Use of Medical Services by Methylphenidate-Treated Children in the General Population

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Objectives.—To examine selected medical services for children treated for attention-deficit/hyperactivity disorder (ADHD) in a general population setting with universal health insurance.

Design.—Retrospective analysis of administrative prescription and health services databases spanning from 1990 to 1996.

Setting.—British Columbia, Canada.

Patients.—Children (<19 years of age) who had received the psychostimulant methylphenidate (MPH; Ritalin) on a chronic basis (chronic-MPH group), who had received MPH on any other basis (nonchronic-MPH group), and who were in a no-MPH comparison group.

Main Outcome Measures.—The number of individuals who received any of the following services based on claims submitted by qualified practitioners: 1) emergency care, 2) critical care, 3) injury-related diagnostic and treatment services, 4) complementary and alternative medical (CAM) care, and 5) other diagnostic and treatment services (audiometry and allergy testing).

Results.—Prevalence of services users was higher among MPH-treated than nontreated children for all types of services (except critical care services in the chronic-MPH group) after adjusting for effects of age, sex, socioeconomic status, and geographic setting, with odds ratios ranging from 1.49 to 3.17. There were no differences between the 2 MPH-treated groups.

Conclusions.—Children treated with MPH for ADHD or presumed ADHD are more frequent users of a wide range of medical services than are other children. Findings support and extend existing evidence of increased use of medical services by this population of children. Findings have implications for service planning, including injury prevention, with these children. High utilization of audiometric, allergy, and CAM services warrants further scrutiny.

KEY WORDS: administrative data; attention-deficit/hyperactivity disorder; children; health services use; injuries; population-based research


The use of whole population data can reduce threats to internal and external validity in health research by eliminating selection bias and affording very high generalizability. Whole population research is made possible in Canada by a single-payer universal insurance program (Medicare) and the capacity developed in certain provinces to use the resulting administrative data for research purposes. We have been investigating the treatment and correlates of attention-deficit/hyperactivity disorder (ADHD) in children and youth through analysis of administrative prescription and health services data from the province of British Columbia (population of 3.6 million at the midpoint of the study period).

ADHD, a chronic neurobehavioral disorder involving dysregulation of attention, impulse control, and activity level, is of public health importance because it affects 5%–10% of school-aged children1 and is associated with academic underachievement, disrupted family and peer relationships, poor self-esteem, substance abuse, and other mental health problems.2 In addition, the medical management of ADHD with stimulant drugs continues to generate public and professional controversy.3,4 Methylphenidate (MPH) has been the most frequently prescribed stimulant drug and the main modality of medical treatment used in ADHD.5 We previously found that MPH-treated children were at increased risk for injuries resulting in admission to hospital.6 The aim of the present study was to investigate relationships between MPH treatment (as a proxy for ADHD) and children’s use of medical services by using practitioner claims data for services provided to both hospitalized and ambulatory patients and for emergency as well as elective procedures.

Recent studies have shown increased utilization of medical services among children diagnosed with ADHD,7–9 but the extent to which this increased utilization is attributable...
to use of services tied to ADHD diagnosis and management remains unclear. In addition, some studies have involved restrictive geographic and socioeconomic cohorts and have failed to consider the effects of potential confounding factors—such as age, sex, socioeconomic status (SES), and geographic setting—that may be associated with prevalence of ADHD and its medical treatment and utilization of hospital and ambulatory services. Other studies have examined a fairly narrow range of range of health care services and have lacked statistical power to detect differences among certain service categories. Finally, all these studies were conducted within US settings, where access to services is affected by an individual’s insurance coverage. To address these issues, we analyzed data from the whole population of British Columbia, Canada, where universal health insurance ensures that access to medical services depends mainly on need and availability, and we built control for possible confounders into the study design.

METHODS

Study Setting, Population, and Data Sources

The study involved analysis of data from administrative prescription and health services databases from the province of British Columbia for the period of January 1, 1990 to December 31, 1996. Children’s MPH status was obtained from the BC’s Triplicate Program Database, a repository for the data collected under the statutory requirements of BC’s Triplicate Prescription Program, which requires reporting all prescriptions of MPH and drugs with the potential for abuse (but not other stimulant drugs). Information collected includes unique personal identifiers for patients and physicians, drug details, and date dispensed. The BC Linked Health Dataset (BCLHD), a repository for health data arising from the province’s Medicare program, was the source of information on use of health services by children. This database contains information about hospitalizations, procedures performed, discharge diagnoses, and claims to reimbursement for services rendered by eligible health care providers, including physicians, naturopathic physicians, and chiropractors. Receipt and settlement of claims is administered under the BC Medical Services Plan (MSP). During the study period, almost all physician services were provided according to a fee-for-service payment mechanism under which practitioners submitted claims to MSP with codes designated for specific fee items. A registration file in BCLHD also contains information on MSP enrollees (essentially all residents of British Columbia), including date of birth, residential postal code, and a code to indicate whether support from the British Columbia Ministry of Health for health insurance premiums was required. The British Columbia Ministry of Health issues a unique personal identification number to residents of British Columbia, which is common to both the Triplicate Prescription database and BCLHD, allowing linkage of person-specific datafiles across databases. Encryption procedures applied to this personal identification number create anonymity in the dataset so that researchers have access to individual-level, nonidentifying data. Data from BCLHD were made available under the access policy of the British Columbia Ministry of Health, and the project was approved by the Research Ethics Review Board of the University of British Columbia. The study population consisted of all children <19 years in the province as of December 31, 1996, which was the last day of the study period.

Study Variables

Use of Medical Services

From the available fee code items within the BCHLD, 2 of the pediatrician-investigators (A.M. and R.A.) identified items that were believed to be of particular relevance in their link to children receiving MPH. Such items were codes linked to emergency, critical care, and injury services and codes that may be linked to seeking of alternative explanations and treatments for behavior problems of the ADHD type, specifically hearing problems, allergies, and alternative and complementary medical services. To be included in the study, a service needed to be identifiable as an item billable by qualified practitioners under MSP and relevant to children and youth with ADHD, but it needed to have limited or inconsistent documentation of the presence or magnitude of such a link. Emergency care services were selected because of the discrepant findings from recent US studies and critical care services, in view of a demonstration that children with chronic conditions are at increased risk for intensive care admissions for severe, acute illness related to the underlying chronic condition. A range of injury-related diagnostic and treatment services (injury-related services) was selected to include procedures carried out in ambulatory settings (in order to extend our earlier findings beyond the range of injuries requiring admission to hospital) and to clarify whether the demonstrated association between behavior problems and severe injuries extends also to less severe injuries. We examined complementary and alternative medical (CAM) care services, because they are increasingly used for a variety of chronic health conditions in adults and children; audiometric testing in view of complex interrelationships that have been described between attentional and learning difficulties and hearing loss; and allergy testing because of the implication of allergies as a cause of behavioral and learning problems.

Utilization of each type of medical service by subjects in this study was measured as the number of individuals against whose names payment had been made by MSP to an eligible practitioner during the study period after submission of a claim that listed one or more of the selected fee codes. (A detailed list of the unique fee codes selected to represent service items and categories is available upon request.) Hence, the use of these services was expressed in terms of the number of users and nonusers during the study period. Subjects were counted only once for each service type regardless of how many services of that type they had received. However, subjects could be counted
more than once if they received different types of services.

**MPH Prescription Status of Persons Using Medical Services**

Three categories for MPH prescription status were recognized. Children who received prescriptions for MPH that lasted for at least 12 months, with no break longer than 4 months between successive prescriptions at any time during the study period, were assigned to the chronic-MPH group. Children who had received one or more prescriptions for MPH during the study period but did not meet the criterion for chronic-MPH treatment were assigned to the nonchronic-MPH group. Children with no recorded prescriptions for MPH during the study period were assigned to the no-MPH group. We reasoned that the chronic-MPH patients would represent a so-called purer group of patients with ADHD, whereas the other group would include children with ADHD as well as those who were tried on MPH therapy in an attempt to manage a less specific range of problems of behavior and learning. If use of medical services were mainly related to ADHD status, we would expect to find higher use of services among the chronic group than the other prescription group. If, on the other hand, use of services were most closely related to presence of problems of behavior and learning, then both of these patient groups should show similar relationships with services use.

**Child-Related Covariates**

The age at the last day of the study period was measured, and subjects were aggregated into 1 of 4 categories: 0–3 years, 11 months; 4–8 years, 11 months; 9–13 years, 11 months; and 14–18 years, 11 months. The geographic setting in which subjects resided was based on the health region in which the child was registered at the onset of the study and designated as either a metropolitan or nonmetropolitan area. Two measures of SES were used: 1) SES quintile used the family’s residential postal code to determine an indicator of SES aggregated at the level of neighborhood (census enumeration area); and 2) MSP premium relief (received/not received), which indicates whether an individual had received relief from the British Columbia Ministry of Health toward payment of health care premiums on the basis of indigence.

**Data Analysis**

Initial analyses took the form of cumulative frequency counts and prevalence rates (technically, prevalence “proportions”) of service users over the 7-year time period with the number of service users as the numerator and the number of children in each of the 3 MPH prescription categories as the denominator. The relative likelihood of being a service user according to MPH prescription category, after controlling for differences in age (4 levels, with the youngest group as referent), sex, SES quintile, MSP subsidy status, and geographic setting, was examined in a series of logistic regression analyses. A relatively strict 99% confidence interval (CI) was adopted for all analyses, given our large dataset.

**RESULTS**

**Description of Study Population**

The study group included 1 028 028 individuals. Of these, 1155 were missing sex codes and were excluded from the analysis, leaving a final total of 1 026 873. Among these, 16 806 (1.6%) had been prescribed MPH during the time period. Of these, 3271 (19.5% of MPH patients) met criteria for the chronic-MPH group; the remaining 13 535 cases were assigned to the nonchronic-MPH group. Frequencies and demographic characteristics of all 3 groups are presented in Table 1. There were no significant differences between the 2 MPH subgroups. A detailed comparison of MPH subjects with no-MPH subjects has been presented elsewhere and can be summarized as follows: compared with the no-MPH group, individuals from the MPH groups were more likely to be male, in the 2 older age groups, in the lower 2 SES quintiles, to have applied for MSP relief, and to reside in nonurban settings.

**Frequency of Service Use in Relation to MPH Status**

Table 2 describes the frequency and prevalence of service users in each of the 3 MPH subgroups. Fairly large

| Table 1. Population Frequencies and Demographic Characteristics by MPH Prescription Status* |
|-----------------------------------------------|------------------|------------------|------------------|
|                                                | No MPH           | Nonchronic MPH   | Chronic MPH      |
|                                                | (N = 1 010 067)  | (N = 13 535)     | (N = 3271)       |
| Gender                                         |                 |                  |                  |
| Female                                        | 495 530         | 2579             | 515             |
| Male                                          | 514 537         | 10 956           | 2756            |
| Age group†                                     |                 |                  |                  |
| 0–3 y, 11 mo                                  | 186 701         | 38               | 1               |
| 4–8 y, 11 mo                                  | 276 573         | 2599             | 472             |
| 9–13 y, 11 mo                                 | 273 571         | 6419             | 1841            |
| 14–18 y, 11 mo                                | 273 222         | 4479             | 957             |
| MSP relief‡                                   |                 |                  |                  |
| Yes                                           | 348 924         | 6552             | 1701            |
| No                                            | 661 143         | 6983             | 1570            |
| SES quintile†                                  |                 |                  |                  |
| Metropolitan                                  |                 |                  |                  |
| Regions                                       | 381 023         | 3960             | 996             |
| Other                                         | 600 510         | 9309             | 2225            |

*MPH indicates methylphenidate; MSP, Medical Services Plan; and SES, socioeconomic status.
†As of December 31, 1996.
‡Government subsidy for Medical Services Plan (British Columbia health insurance) premiums.
discrepancies were observed between the MPH groups and the non-MPH group across categories of service, whereas differences between the 2 MPH groups appeared to be small or minimal. This pattern is confirmed in Table 3, in which the odds for service use associated with each MPH group and their 99% CIs are compared with the non-MPH group after controlling for differences in sex, age group, SES, and geographic setting. The odds for service use was significantly greater in both MPH groups as compared with the non-MPH group, except for one with a low frequency of service use (critical care services in the chronic-MPH group). Overlapping of CIs for the odds of service use in the 2 MPH subgroups indicated that prevalence of service use did not differ between these subgroups.

**DISCUSSION**

Our results show that MPH-treated children are more frequent users of a variety of medical services than are non–MPH-treated children, with the largest differences seen for naturopath consultations, audiometry services, allergy testing, and use of emergency care services. This pattern was true for chronic-MPH patients and for those with other exposure histories, and the pattern held after statistical adjustment for differences in factors that may be related both to MPH treatment and to use of medical services. The demonstration of these relationships in a whole population setting with universal Medicare strengthens and extends recent reports of higher use of services among children with ADHD.\(^7\)\(^{-9}\) Below, we consider the extent to which present findings from MPH-treated children may be interpreted as evidence of increased service use among children with ADHD.

The principal indication for MPH in pediatrics is ADHD, and over 90% of MPH prescriptions to children in Canada are for ADHD\(^2\)\(^1\),\(^2\)\(^2\); therefore, our MPH-treated subjects are very likely to have ADHD or suspected ADHD. Some children with ADHD may be treated with other stimulant drugs, but because MPH accounted for about 85% of medication prescriptions used for ADHD in Canada in the mid-1990s (IMS Health Canada, Compuscript, 1995), this group would be very small, and their
use of services should not differ from those of MPH-treated children. On the other hand, between about 70% and 80% of children with ADHD are treated with stimulant drugs, leaving a group of 20%–30% who are not. This proportion is relatively small compared with children who do receive MPH, and, given our 7-year study period, it may be even lower than 20%–30%. Nevertheless, if this omitted group differed in some way from children with ADHD who did receive stimulants (the MPH subjects of our study), this could distort the applicability of our findings to children with ADHD. It is conceivable that children with more severe ADHD are more likely to receive MPH and also to require more diagnostic and treatment services. This would tend to inflate the estimate of service use for children with ADHD. However, there is very little evidence to determine the presence or extent of this potential bias. Alternatively, having a child on medical treatment may increase the likelihood of the child using other medical services because of clinical-level surveillance bias. This seems unlikely as a source of bias in the present study compared with existing studies in this area, because subjects diagnosed as ADHD in these other studies were themselves the subject of medical attention. It is also possible that parents of children who receive medical treatment for ADHD are somehow prone to pursuing and using other kinds of medical services, but this would be unlikely to result in an excessive use of emergency or injury-related services or elective investigations such as allergy tests, to which access is controlled by physicians. In sum, we believe that although some caution should be exercised in drawing inferences about use of services among children with ADHD from MPH-treated children, it is justifiable to do so, in part because the possible sources of bias discussed above are unlikely to be major, and also because the present findings are highly consistent with existing evidence.

Present findings add to the existing literature in a number of ways. First, they establish that ADHD is associated with a range of injury events and not just more severe injuries that result in admission to the hospital, extending our earlier findings of the link between behavior problems and injuries. Second, they demonstrate that children with ADHD are higher users of emergency services than are children without such problems, a relationship that has previously been unclear. It would be very helpful to know the extent to which the use of emergency (and critical care) services were attributable to injury events, but we could not determine this from available data. Third, our findings of similarly increased rates of users among chronic- and nonchronic-MPH patients suggest it may not be the presence of ADHD only that leads to higher use of services, but the presence of a broader range of problems of behavior and learning for which MPH may be prescribed.

Having selected a range of services that we suspected would show some relationship to ADHD, we can comment on the appropriateness of the specific findings. The increased use of audiology services by this population can probably be justified on the basis of recommendations and guidelines that hearing loss be ruled out in children suspected of having ADHD as well as having overlaps between so-called central auditory processing disorder and ADHD. We note in passing, however, a lack of evidence from population-based studies of the utility of routinely testing hearing in all children suspected of having ADHD. On the other hand, the greater than twofold likelihood of MPH-treated children undergoing allergy testing compared with no-MPH children is a concern given that commonly used skin reactivity tests are not related to ADHD or ADHD symptoms. Furthermore, although some children with ADHD do appear to respond to dietary manipulations, there is no evidence to suggest that skin testing is a necessary or useful adjunct to dietary changes. Some concern is also warranted about the apparent popularity of naturopathy and chiropractic among stimulant-treated children in British Columbia, because the efficacy of these interventions for ADHD is not established. There is also no convincing evidence for their efficacy with other chronic health problems that have occasionally been reported as associated with ADHD in children. It is of incidental interest to note the increased use of CAM by MPH-treated children because it confirms a phenomenon previously reported in adult patients; namely, CAM tends to be used along with rather than instead of mainstream therapies.

Possible limitations to our study findings include issues of bias when we attempt to extrapolate results from MPH-treated cases to those with ADHD, as discussed above. In spite of these issues, we believe that identification of cases by treatment status is a strategy that warrants further investigation and possibly wider application in population-based research. Prescription claims databases offer strengths in terms of completeness and accuracy that diagnostic data in administrative databases may sometimes lack, and the strategy is feasible and economical. Other types of misclassification could have arisen in our study if some younger children with ADHD had not been treated with MPH by the end of the study period, if some older children with ADHD had completed MPH treatment before the beginning of the study window, or if some nonidentified-ADHD children had been included in the no-MPH group. We note, however, that these instances of misclassification would lead us to underestimate the strength of relationships found between service utilization and ADHD, based on MPH status. We would also point out that the data we used provide information on prescriptions written, not filled. Thus, the MPH-treated groups may include children who received prescriptions but did not actually receive the medications prescribed. A final area of potential limitation relates to our use of data collected for administrative rather than research purposes. Although there are issues concerning the quality of administrative health data, analysis of administrative databases is one of the few methods whereby health issues at the population level can be addressed. Canadian studies of similar databases to those in British Columbia have concluded that such sources provide a reasonably accurate
picture of prescriptions issued and patient-physician contacts.

We have demonstrated that MPH-treated children are significantly more likely to use a range of medical services than are nontreated children and have argued that the most likely explanation is the presence of ADHD or related problems of behavior and learning in the treated children. Our findings have implications for further research and health policy. First, empirical confirmation is needed of the suspicion that much of the excessive use of emergency and critical care services by children with behavior and learning disorders is attributable to injuries. Such confirmation will mandate the need for comprehensive efforts, including parent and physician education, aimed at prevention of injuries in this vulnerable population. It will also be important to establish whether current management strategies for ADHD, such as stimulant drugs, reduce risk of injury among children. Second, physician practices regarding allergy testing with this population of children need to be reviewed with possible implications for physician and patient education. Third, the use of routine audiometric testing requires more systematic investigation. And finally, the increased use of CAM services in this population suggests that parents continue to look for alternative or complementary treatments, in spite of lack of evidence of benefit to children with ADHD from chiropractic or naturopathy treatment. Physicians need to understand this behavior and explore effective strategies for working with families in understanding the limitations of these approaches.

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