF, except for peer problems. Using a SDQ-T cut-off score > 14, the SDQ-T had a good sensitivity and specificity. Our study shows a mostly good reliability and validity of the SDQ-T in 4 -10 year old children.

4. **What is the rate of teacher-reported emotional and behavioral problems in children with Developmental Coordination Disorder (DCD) compared with their peers? How well does the SDQ-T perform compared to the TRF in children with DCD?**

Teachers reported significantly more emotional and behavioral problems in children (aged 4 -10 years) with DCD than in their peers without DCD. Children with DCD had increased odds of problems on the TRF domains Thought, Externalizing and Internalizing problems, and on all SDQ-T-domains and Total Difficulties scale. In the DCD group, the SDQ-T scores correlated strongly and showed moderate agreement with the TRF scores. The brevity and good validity of the SDQ-T make it an ideal questionnaire to identify emotional and behavioral problems by teachers in children with DCD.

5. **Is temperament (negative affectivity, effortful control and surgency) in early childhood associated with nutritional risk factors?**

Each child has three main reactive dispositions of temperament: 1) negative affectivity (e.g. sadness, discomfort), 2) effortful control (e.g. attention shifting, focusing, inhibitory and activational control) and 3) extraversion/ surgency (e.g. positive emotionality, activity, impulsivity). In our study, children with higher negative affectivity had higher odds of concurrent nutritional risk, but higher negative affectivity was not associated with a change in nutritional risk over time. Furthermore our study demonstrated both a concurrent and longitudinal protective effect of higher effortful control on nutritional risk in early childhood. Children at age three who had higher effortful control had a reduced nutritional risk at age five. We found no relationship between surgency and nutritional risk. Results from this study contribute to the growing recognition of temperament as an important early childhood behavioral risk factor in child nutritional outcomes.
DISCUSSION OF THE MAIN FINDINGS

In this paragraph the main findings of our study will be discussed.

Child development; the social environment

In Chapter 2, we selected four social determinants to explore the social environment of early child development important in the early years. These determinants were (1) prenatal care, (2) maternal leave, (3) child health care, and (4) early childhood education. They were compared between five countries with different political traditions, as classified by Navarro et al. In our study countries with political traditions of generous redistributive policies had a better organization of early child development services such as higher maternal leave allowances and more preventive child healthcare visits. Generous redistributive policies were also associated with improved child health outcomes; a decreasing trend in low birth weight rate, infant mortality, and under-five mortality rate were observed with an increase in redistributive policies.

In this thesis studies have been conducted both in the Netherlands and in Canada. In Navarro’s classification in the period 1950-2000 the Netherlands has mainly had a Christian Democratic political tradition, with redistributive policies funded by payroll taxes through social security systems. Canada has had a history of a more conservative political tradition in the same period, with no strong commitment to redistributive policies. In our comparison of early childhood services between the Netherlands and Canada we identified a striking difference in organization of pediatric primary care between the two countries. The Netherlands has had a long history of preventive child health care provided by specialized child health centers and had in our study, next to Sweden, the highest number of preventive care visits in early childhood (10 visits in the first 18 months). Importantly, the Netherlands is, next to Sweden, the only country that monitors the coverage rate for preventive child health care visits. In contrast, various healthcare providers offer pediatric primary care in Canada and there is no system in place to monitor preventive health care visits in individual children.

Another important finding in our analysis was a lack of uniform measures of the quality of early childhood education services and child development outcomes in the various countries. Recent data from the UNICEF Innocenti Report Card 11 “Child well-being in rich countries” included participation in early childhood education for the first time in the overall picture of children’s well-being. In that report, the Netherlands had one of the highest preschool enrolment rates (99%) and it was the only country that ranked among the top five in all dimensions of child well-being (material well-being, health and safety, education behaviors and risks and housing and environment). In contrast to the Netherlands, Canada was in the overall UNICEF league somewhere “stuck in the middle”. No Canadian data was
provided for the participation in early childhood education before the start of compulsory education, however a recent report estimated this at 62% (which would put Canada at the bottom of that league table). The large size of Canada, its remote and scattered communities, the large immigrant population and the longstanding poorer health status of their Indigenous people may be among factors that impede an improvement of Canada’s position. The Chairs of the 16 Departments of Paediatrics at Canadian medical schools emphasized the importance of a vigorous child health advocacy strategy that included the promotion of a social security net in Canada in order to improve the social environment of disadvantaged children.

**Developmental problems; early identification of communication problems**

We found that the Canadian NDDS, compared to the ITC, did not adequately identify children with a range of communication delays. This confirms recent findings of Cairney et al. who compared the NDDS with the Bayles Scales of Infant Development (BSID, 3rd edition). They found that the NDDS had poor to moderate sensitivity and specificity using the BSID as criterion. The authors concluded that the NDDS should not be used on its own for the identification of developmental delay in community or population-based settings. Our study results well align with this conclusion and the use of the NDDS in pediatric primary care as a developmental or communication screening instrument cannot be supported. The NDDS was originally not designed as a developmental screening tool, but as a short tool to promote a conversation about child development between health care providers and caregivers. In our study we did not examine if the use of the NDDS resulted in a more detailed discussion of general developmental concerns with caregivers.

Universal screening for developmental delay in children is still debated in the literature. A recent guideline “Recommendations on screening for developmental delay” from the Canadian Task Force on Preventive Health Care stated that there is no evidence from randomized controlled trials (RCTs) that screening for (any) developmental delay improves health outcomes in children. The Task Force recommended against screening for developmental delay using standardized tools in children aged one to four years with no apparent signs of developmental delay and whose parents and clinicians have no concerns about development. It is important to recognize that this guideline made a clear distinction between population based screening at one time point or developmental surveillance, which is defined as the monitoring of a child’s development at each clinical encounter. In the Netherlands the systematic surveillance of physical, psychosocial and cognitive development of children and youth is one of the main tasks of the preventive healthcare for children. In Canada, developmental surveillance defined as the ongoing monitoring of development, identification of risk factors, and the response to parental concerns is also considered to be part of standard clinical care for children.
An important limitation of the Canadian guideline is that it only focused on the screening of developmental problems and it did not include the screening of behavioral problems in this age group. The SDQ has been identified as a valid tool for the identification of emotional and behavioral problems in preschool children.\textsuperscript{10,11} There is also evidence that early identification and treatment of these emotional and behavioral problems can prevent poor outcomes in preschool children.\textsuperscript{12}

**Early identification of behavioral problems; the role of teachers**

In two studies we demonstrated the good reliability of the SDQ-T and its validity if compared with the TRF. The first study was conducted in 4-10 year old community school children and the second study included 4-10 year old children with DCD. Both studies demonstrated that teachers could make a valuable contribution to the identification of emotional and behavioral problems in children in the school community.

Our findings on the added value of teachers’ ratings confirm that obtaining information from teachers in addition to parental information is highly valuable. Teachers provide information on emotional and behavioral problems in children in a second setting, which may also be of help in the management of these problems in children.\textsuperscript{13,14} However, collecting teacher ratings of children’s emotional and behavioral problems also provides some challenges.\textsuperscript{15} Teachers who will participate in screening for emotional and emotional problems will need adequate training regarding these problems in children.\textsuperscript{16,17} Also, in practice it is not feasible for most teachers to fill in an SDQ for each child in their class. That probably implies that a teacher version of the SDQ cannot be used routinely for all children. Currently the Dutch guideline “psychosocial problems” in the Dutch preventive healthcare is under revision, and at this time it is not clear in what way the teacher version of the SDQ will be used in the Dutch preventive healthcare.

**The relation of early childhood temperament and nutritional risk**

Nutrition plays an essential role in growth and development, in academic success and in the social and emotional well-being of children. Our study investigated if a child’s early temperament is associated with nutritional risk factors over time. We demonstrated both a concurrent and longitudinal protective effect of higher effortful control on nutritional risk in early childhood. Children at age three who had higher effortful control had reduced nutritional risk at age five. Children with higher negative affectivity had higher odds of concurrent nutritional risk but higher negative affectivity was not associated with a change in nutritional risk over time.

Our results showed that early childhood temperament has an impact on later nutritional risk. This contributes to the growing recognition of temperament as an important early childhood behavioral risk factor in child nutritional outcomes.\textsuperscript{18-20} Preventive strategies to
decrease nutritional risk factors in preschool children might therefore consider approaches to address temperament. While temperament of individuals tends to be relatively stable over time, there is evidence that links between early temperament and child outcomes are malleable and that self-regulation can be improved with interventions that promote sensitive, responsive parenting. Because of the longitudinal protective effect of higher effortful control new nutrition prevention strategies in preschool children might consider programming to increase effortful control as opposed to decreasing negative affectivity.

**METHODOLOGICAL CONSIDERATIONS**

**Sample**
Our study was conducted in relatively large Dutch and Canadian pediatric community populations. Both Dutch studies took place in a school population of 4-10 year old children. A limitation of this school population sample concerned the relatively low response rates by schools and parents. We could not assess if the schools that refused to participate in our study differed in any respect from the schools that chose to participate in our study. A second limitation was that children from immigrant origin and parents with lower vocational education were underrepresented in this Dutch population. This small share of immigrants may be due to the fact that the schools were located in the middle and eastern regions of the Netherlands. An additional factor may be that immigrant parents refused to participate in our study.

The community-based nature of our study in the Netherlands resulted also in a relatively small number of children with DCD. Prevalence rates of DCD, based on the strict Leeds criteria for DCD that we used, will seldom lead to more than 5% of children with DCD in a community-based cohort. This limited number of children with DCD in our community sample led to broad confidence intervals for ORs of emotional and behavioral problems. Additionally, this also could have led to some overestimation of the sensitivity and specificity of the SDQ-T in the DCD group.

In Canada, children were included from a large community based primary care research network in Toronto, Canada (TARGet Kids!). TARGet Kids! is the only child health research network embedded in primary care practices in Canada. A limitation of the TARGet Kids! study population was that parents with a relatively high parental education level were overrepresented. Regarding ethnicity, in the complete TARGet Kids! study population a majority of people with an European background (66.8%) was included.

**Quality of data**
In our first study we explored the social environment of early child development in different countries. We searched international databases and reports to obtain information
on policies, services and outcomes of interest. Global databases, such as Organisation for Economic Co-operation and Development (OECD.Stat) and World Data Bank rely on data collected by national statistics. Although these large databases have made increasing strides to standardize indicator definitions, data sources, and collection methodology, inherently, there will be differences between countries that limit comparability.

In three studies we examined the validity of existing questionnaires and compared them to a gold standard. The choice of the gold standards in our studies could be criticized. In Chapter 3, the criterion validity of the NDDS with the ITC was investigated. The goal of our study was to compare two short developmental screening instruments that can be used in primary pediatric care. Therefore we did not assess communication with an independent, standardized measure such as the MacArthur-Bates Communicative Developmental Inventories (MB-CDI) or the Bayley Scales of Infant Development (BSID). The ITC is a standardized screening questionnaire and well validated in multiple studies. The NDDS is not standardized and at the time of our study the psychometric properties of the NDDS had not yet been published.

In Chapters 4 and 5 the validity of the SDQ-T was assessed using the TRF as gold standard. Strength of these studies was that we were able to use Dutch norms for both questionnaires. Although the TRF is one of the best instruments available, it cannot be regarded as the ultimate gold standard, because that position is reserved for clinical diagnosis. Because of complexity and high costs, structured clinical interviews such as the Diagnostic Interview Schedule for Children were not used as criterion. Based on the literature however, the TRF can be considered to be a good criterion for the early detection of mental health problems by professionals.

In Chapter 6 we explored the concurrent and longitudinal relation of temperament and nutrition risk. Both the Nutrition Screening Tool for Every Pre-schooler (NutriSTEP®) and the very short form of the Child Behavior Questionnaire (CBQ-VSF) are parent reported which could have led to ascertainment bias. However, both questionnaires have demonstrated strong measurement properties when validated against direct observation.

**Causality**
An important limitation in our comparative analysis of early child health and development services and outcomes is that this analysis only allowed for correlation, not for causation. A web of different social, cultural, economic, genetic, political, and environmental conditions influences early child development and could not be captured completely in our study. Our study examining the identification of emotional and behavioral problems by teachers in children with DCD presented only cross-sectional data and therefore does not allow causal inferences. Studies explaining the increased risk for emotional and behavioral difficulties in DCD are still scarce. Specifically, the considerable overlap between DCD and Attention
Deficit/Hyperactivity Disorder (ADHD) has been subject to debate in literature with studies arguing that DCD could be one facet of broader syndrome including learning difficulties and attention deficits and studies suggesting that DCD and ADHD are distinct disorders.\textsuperscript{33,34}

In our study on the relation between temperament and nutritional risk in early childhood a limitation was the lack of measurement of parenting style. In literature, both emotional development and the development of healthy eating behaviors in children are thought to be dependent on responsive parenting behaviors, in other words on parenting behaviors that reflect reciprocity between child and caregiver.\textsuperscript{35} In contrast to a direct association another possibility could be that parenting style has a mediating influence on the development of nutritional risk factors. For example, it is reported that parents use food to sooth their ‘fussy’ (i.e. high in negative affectivity) infants.\textsuperscript{36}

**Generalizability**

The results of the studies conducted in the school population in the Netherlands (Chapter 4 and 5) are likely generalizable to other school populations in the Netherlands and possibly to other Western European school populations as well. In our school population, children from immigrant origin and parents with lower vocational education were underrepresented. This may have led to an underestimation of the prevalence of clinical SDQ and TRF scores as previous studies show rates of emotional and behavioral problems to be somewhat higher among children from low-SES families and among Moroccan and Turkish children.\textsuperscript{37} However, it is unlikely that this has significantly influenced the correlation between the SDQ-T with the TRF. Anyhow, these results need to be confirmed in other groups of children, including children with a non-Western European background.

The results of the studies conducted in the pediatric research group \textit{TARGet Kids!} in Canada (Chapter 3 and 6) are likely to be generalizable to other pediatric primary care populations in Canada and other European populations. Parents are only included in the \textit{TARGet Kids!} population if they are able to communicate in English. Therefore our results may not hold for immigrant populations who don’t speak English. This is especially an important limitation in our study investigating communication in 18-months old children. Language development is inextricably integrated with culture.\textsuperscript{38}

In our study examining the influence of temperament on nutritional risk the majority of parents had a relatively high education level (>90% college level). Confirmation of our findings is therefore needed in in a low-income population.
Chapter 7

IMPLICATIONS

Implications for policy and pediatric practice

Our study reported that redistributive policies aimed at reducing social inequalities were associated with a positive influence on the social determinants of early child development. Our study adds to the literature that mandates governments to increase their redistributive policies as a means to improve early child development outcomes and services. For both policy makers and researchers, a population linked administrative database, including information about early child development and the social environment, would provide a powerful resource in obtaining longitudinal data on large populations over the life-course. In Sweden, Western Australia and in Ontario the Institute for Clinical and Evaluative Sciences (ICES) the linkage of administrative records from multiple sources to create a longitudinal data set is well established. However, in order to improve child development outcomes on both an individual and population level, mechanisms should be developed to systematically collect, analyze, and respond to universally accepted early child development indicators.

Based on our results of the poor psychometric properties of the 18-month NDDS, we would not advise primary care practitioners to use the 18-month NDDS to identify children with communication delays. The ITC has been validated and studied in a large pediatric population and might be a more promising screening tool for the early identification of communication and other developmental delays in primary pediatric care.

This thesis reported on the good reliability and validity of the SDQ-T with the TRF in 4-10 year old children in the Netherlands. Pediatric primary care providers are increasingly held accountable to assess emotional and behavioral problems in their practice and are mandated to collaborate with parents and teachers on these problems. The use of the SDQ-T to identify teacher reported emotional and behavioral problems can be supported in the general school population and also in children with DCD. The SDQ-T TDS may highly add to the identification of emotional behavioral problems in the school setting.

In Canada, specifically in large urban cities, there has been experience with obtaining information from teachers directly in the school environment in “school-based health clinics”. In these school-based health clinics, family physicians and pediatricians collaborate with teachers and other school staff. These clinics were designed to improve access to developmental and medical services, especially for economically disadvantaged and new immigrant families. A feasibility study demonstrated that one in five children were diagnosed with a new mental health disorder in these school based health clinics. The SDQ-T could be of value for the clinicians working in these clinics. The brevity, good validity, free accessibility, the availability in many languages, and cultural acceptability of the SDQ-T would make it an ideal questionnaire in this setting to obtain information from teachers.
Implications for research

Based on our finding of poor psychometric properties of the NDDS we concluded that the NDDS is not suitable to identify children with a range of communication delays. Because of its good psychometric properties and substantial validation over the past decades the ITC is a more promising instrument to detect early communication delays in pediatric primary care.\textsuperscript{25-27} A recent systematic review that investigated the screening for speech and language delays in children 5 years or younger did not find any well-conducted trials that addressed the question whether early screening and subsequent treatment of speech and language delays lead to improved outcomes.\textsuperscript{42} Therefore, evidence from randomized controlled trials is needed to decide whether screening for communication delays with the ITC and subsequent early treatment should be implemented.

Our study demonstrated a strong correlation and moderate agreement of the SDQ-T with the TRF in children with DCD. Future studies should explore the use of the SDQ-T in children with DCD in a larger community-based population. In addition, further research is needed to explore the relationship between DCD and emotional and behavioral difficulties further, including causal pathways.

Our study regarding the influence of early childhood temperament on later nutritional risk was one of the first studies that demonstrated the longitudinal protective effect of effortful control. The study population included an overrepresentation of parents with a higher education. Confirmation of our findings is therefore needed in other populations. Future research should explore the relationship between temperament and nutritional risk in families with a lower socioeconomic status. Since temperament and parenting style are thought to have a bidirectional relationship additional research should also explore if parenting style mediates the association between temperament and nutritional risk. Ultimately, intervention studies are required that evaluate if prevention strategies to increase effortful control will lead to a decrease in nutritional risk in preschool children.

FUTURE PERSPECTIVES

As the understanding deepens and expands regarding the profound influence of social factors on developmental process through multiple gene-environment interactions, the long-standing role of pediatric care providers to promote the bio-psycho-social well-being of all children also must evolve.\textsuperscript{43,44}

Social pediatrics is the pediatric subspecialty that focuses on the child’s health, development and behavior within the child’s social, environmental and political context. In the Netherlands, social pediatrics has been a subspecialty since 1974, and four universities offer this training. The focus of social pediatrics in the Netherlands has been on the identification and management of psychosocial problems in children at risk e.g. children
experiencing abuse, children with chronic diseases and/or developmental concerns and children living in poverty. Essential in the work of a social pediatrician in the Netherlands is the participation in multidisciplinary teams inside the hospital, as well as outside with community partners.

In Canada, developmental-behavioral pediatrics is the subspecialty that focuses on childhood neurodevelopmental (e.g. autism spectrum disorder, attention deficit hyperactivity disorder) and neuro-rehabilitation disorders (e.g. cerebral palsy) and partly overlaps with social pediatrics in the Netherlands. Social pediatrics in Canada is the subspecialty that focuses on the social determinants of health as critical mediators of health especially applied to disadvantaged and vulnerable children and their families. The Chairs of Departments of Paediatrics at Canadian medical schools advocated for the importance of social pediatrics in curriculum development. However, social pediatrics is not recognized as a separate subspecialty by all universities, though multiple opportunities exist for students and residents to explore social pediatrics in many universities in Canada.

Pediatric medicine is a discipline of subspecialties and one could argue that pediatricians with a focus on child health, development and behavior in relation to the social environment, working both in a hospital and in a community setting (e.g. in public health, mental health centers, government institutions) are highly needed. These paediatricians can help to design new science-based multidisciplinary strategies to promote optimal child development.

**CONCLUSION**

In this thesis the importance of redistributive policies on the social environment of early child development was demonstrated. For the early identification of communication problems the 18-month NDDS showed not to have adequate diagnostic properties. For the early identification of behavioral problems, the SDQ-T demonstrated good reliability and validity in a pediatric community population and also in children with DCD. Our last study provided evidence that child temperament influenced nutritional risk factors in early childhood.

Pediatric primary care providers need to identify developmental and behavioral problems early and monitor the social environment of children. New, creative strategies, including multidisciplinary collaborations locally and globally are urgently needed to address the social, behavioral, and economic determinants of lifelong disparities in order to promote optimal child development.
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