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ADHD medication prescription: Effects of child, sibling, parent and general practice characteristics

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ABSTRACT

Many children receive attention-deficit hyperactivity disorder (ADHD) medication, but factors that determine medication prescription are largely unknown. This study aimed to determine the relative impact of factors on the child, family and general practitioner (GP) practice level on ADHD medication prescription. We included 1259 Dutch children aged 6–18 years with a diagnostic code of ADHD or related behavioural problems (ICPC codes P20-P22) in NIVEL primary care database.

Using multilevel analyses, we examined predictors of ADHD medication prescription. Children diagnosed as 'hyperactive' were 16 times more likely to be prescribed ADHD medication than those with 'behavioural concerns'. Children with a parent or sibling receiving ADHD medication were three to four times more likely to be prescribed ADHD medication themselves.

Children from GP practices with a high percentage of children with ADHD were twice as likely to be prescribed ADHD medication. Concluding, factors on the individual, family and GP practice level determine ADHD medication prescription. Future research into the decision-making process for ADHD medication is warranted.

INTRODUCTION

Attention-deficit hyperactivity disorder (ADHD), characterized by concentration problems, hyperactivity and impulsivity (American Psychiatric Association, 2000), is the most common neuro behavioural disorder in children. Worldwide, 5%–7% of children and adolescents fulfil the DSM-IV criteria for ADHD (Willcutt, 2012). Most of them receive medication (Chen et al., 2009, 2011; Visser et al., 2014; Winterstein et al., 2008), which effectively reduces symptoms in about 80% (Schachter et al., 2001;Wigal, 2009).However, its effect seems to decreasewith time (Jensen et al., 2007) and functioning usually remains below normal levels (Shaw et al., 2012). In the United States, 6%of children aged 4–17 years useADHDmedication (Visser et al., 2014). In the Netherlands, 3%of children aged under 20 years receive ADHD medication (Stichting Farmaceutische Kengetallen, 2012).

The question is being raised whether ADHD medication is always necessary. Studies indicate that children may be overdiagnosed (Bruchmu¨ller et al., 2012; Chilakamarri et al., 2011; Evans et al., 2010; Kjeldsen et al., 2012), although others contradict this (Sciutto and Eisenberg, 2007) or conclude that ADHD may be both under- and overdiagnosed (Cuffe et al., 2005). Unnecessary ADHD medication use is undesirable for financial reasons but also because ADHD medication can have short-term side effects like decreased appetite and insomnia (Stein et al., 2003). Its long-term safety (Ashton et al., 2006) and effects on the developing brain are unclear (Graham et al., 2011; Urban and Gao, 2015; Wigal, 2009).
ADHD medication prescription results from a complex interplay between different actors within a child's ecological system. Based on Bronfenbrenner's ecological systems theory (Bronfenbrenner, 1979), we developed a model including factors on three levels (Figure 1). First, characteristics of the child itself: boys with ADHD more often use medication than girls (Chen et al., 2009, 2011; Winterstein et al., 2008) and school-aged children have the highest rates of ADHD medication prescription (Chen et al., 2009).

[FIGURE 1]
Second, family characteristics: children with a family member withADHDmay be more likely to use ADHD medication because of increased recognition of ADHD symptoms or positive experiences with medication. Parents using psychotropic medication also seem more positive towards ADHDmedication (Al-Haidar, 2008). Third, factors related to the healthcare system.Wefocused on the general practitioner (GP) practice. In the Netherlands, the GP is a gatekeeper to secondary care and will decide to refer a child with ADHD symptoms to a paediatrician or child psychiatrist. Prescription behaviour differs considerably between practices (Ohlsson et al., 2011), probably also for ADHD medication. GPs seeing many children with ADHD may more often recommend treatment because of previous positive experiences but may also have seen more side effects. Practice type may influence prescription behaviour, as GPs in group practices can more easily consult their colleagues. Finally, as ADHD is more prevalent in children with a lower socio-economic status (Hjern et al., 2010), GPs in deprived areas may be more inclined to prescribe ADHD medication.
We aimed to determine the impact of the child, family and GP practice on ADHD medication prescription in children with ADHD. Based on extant research, we hypothesized that child characteristics would have the largest impact, followed by family and then GP practice characteristics.

METHODS

Database

We used data from the Netherlands Institute for Health Services Research (NIVEL) Primary Care Database (Netherlands Institute for Health Services Research, 2014), formerly known as LINH. [figure 1] In a network of Dutch practices nationally representative as to practice type, geographical coverage, age and sex of patients, GPs routinely record all contacts, diagnoses and prescriptions. Diagnoses, that is, reasons for encounter, are coded using the International Classification of Primary Care (ICPC), consisting of 17 chapters with underlying sub-classifications (Lamberts and Wood, 2002).

Prescriptions are coded using the Anatomical Therapeutic Chemical (ATC) code (WHO, 2011).
Coded data are extracted from the electronic medical records (EMR) twice a year. Dutch inhabitants are obligatorily insured for standard medical care and nearly all are listed with a GP.
According to the Dutch Medical Research Involving Human Subjects Act, this study does not require ethics approval. As obtaining individual consent from each individual patient is not achievable, the medical ethical committee agreed on a procedure in which information about NIVEL Primary Care Database is provided in the waiting room of the participating practices. This information also describes an opt-out procedure. Information of patients who do not want to be included in NIVEL Primary Care database will be deleted. We do not receive information that could be used to directly identify patients, such as birth date or full postal code.

Patients and family members

We included children aged 6 to 18 years whose EMR contained one of the following ICPC codes in 2010: 'disturbance memory/concentration' (P20), hereafter called concentration problems, 'overactive/hyperkinetic child' (P21), hereafter called hyperactivity, and 'other concern behaviour childhood' (P22), hereafter called behavioural concerns. We used these three different codes as, contrary to the ICD or DSM coding, the ICPC has no specific code for ADHD.
Within a practice, every household receives a unique number, so we could identify persons belonging to the same household. Households of more than six persons were excluded because these could be boarding schools or other institutions. Persons 20–45 years older than the child were assumed to be parents. Persons <20 years older were assumed to be siblings. When more than two parents were identified (n = 17, 1%), all were considered as parents. In households with multiple children with ADHD, we selected the youngest child and considered the other(s) as sibling(s), because we did not have enough power to add family as a level in the multilevel analyses. It is likely that the youngest child is diagnosed at a later time than older sibling(s). Prior treatment choices and possible experience with ADHD medication in older siblings may affect treatment choices in younger children. By selecting the youngest child, we were more likely to find an effect of family characteristics, should there be one.

ADHD medication prescription

ADHD medication prescription was defined as receiving a prescription in 2010 for dexamphetamine (ATC-code N06BA02), methylphenidate (N06BA04) or atomoxetine (N06BA09).

Child/family/practice characteristics

We examined age, sex and specific ICPC code (P20/P21/P22) as child characteristics and ADHD with or without medication in parents and siblings as family characteristics. Practice characteristics studied were solo or group practice, neighbourhood deprivation, percentage of children in the practice population and percentage of children with ADHD. Neighbourhood deprivation was determined through the patient tariff. In the Netherlands, GPs receive a quarterly tariff per patient, which is higher for practices in deprived neighbourhoods.

Statistical analysis

Children were nested within practices (more than one child in a GP practice with the same practice characteristics), so we performed multilevel logistic regression analysis with ADHD medication prescription as dependent variable and two levels: child (level 1) and practice (level 2). We started with a null model only containing the level structure. This model is used to examine to what extent (unmeasured) practice characteristics affect ADHD medication. To quantify this, we calculated a 95% confidence interval for the percentage of children in a practice being prescribed ADHD medication (inter-practice variation) (Nielen et al., 2009). To assess the effect of variables on the child and family level, we then added explanatory factors linked to the child, family and practice as independent variables. Analyses were performed using STATA 12.11 and MLWin 2.25.

RESULTS

We included 1264 children from 62 practices. They had a mean age of 11.0 years (SD = 3.4 years) and 71% were boys. Most children received the ICPC code 'overactive/hyperkinetic child' (48%) or 'other concern behaviour childhood' (50%), and 40% were prescribed ADHD medication (Table 1).

[TABLE 1]

The main factor influencing ADHD medication prescription was the specific ICPC code (Table 2). Compared to children diagnosed with 'behavioural concerns', children with 'hyperactivity' were 16 times more likely and children with 'concentration problems' were 4 times more likely to be prescribed ADHD medication. Children aged 6–8 years were less likely (odds ratio (OR) = 0.6) to be prescribed ADHD medication than those aged 9–12 years, whilst those aged 13–18 years were more likely (OR = 1.6).

[TABLE 2]

Having a parent or sibling using ADHD medication led to a three times higher likelihood of ADHD medication prescription. Children from solo practices or from practices with a high percentage of children with ADHD were more likely to be prescribed ADHD medication (OR = 1.5, and 2.1, respectively), whilst those from practices with a low percentage of children aged 6–18 years were less likely to be prescribed ADHD medication (OR = 0.7). The percentage of ADHD medication prescription in practices varied from 17% to 63% (Table 2). However, the inter-practice variation dropped with 99% (from 0.29 to 0.001) after controlling for child, family and practice characteristics.

Because the ICPC code seemed an important factor, we performed post hoc analyses, which showed small differences between the groups of children diagnosed with hyperactivity and behavioural concerns. The first group was less often female (22% vs. 36%), somewhat older (mean age 11.5 vs. 10.4), and although they were not more likely to have a parent diagnosed with ADHD (8% vs. 9%), a larger percentage of these parents were prescribed medication (65% vs. 19%). We built two separate models explaining medication prescription for children with hyperactivity and behavioural concerns (See Supplementary material, file 1).

The number of children with concentration problems was too small for a separate model (n = 69). In both models, patients with a family member using ADHD

medication and older patients were more likely to be prescribed ADHD medication. Children with hyperactivity with a family member with ADHD not using medication were less likely and boys with behavioural concerns were more likely to be prescribed ADHD medication. The percentage of ADHD medication prescription in practices varied between 61% and 76% in children with hyperactivity and between 4% and 28% in children with behavioural concerns.

DISCUSSION

General findings

According to the results of this study, factors at the individual, family and GP practice level influence ADHD medication prescription. At the individual level, children with hyperactivity were most likely to be prescribed ADHD medication. A US study also found that children with ADHD more often received medication when they showed hyperactive symptoms (Chen et al., 2009), possibly because hyperactive symptoms are more noticeable and disruptive than internalizing symptoms (Derks et al., 2007). As boys more often show hyperactive symptoms, this may also explain why boys are more easily diagnosed with ADHD (Bruchmu¨ller et al., 2012) and more often use ADHD medication (Chen et al., 2009, 2011; Derks et al., 2007; Winterstein et al., 2008; Chen et al. 2011). In our study, boys were more often prescribed medication in the subgroup of children with behavioural concerns but not in the subgroup with hyperactivity. Age also influenced ADHD medication prescription. Children aged 13–18 years were almost three times more likely to be prescribed ADHD medication than those aged 6–8 years. Chen et al. also found that the likelihood of ADHD medication prescription in children increased with age (Chen et al., 2011).

At the family level, children were more often prescribed ADHD medication when their parents were using ADHD medication. Having a family member with ADHD not using medication did not affect the likelihood of medication prescription, so it is not having a family member with ADHD per se, but previous experience with ADHD medication that affects ADHD medication prescription.

When a family member successfully uses ADHD medication, parents will be more positive towards medication (Al-Haidar, 2008) and GPs may be more inclined to refer a child or prescribe medication.

At the level of the GP practice, the most important predictor of ADHD medication prescription was a high percentage of children aged 6–18 years with ADHD. Maybe these GPs are more positive towards ADHD medication or they are more familiar with ADHD and therefore are more likely to diagnose children with ADHD. Most of the variation between GP practices can be explained by differences in the individual, family and healthcare factors we studied. However, in the subgroup of children with behavioural concerns variation between practices remains considerable after correction for these factors. This finding may be related to diagnostic uncertainty, leading to more physician-driven medication prescription (Zuidgeest et al., 2009). This is interesting, as use of stimulants to treat behaviour outside of an ADHD diagnosis is controversial (Marcovitch, 2004; Rey and Sawyer, 2003). Alternatively, the group of children with behavioural concerns likely comprises a variety of behaviour problems, leading to more heterogeneity in practice populations.

Strengths and limitations

We used a database of EMRs from GP practices, enabling us to study a large cohort of children with ADHD and their relatives. We assessed factors affecting ADHD medication prescription on three levels: the child, family and practice. This enabled us to assess inter-practice variation and control for unmeasured practice characteristics. It also has some limitations. The diagnosis was based on the ICPC code registered by the GP. The ICPC has no specific code for ADHD. We therefore selected three codes: disturbance memory/concentration (P20), overactive/hyperkinetic child (P21) and other concern behaviour childhood (P22). The group of children with concentration problems (P20) was too small to examine separately. Besides, we could not directly identify siblings and parents of children in our database but identified probable parents and siblings by their age and household number in the EMR. We could thus only study family members living at the same address and registered with the same practice. We may therefore have underestimated the effect of family characteristics.

We based our results on GP data, whilst in the Netherlands, medication prescription in children with ADHD is often initiated by a paediatrician or psychiatrist (Hodgkins et al., 2011).

However, the GP is the first to see children with ADHD symptoms, will decide on referral to the paediatrician or psychiatrist and often provides repeat prescriptions. In a Dutch study, GPs provided repeat prescriptions for 61% of the children. Child psychiatrists and paediatricians accounted for 30% and 21% of the prescriptions. Fifteen per cent of the children received repeat prescriptions from two or more different types of physicians (Faber et al., 2006). We may thus have underestimated the percentage of children receiving medication. In two recent studies, about 80% of Dutch children with ADHD were using medication (Fliers et al., 2013; Groenman et al., 2013), so the 70% we found seems a small but acceptable underestimation. We can, however, not exclude that part of the variation between practices is caused by the specialist a GP refers to. GPs may also more often record the ICPC code hyperactivity, rather than behavioural concerns, when they refer a child to a paediatrician. Subsequently, these children are more likely to receive ADHD medication. Besides, factors influencing prescribing patterns of specialists and GPs may differ.

It is likely that factors that we did not study influence medication prescription. On the individual level, these may be, for example, symptom severity and duration, previous therapies (Hjern et al., 2010). On the family level, these may be nationality, ethnic origin and socio-economic group and educational level (Wittkampf et al., 2010; Zwirs et al., 2006). On the practice level, factors like gender, age, personal opinion of the GP about ADHD medication and previous experience of the GP with ADHD medication are likely to affect prescription of ADHD medication. Unfortunately, we had very limited data on the characteristics of individual GPs. However, children may be treated by different GPs within a practice, making analysis on the GP level difficult. Factors related to the school and teacher (Sax and Kautz, 2003) may also influence ADHD medication prescription.

Also, our sample size was relatively small for the current models, as indicated by the sometimes wide confidence intervals of the odds ratios.

CONCLUSION AND IMPLICATIONS

According to the results of this study, ADHD medication, although mainly prescribed in children with hyperactivity, is also prescribed in children with behavioural concerns. It may be questioned whether prescription is justified in this latter group. We also found that GPs prescribe ADHD medication more easily when a family member already uses it and when the percentage of children with a diagnosis of ADHD in the practice population is high. This indicates that previous experience of parents and GPs with ADHD medication influences the decision to start ADHD medication.

Future research into the decision-making process for ADHD medication in general practice is therefore warranted.

Conflict of interest The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Supplemental material The online Supplementary materials are available at http://chc.sagepub.com/supplemental

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TABLES AND FIGURES

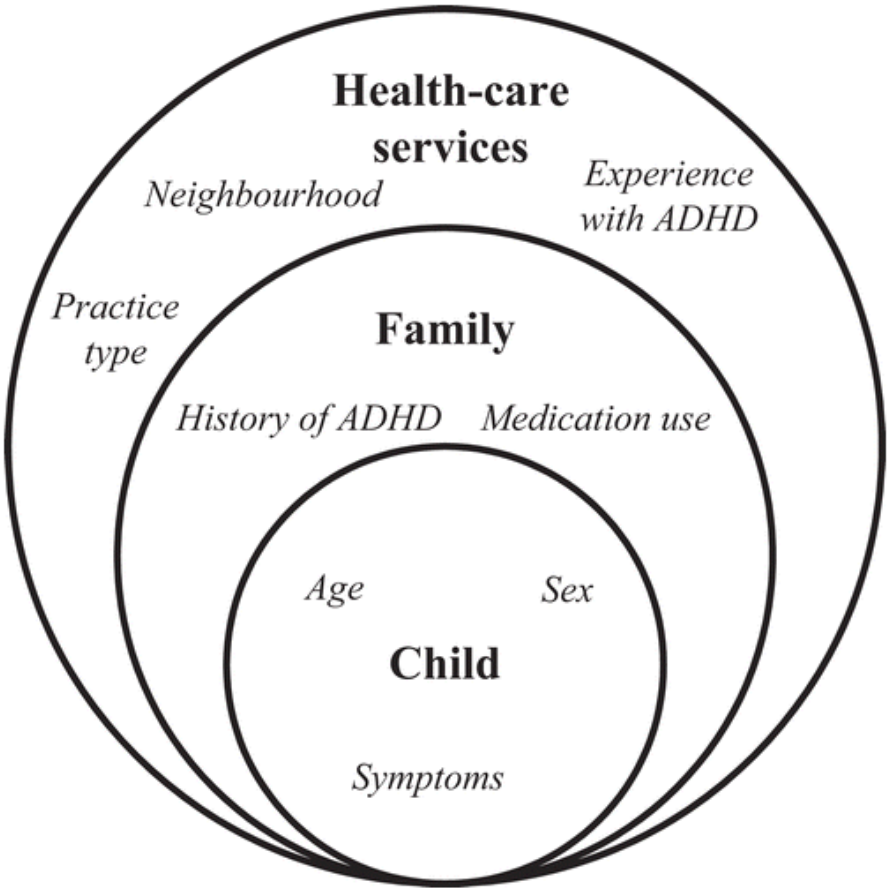

Figure 1. Conceptual model of factors affecting ADHD medication prescription. ADHD: attention-deficit hyperactivity disorder.

Table 1. Baseline characteristics of the child ($N = 1259$), family ($N = 1199$) and practices ($N = 62$).

	Mean (SD)/*n* (%)
Child characteristics	
Age(years)	11.0 (3.4)
Sex (male)	895 (70.8%)
ICPC code	
Memory/concentration (P20)	69 (5.5%)
Hyperkinetic/hyperactive (P21)	607 (48.0%)
Other concern behaviour (P22)	628 (49.7%)
More than one of the above	40 (3.2%)
ADHD medication	509 (40.3%)
Family characteristics	
ADHD parents	
No ADHD (%)	1124 (89.9%)
ADHD without medication	65 (5.1%)
ADHD with medication	42 (3.3%)
Parents registered with different GP	33 (2.6%)
ADHD siblings	
No ADHD	977 (77.3%)
ADHD without medication	31 (2.5%)
ADHD with medication	67 (5.3%)
No siblings registered with same GP	189 (15.0%)
Practice characteristics	
Solo practice	34 (54.8%)
Practice in deprived neighbourhood	5 (8.1%)
Practice population 6–18 years (%)	16.6 (2.6)
Practice population 6–18 years with ADHD (%)	4.3 (1.8)

ICPC: International Classification of Primary Care; ADHD: attention-deficit hyperactivity disorder; GP: general practitioner.

Table 2. Multilevel logistic regression models of the influence of characteristics of the child, family and practice on the risk of ADHD medication.

	Null model	Model containing explaining factors
Fixed Part		OR (95% CI)
Child characteristics		
Age(years)		
6–8		0.57 (0.40–0.82)
9–12		1.00
13–18		1.62 (1.15–2.28)
Sex (male)		1.17 (0.84–1.62)
ICPC code		
Behavioural concern (P22)		1.00
Concentration problems (P20)		3.89 (2.13–7.12)
Overactive child (P21)		16.33 (11.82–22.57)
Family characteristics		
ADHD parents		
No ADHD		1.00
ADHD without medication		0.50 (0.23 – 1.07)
ADHD with medication		2.71 (1.18 – 6.22)
No mother/father registered with same GP		1.23 (0.50 – 3.06)
ADHD siblings		
No ADHD		1.00
ADHD without medication		0.52 (0.20–1.37)
ADHD with medication		3.39 (1.73–6.64)
No siblings registered with same GP		1.05 (0.69 –1.60)
Practice characteristics		
Solo practice		1.46 (1.01–2.09)
Practice in deprived neighbourhood		0.98 (0.43–2.22)
% of Practice population 6–18 years[a]		
Low (9–15%)		0.68 (0.47–0.98)
Middle (16–17%)		1.00
High (18–25%)		0.76 (0.53–1.09)
% of Practice population 6–18 years with ADHD[a]		
Low (0.5–3.2%)		1.33 (0.91–1.95)
Middle (3.2–5.4%)		1.00
High (5.4–7.8%)		2.05 (1.36–3.10)
Random part		
Variance at practice level (SE)	.287 (.102)	.001 (.043)
95% CI for inter-practice variation	17–63%	

ICPC: International Classification of Primary Care; ADHD: attention-deficit hyperactivity disorder; GP: general practitioner; CI: confidence interval; OR: odds ratio.
[a]Split in three equal groups.