ARTICLE

Medical and Psychiatric Comorbidity and Health Care Use Among Children 6 to 17 Years Old

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Background: The association of psychiatric disorders (PDs) with other PDs and medical disorders (MDs) has been insufficiently explored in children and adolescents.

Objectives: To estimate medical and psychiatric comorbidity present in children with PDs and to determine the medical service usage of children with PDs.

Design: We use administrative health care data to describe the health care provided for study children. Psychiatric disorders were classified into the following 3 categories: psychosis, emotion, and behavior. We used logistic regression to assess medical comorbidity for each category. Psychiatric comorbidity was determined using χ^2 test analysis. Health care use was determined by comparing the frequency of visits for MDs and PDs between children with PDs and children without PDs.

Setting: We studied 406 640 children (50.6% male) between 6 and 17 years old, living in Alberta, Canada, during the fiscal year April 1, 1995, through March 31, 1996.

Results: A PD was diagnosed in 32 214 (60.3% male) children. Psychiatric comorbidity was present in 13.6% of the children; comorbidity existed in all 3 psychiatric groups and peaked in postpubertal children. More girls than boys had significant medical comorbidity. Significant odds ratios (ORs) for girls varied from 1.2 (behavior and sinusitis, bronchitis, and chronic disorders; psychosis, and menstrual problems) to 15.3 (behavior and developmental delay). Among boys, the highest OR was seen with the combination of behavior and developmental delay (OR, 8.3) and psychosis and poisoning (OR, 8.2). With ORs ranging from 4.6 to 15.3, developmental delay consistently had high ORs for both sexes and all 3 types of PDs. Poisoning also had high ORs (3.3-14.1) with all 3 PDs and both sexes. Among girls, disorders associated with pregnancy and the genitourinary system had modest associations (OR, 1.9-2.2, for behavior) to moderate (OR, 2.5-4.0, for emotion). Children with PDs had significantly greater medical service usage than did children without PDs. Girls had greater medical health care usage than boys. Psychiatric service usage was similar for both sexes.

Conclusions: Medical and psychiatric comorbidity exist in children with PDs. Girls are more commonly affected. Health care usage is higher in children with PDs.

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COMORBIDITY REFERS TO the presence of 2 or more illnesses in the same person at the same time.[1] Individuals with psychiatric disorders (PDs) may have comorbid psychiatric[2] or physical illness[3-8] and may use the health care system more intensively than individuals without PDs,[9-11] in part, because of the demands of the illness itself, plus the demands of other coexisting problems. In this article, *psychiatric comorbidity* refers to the simultaneous presence of 2 or more types of PDs in an individual,[12] and *medical comorbidity* refers to the presence of nonpsychiatric illness in an individual with a PD. Several studies have examined psychiatric comorbidity in children,[3,13-15] but few have studied the medical and psychiatric comorbidity in a diverse group of children.

Many studies have examined only adults; few involved only children or adolescents. Cohen et al[3] studied 700 randomly selected children aged from 1 to 10 years and showed that psychiatric comorbidity and PD were significantly related to medical illness. Two studies[5,8] examined childhood psychiatric-medical comorbidity, but usually only with reference to one specific disorder, such as asthma. To our knowledge, no study has looked at a broad cross-section of childhood medical disorder and related it to PD.

This study explored the relationship of medical disorder (MD) with general categories of PD diagnosed in 32 214 children aged 6 through 17 years living in Al-

Table 1. Classification of Psychiatric Disorder

Category	*ICD-9-CM* Code
Psychoses (psychosis)	
Organic psychotic conditions	290-294.9
Other psychoses	295-299.9
Emotional disorders (emotion)	
Depression	311
Acute reaction to stress	308-309.9
Adjustment reactions	309-309.9
Neurotic disorder	300-300.9
Disturbance of emotions specific to child and adolescence	313-313.9
Behavioral disorders (behavior)	
Alcohol-dependence syndrome	303-303.9
Drug dependence	304-304.9
Drug abuse	305-305.9
Personality disorders	301-301.9
Sexual deviations and disorders	302-302.9
Disturbance of conduct, NEC	312-312.9
Hyperactivity	314-314.9
Special symptoms or syndromes, NEC	307-307.9
Physiological malfunction arising from mental factors	306-306.9
Psychological factors linked with disease elsewhere	316-316.9

Abbreviations: *ICD-9-CM*, *International Classification of Diseases, Ninth Revision, Clinical Modification*; NEC, not elsewhere classified.

berta, Canada, during the fiscal year April 1, 1995, through March 31, 1996. We provide estimates of health services use for these children and compare the results obtained against 374 426 children of the same age range who did not have a diagnosed PD. This article expands on a previous one[16] describing the pattern of PD in children from the province of Alberta and uses part of the same group but explores specifically issues of comorbidity and use. While the exploration is largely one of known associations of PD with specific illness, some disorders were explored with a less certain basis with no firm hypothesis and were more opportunistic in nature. The information gained could be useful in understanding the psychopathology of mental disease and will be important in reminding physicians taking care of those with a PD that mental disease is not an isolated event but can coexist with MDs at probabilities higher than chance.

METHODS

Data consist of all fee-for-service information for all children registered with Alberta Health and Wellness for the fiscal year April 1, 1995, through March 31, 1996, and aged between 6 and 17 years inclusive on March 31, 1996. Diagnoses were provided by the attending physician, usually a family physician, a pediatrician, or a psychiatrist, and coded using the *International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM)*.[17] Our prior article[16] describing the general patterns of mental disorder in children stratified by age and sex provides estimates of the rates of specific MDs and details of the data and the environment in which data were obtained. As in that study, data for this article were based on a single principal diagnosis provided to Alberta Health and Wellness by the physician providing care. Health care in Alberta is universal and Alberta Health and Wellness has estimated that more than 99% of the children in the province of Alberta are registered and, thus, are available for study.[18] Demographic data regarding sex and date of birth were obtained for all children from a registration file listing individuals registered with Alberta Health and Wellness as of March 31, 1996.

Relevant available data included the child's identity code, the service date, and the *ICD-9-CM* diagnostic code. Only diagnostic data were provided and each diagnosis could be reported at up to 4 digits (eg, 300.1). For PD, only records in which the *ICD-9-CM* code reflected chapter 5: "Mental Disorder" were used. For MDs, codes from all chapters in the *ICD-9-CM* manual were used except for chapters 2, 15, and 18. Cancer (chapter 2) was excluded because all cancer care received by children was covered by the Alberta Cancer Board and would not be included in the fee-for-service database. The excluded Chapters 15 and 18 dealt with problems associated with the newborn period and general service codes (V-Codes), respectively. In chapter 1 we used only the specific diagnosis of infectious mononucleosis; this illness was chosen because Greenberg[19] provided evidence of an association of PD and infectious mononucleosis. Nonphysician contacts, such as contacts with psychologists or mental health counselors are excluded as they are not part of the database.

Psychiatric disorders were grouped by 1 of us (A.H.T.) into the following 3 main categories: psychosis, emotion, and behavior (**Table 1**). These categories subsume the categories used in our original article[16] and their names reflect the general nature of the disorders comprised by each. While developmental delay falls into the domain of PD, it is more associated with medical origins and services than psychological and it was used as an independent variable in analysis.

The medical categories analyzed consist of individual disorders or groups of disorders. The grouped disorders were grouped so as to be loosely similar to each other. In some instances they were examined separately and also as a group. Thus, diabetes mellitus and obesity were considered separately but also as part of metabolic disorders. All abortions were considered together, even though there may be different underlying causes for the abortion. While spontaneous and legal abortions have different causes, they may affect the individual in a similar manner at least within the relatively loose grouping of mental disorder used here. Some categories consist of several different disorders with a common base. Thus, disorder of the genitourinary system includes cystitis, inflammatory disease of the female genital organs (girls), disorders of the penis (boys), and other disorders of the bladder, urethra, and/or urinary tract. Some disorders, for example, metabolic disorders, injury, and general signs and symptoms, composed all or most of an entire *ICD-9-CM* chapter. Chronic disease is a composite of long-lasting disorders such as renal failure, thyroid disorders, diabetes mellitus, obesity, noninfectious enteritis, congenital anomalies, disorders of synovium, asthma, and bronchitis. To some degree this is an arbitrary grouping but it does cover most chronic childhood disorders. Most of the remaining MDs are self-evident. The results show only those chapters in which there was a statistically significant relationship with 1 of the 3 categories of PDs.

The crude prevalence of medical comorbidity was calculated from the number of children affected with a specific MD (denominator) who also had any mental disorder (numerator). Service use was determined from the mean number of medical and psychiatric services provided for children with and those without a PD. The *t* test was used to compare the mean number of medical services between the PD group and the non-PD group. Calculations were stratified by sex. Medical use in children was compared by estimating the average medical use between children with and those without a PD. All tests were done using Stata software.[20]

Table 2. Psychiatric Comorbidity*

Class of Psychiatric Disorder	Males			Females		
	Age Group, y			Age Group, y		
	6-9	10-13	14-17	6-9	10-13	14-17
Emotion	19.7	25.8	43.2	35.6	51.4	73.8
Behavior	66.9	57.6	37.3	54.0	35.6	11.3
Psychosis	1.1	1.3	2.4	1.5	1.6	1.7
Behavior and emotion	10.9	13.1	12.9	8.0	8.8	8.1
Behavior and psychosis	0.6	0.7	0.9	0.3	0.2	0.2
Emotion and psychosis	0.3	0.7	1.8	0.4	1.6	3.1
All 3 disorders	0.4	0.8	1.5	0.3	0.5	1.7
Total psychiatric disorder, No.	6669	7210	5541	2585	3133	7076
Total psychiatric comorbidity, No.	817	1108	946	230	347	934
Psychiatric comorbidity, %	12.2	15.3	17.1	8.9	11.1	13.2
Total medical comorbidity, No.	6069	6362	5002	2412	2872	6818
Medical comorbidity, %	91.0	88.2	90.3	93.3	91.7	96.4

*Data are given as a percentage of the total psychiatric disorder unless otherwise indicated.

For psychiatric comorbidity, we stratified data into 3 age groups roughly paralleling pubertal development (6-9, 10-13, and 14-17 years). Psychiatric comorbidity was determined by cross-tabulating the 3 categories of PD and noting cross-linked categories. Medical comorbidity was assessed using logistic regression with each of the 3 psychiatric categories as the dependent variable in turn, and the medical category as the independent variable. All analyses were stratified by sex and adjusted for age. Comorbidity was considered present if the significance of the odds ratio (OR) was $P<.000$. Ethical approval for this research was provided by the Capital Health Authority Health Research Ethics Board, Edmonton.

RESULTS

There were 406 640 children (50.6% male) aged between 6 and 17 years. Overall, males exceeded females in prevalence of PD. Eight percent (60.3% male) of the children older than 5 years had a health service attributed to a PD.

Table 2 summarizes the broad nature of PD affecting the children and their psychiatric comorbidities. Psychiatric comorbidity was present in 4382 children (13.6%) with PD, with significantly more males (14.8%) than females (11.8%) affected (derivable from Table 2). This male preponderance of comorbidity persists across the age groups. Most comorbidity occurs in the 14- to 17-year age group. The most common comorbidity is between behavior and emotion; they are also the most common disorders and most often presented alone. The other combinations are much less common. Psychosis was most commonly associated with emotion or with all 3 forms of morbidity together.

Among the 32 114 children with PD, coexisting medical illness was present in 29 535 children (94.6% female; 89.7% male). Many illnesses were incidental events common to all children; however, some were significantly associated with PD.

The prevalence of MDs among children who were diagnosed as having at least 1 mental disorder is shown in column 1 of **Table 3**, together with the name of the disorder. Prevalence of MD varied from 7.2% (skin disorders) to 41.5% (developmental delay); thus, for example, of all of the children with developmental delay, 41.5% had some mental disorder. Most categories had a prevalence of less than 20%. Four of the 6 categories with a prevalence greater than 20% related to various problems attributed to pregnancy, contraception, and menstruation. The remaining 2 were developmental delay (41.5%) and poisoning (34.7%).

The remaining columns of Table 3 give details of ORs describing the likelihood of PD given a specific condition for each sex and adjusted for age. There were 37 significant ORs for boys compared with 58 for girls (plus 9 significant ORs among disorders unique to girls). In each psychiatric group, significant ORs were more common in girls. In the 33 instances in which there was a possible comparison, ORs were more extreme in girls 32 times. Odds ratios varied from 1.1 for chronic disorders associated with emotion in girls to 14.1 for poisoning associated with psychosis in girls. Overall, there were 61 ORs less than 2, 21 ORs between 2 and 3, 10 ORs between 3 and 5, and 11 ORs exceeding 5. Developmental delay was associated with 5 ORs greater than 5. Poisoning had 6 ORs greater than 3. In 5 instances, epilepsy had ORs greater than 2, most often in association with behavior or emotion but had an OR of 5.9 for males with psychosis. The disorders surrounding reproduction were consistently significantly associated with emotion and behavior disorders but less so for psychosis. Menstrual disorder was also associated with all 3 PD groups, with moderate ORs. Contraception was associated with emotion and behavior. Interestingly, iron deficiency anemia was associated with psychosis in males with an OR of 5.1.

Details regarding service use are given in **Table 4**. Children diagnosed as having a PD had greater total services (12.1) and medical (nonpsychiatric) services (8.2) than those without a PD (5.3). Boys with a PD averaged 1.4 (0.04) (mean [SE]) more medical services than boys without a PD; in contrast, girls with a PD averaged 5.2

Table 3. Medical Comorbidity*

Type of Disorder	% Prevalence of Mental Disorder	Type of Psychiatric Disorder					
		Behavior		Emotion		Psychosis	
		Males	Females	Males	Females	Males	Females
Any pregnancy	29.4	NA	1.9 (1.4 – 2.4)	NA	4.0 (3.6-4.6)	NA	NA
Abortion	34.4	NA	2.2 (1.6-3.1)	NA	5.1 (4.4-6.0)	NA	NA
Menstrual problems	20.5	NA	2.0 (1.8-2.2)	NA	3.0 (2.9-3.2)	NA	1.2 (1.9-2.8)
Contraception	20.3	NA	1.9 (1.6-2.2)	NA	2.5 (2.3-2.7)	NA	NA
Diseases of genitourinary system	F:15.2 M:12.2	1.3 (1.1-1.4)	1.9 (1.7-2.0)	1.5 (1.3-1.7)	2.9 (2.7-3.0)	NA	2.4 (2.0-2.8)
Renal infections/failure	12.6	NA	2.0 (1.5-2.7)	NA	2.1 (1.7-2.6)	NA	NA
Developmental delay	41.5	8.3 (7.7-9.2)	15.3 (13.1)	4.6 (4.0-5.2)	6.4 (5.3-7.7)	7.3 (5.4-9.9)	11.7 (7.5-18.3)
Metabolic disorders	12.6	NA	1.7 (1.4-2.0)	1.6 (1.3-1.8)	1.8 (1.6-2.1)	3.3 (2.2-4.7)	2.7 (1.9-3.7)
Diabetes mellitus	10.5	NA	NA	NA	1.7 (1.3-2.2)	3.8 (2.0-7.4)	NA
Obesity	12.5	NA	NA	NA	1.9 (1.5-2.4)	NA	NA
Asthma	9.1	NA	1.4 (1.2-1.5)	NA	1.5 (1.4-1.6)	NA	1.7 (1.3-2.2)
Sinusitis-rhinitis	9.6	NA	1.2 (1.1-1.4)	1.3 (1.2-1.4)	1.4 (1.3-1.5)	NA	1.6 (1.3-2.0)
Bronchitis	8.5	0.88 (0.83-0.92)	1.2 (1.1-1.3)	NA	1.6 (1.5-1.7)	NA	1.6 (1.3-1.9)
Hearing loss	11.8	1.6 (1.3-1.8)	2.2 (1.7-2.9)	NA	NA	NA	NA
Chronic disorders	8.7	0.93 (0.89-0.97)	1.2 (1.2-1.3)	1.1 (1.0-1.2)	1.6 (1.5-1.6)	NA	1.6 (1.4-1.9)
Injury	9.1	NA	1.4 (1.3-1.5)	1.2 (1.1-1.2)	1.5 (1.4-1.6)	NA	1.9 (1.7-2.3)
Poisoning	34.7	3.3 (1.9-4.0)	7.1 (6.1-8.2)	4.8 (4.1-5.7)	8.2 (7.3-9.2)	8.2 (7.3-9.2)	14.1 (11.2-17.8)
Intracranial injury	10.8	NA	1.9 (1.5-2.4)	1.4 (1.2-1.7)	1.7 (1.4-2.0)	NA	3.4 (2.1-5.5)
Wounds	8.9	1.5 (1.3-1.7)	2.4 (1.8-3.1)	1.6 (1.4-1.9)	2.4 (1.9-2.9	NA	NA
Burns	12.2	1.4 (1.1-1.6)	1.7 (1.3-2.2)	1.6 (1.2-1.8)	1.8 (1.5-2.2)	NA	NA
Musculoskeletal	10.5	NA	NA	1.2 (1.1-1.3)	1.4 (1.3-1.5)	NA	NA
Gastrointestinal tract disorder	10.6	NA	1.5 (1.4-1.6)	1.5 (1.4-1.6)	2.0 (1.9-2.2)	1.9 (1.5-2.4)	2.1 (1.7-2.6)
Migraine headache	13.3	NA	1.7 (1.4-2.2)	1.8 (1.5-2.2)	2.1 (1.8-2.4)	2.7 (1.7-4.4)	NA
Epilepsy	18.8	2.2 (1.9-2.7)	3.9 (3.0-5.0)	2.7 (2.1-3.3)	2.5 (2.0-3.2)	5.9 (3.8-9.1)	NA
Infectious mononucleosis	9.9	NA	NA	NA	1.9 (1.5-2.4)	NA	NA
Skin disorders	7.2	1.2 (1.1-1.2)	1.3 (1.3-1.4)	1.2 (1.1-1.4)	1.4 (1.3-1.5)	NA	1.5 (1.2-1.7)
Conduction disorder heart	17.3	2.0 (1.4-2.7)	2.6 (1.7-4.1)	NA	3.2 (2.4-4.3)	NA	NA
General signs and symptoms	10.3	1.3 (1.2-1.3)	1.6 (1.5-1.7)	1.7 (1.6-1.7)	2.1 (2.0-2.2)	1.8 (1.6-2.1)	1.9 (1.7-2.3)
Iron deficiency anemia	13.8	NA	NA	NA	2.4 (1.9-3.1)	5.1 (2.1-12.5)	NA
Congenital anomalies	10.4	NA	NA	NA	1.6 (1.3-3.1)	NA	NA

Abbreviation: NA, not applicable.
*Data are given as the odds ratio (95% confidence interval). Results are expressed to the nearest tenth. To minimize spurious association, only those data with $P<.000$ are given.

Table 4. Use of Health Services by Children With and Without a Psychiatric Disorder (PD)

Service Combinations	Male Patients		Female Patients	
	Mean (SD)	Total	Mean (SD)	Total
All services for children without a PD	5.0 (5.2)	186 524	5.7 (6.0)	187 902
All services for children with a PD	10.3 (10.6)	19 420	14.7 (15.9)	12 794
Medical services for children with a PD	6.4 (7.0)	19 420	10.8 (11.1)	12 794
Psychiatric services for children with a PD	3.9 (7.3)	19 420	3.9 (10.2)	12 794
"Excess" medical services for children with a PD	1.4 (0.04)		5.2 (0.06)	

(0.06) more medical services than girls without a PD. The number of psychiatric services was similar for both sexes. Girls without a PD had 5.7 visits vs 5.0 for boys without a PD ($P<.000$).

COMMENT

The availability of a data set describing all the medical contacts occurring in a given year for all children aged 6 through 17 years provides an opportunity to explore medical-psychiatric associations. Clinicians often tend to view a patient as having only 1 disorder when, in fact, other disorders coexist. Data in this study emphasize the fact that such associations do exist between PDs and MDs and knowledge of such associations could be useful in planning health services for children, in the education of medical students and residents, and in providing appropriate therapy.

In this study, we are investigating the presence of 2 or more morbidities occurring more often than by chance

alone within a 12-month period. We make comparisons using 3 broad diagnostic groupings of mental disorders and 31 categories of MDs. In trying to detect a relationship, we report only those MDs associated with a PD with a probability of $P<.000$. This significance level was chosen because the analysis was exploratory and not always hypothesis driven and the large sample size resulted in great power for detecting significant differences. Even so, a wide variety of comorbidity exists. In contrast to some studies,[3] in our case these data are cross-sectional and we can only conclude that an association exists; we cannot put context to the data.

Three groups of mental disorder were chosen because they reflect the essence of the PD of interest and, while tempting, using finer groupings proved unwieldy and it is not the intent of this article to discuss specific disorders, such as hyperactivity. The amount of psychiatric comorbidity is appreciable with 13.6% of all children with a PD having psychiatric comorbidity. Documented comorbidity between psychiatric and physical illness is substantial.[3,21] In our study more than 90% of the children who had a PD had some type of MD; it is among these disorders that psychiatric-medical comorbidity is concealed. The prevalence of MDs among children with mental disorders varied widely from 7.2% to 41.5%. A striking finding was the high prevalence of disorders relating to the female genitourinary system, with prevalence ranging from 20.3% to 34.4% thus, at least one fifth to one third of all girls with a disorder of the genitourinary system had some form of MD. These same disorders had ORs ranging from 1.2 to 5.1. These estimates of prevalence are valuable because they reflect the prevalence of a PD within the total population diagnosed with a specific MD. Such information is useful when planning health care services and in anticipating service demand.

The diagnostic criteria for the 3 major PDs are those used by the physicians providing the diagnosis; thus some may use formal diagnostic criteria based on *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* and others may use less formal criteria. Practically speaking, the diagnostic criteria for specific disorders may vary between physician type, but this is likely not to be seen because the disorders are grouped. It is likely that the patterns of diagnostic criteria are similar between the United States and Canada. Family physicians provided services to 59% of children; pediatricians, 35%; and psychiatrists, 22%. Almost 18% of the children were seen for their problem by more than 1 type of practitioner.

The meaning of comorbidity is not always clear. For psychiatric comorbidity, it could mean that the 2 disorders have an underlying cause, it could be diagnostic error or misclassification, or it could be that diagnostic procedures are insensitive to separate illnesses[12]; for medical comorbidity similar caveats apply. Using our 3 groups, it is difficult to discern the exact nature of psychiatric comorbidity except to say that it appears to exist and seems more common in adolescents than children. It may well be an underestimate because only 1 year of observation is present and an individual had to visit a physician at least twice within the year to have any evidence of comorbidity; however, that should have no effect on the trend of increasing comorbidity with age or sex. While the greatest absolute comorbidity lay between emotion and behavior disorders, the greatest relative comorbidity was between psychosis and emotion and behavior disorders. This may reflect a more complex nature of psychosis; it also could reflect the varying ways of presentation of disease.

There is abundant adult literature to demonstrate the association of medical illness with PD but less so in children and adolescents. It is surprising that such a wide variety of MDs was associated with PDs, and although the ORs are generally small and the sample from which these data are comprised is large, it appears that a wide variety of medical illness may have psychiatric overtones. Cohen et al[3] found that physical ill health was associated with psychiatric disorder at all ages, with ORs from 1.76 to 3.26. Our results are generally in agreement.

Children with developmental delay were 1 of 4 groups having significant associations with PDs of all types. Einfield and Tonge[22] found that about 41% of the individuals with intellectual disability between the ages of 4 and 18 years were classifiable as having severe emotional and/or behavior disorder or were psychiatrically disordered. Tonge et al[23] found in a survey of 582 young people with intellectual disability that PD was 3 to 4 times more prevalent than in the general population. In our study, approximately 7.7% of the children who were nondevelopmentally delayed had a PD compared with 41.5% of those who had developmental delay, a figure in good agreement with Einfield and Tonge.

Poisoning was another disorder that had significant ORs for each type of PD but particularly for psychosis; again, boys had smaller ORs than girls. Poisoning is a common method of attempted and successful suicide in adolescence. Adolescent self-poisoners appear to have high levels of psychopathologic disorders, particularly major depression.[24,25] We found that girls were most likely to have a diagnosis of poisoning and the ORs were among the highest in the overall data set. Overall, 35% of the children with poisoning were diagnosed as having a PD.

Disorders of the female genitourinary system were prominently associated with PD. Among girls with no PD, 7.8% attended a physician for issues relating to contraception compared with 20.3% of girls with a PD (data not shown). There may be many reasons for the use of a contraceptive and, without more information, it is difficult to be sure of the reasons for contraception in our group. Abortion occurred in 617 individuals (data not shown), 218 had a PD. In a 4-year survey of women experiencing childbirth or those having an induced abortion, Reardon et al[26] found that women who underwent an abortion had significantly higher relative risk of psychiatric admission after the abortion compared with those giving birth. In our instance, it is difficult to know if the PD arose because of the abortion or vice versa, but clearly there is a strong relationship, particularly among those with emotional disorders.

In our study, pregnancy was associated with both behavior and emotion but seemed to be more strongly associated with emotional disorders. The role of PD in pregnancy is unclear. Kessler et al studied teenage motherhood and determined that PDs were associated with several ad-

verse life consequences and that "mental health professionals treating adolescents need to be sensitized to the higher risk of pregnancy."[27(p1405)] Keenan et al[28] determined that conduct disorder had several serious outcomes, including early pregnancy.

Disorders of the genitourinary system had moderate ORs for females but not males. This grouping also included menstrual disorders, thus the OR seen in girls may be reflecting the menstrual disorders rather than the other diseases in the category. Psychological distress is a recognized complication of renal failure[29] and it may also account for a portion of the observed OR. Subgroup analysis (not shown) reveals that there were 123 children who had renal failure and of those 23 had a PD.

Ten percent of the children who have asthma had a mental disorder. Asthma is the most common chronic medical illness in childhood and it has significant psychiatric overlay, particularly depression and anxiety disorders.[30] Children who have asthma may be at greater psychological risk.[31] Among Australian children, Ortega et al[6] found that having a history of asthma was associated with anxiety disorder but not with an affective disorder. In our study, asthma was significantly associated with all 3 PDs but for girls only and with modest ORs (all ≤1.7). Two other respiratory disorders, bronchitis and sinusitis-rhinitis, were also significantly associated with PD, usually in girls and with only modest ORs (all ≤1.8).

Chronic disease is a significant cause of morbidity in childhood and has significant associations with PD.[6,32] We created a separate variable for chronic disease. The ORs observed were modest and mostly associated with emotional disorders. A problem with examining chronic disorders as a group is that by pooling the diagnoses, which are widely disparate, we lose insight into the problem. For example, more specific chronic illnesses such as diabetes mellitus had isolated associations with psychosis in boys, whereas there is no significant relationship of chronic disease and psychosis in boys.

General signs and symptoms (*ICD-9CM* chapter 16) had significant associations for each group-sex combination. The ORs ranged from 1.3 to 1.9 and boys had lower ORs than girls. The consistent, but modest, association seen here may reflect the individual with a PD visiting the physician for vague symptoms, or the physician diagnosing the symptom and not the disease. This may also account for the consistent ORs seen with gastrointestinal tract disorder.

Migraine had significant ORs in all 3 PD groups. Migraine may be comorbid with several other neurologic and psychiatric conditions, including mood disorders, epilepsy, stroke, and essential tremor.[33] Epilepsy had moderate to high ORs for all 3 groups and both sexes. Epilepsy in childhood is associated with psychosomatic disorders in adulthood,[34] but it is less clear if it is associated with PDs in childhood.

An unusual association found is that between conductive diseases of the heart and behavior and emotion. A search of the literature showed no obvious relationships documented, yet the ORs are all greater than 2. Other disorders are also listed in Table 3, but it is difficult to determine any specific rationalization to a PD. They are reported for interest and could be used as sources for further investigation or to corroborate other research.

The consequence of grouping illnesses is illustrated by comparing metabolic disorders, obesity, and diabetes mellitus. Metabolic disorders had 5 significant ORs whereas diabetes mellitus had only 2 and obesity 1. The ORs are similar where comparison is possible; however, using metabolic disorders alone would not have picked up specific associations for diabetes mellitus and obesity. In injury, the OR for poisoning, which is subsumed by injury, is several times greater than the similar OR for injury. Thus, for behavior disorders and girls, the OR for injury is 1.3, whereas for poisoning it is 7.1. These observations would seem to suggest that joining illnesses together in a larger, common group generally is not a wise approach to analysis. A potential exception might be ORs associated with general signs and symptoms (*ICD-9-CM* chapter 16) where the relative vagueness of the symptoms might itself reflect the aches and pains that might be associated with a PD. Certainly in our instance, the ORs were not high, but they were consistent and may be a partial source for the increased number of medical services provided.

Medical services usage for those with PD was high; particularly for girls. The number of services for PD was similar between the 2 sexes, possibly suggesting that the severity of PD was comparable between the sexes. The overall male-female ratio of 1.5:1 is consistent with the findings of Anderson et al[35] who found a male-female ratio of 1.7:1 among 11-year-old adolescents with *Diagnostic and Statistical Manual of Mental Disorders, Third Edition* disorders.

LIMITATIONS

This study has the strengths of size and completeness of coverage of the subjects studied. It is not dependent on parental report, nor does it capture only a particular stratum of society. Not all children with PDs are captured, but the likelihood is good that a significant PD is well represented. An unknown number of children with a PD may see a psychologist or other nonphysician provider for psychiatric care but since health care in Alberta is universal, it is unlikely they would not have had some contact with a physician. These data provide some insight into the degree of comorbidity existing in children having a diagnosis of PD. Numerically, the figures are likely an underestimate, but the patterns of comorbidity seen probably fairly represent reality.

We use administrative data and diagnoses provided by physicians that could not be verified. This is one reason why broad categories were used. As well, comorbidity implies that the problems on both sides have been identified. Psychiatric disorders are not well identified in general medical practice, thus the possibility of detecting comorbidity is reduced. The definitions of PD are based on *ICD-9-CM* diagnoses rather than *Diagnostic and Statistical Manual of Mental Disorders* categories; within the *ICD-9-CM* codes, groupings of PDs were arbitrary, although done by an experienced psychologist. Psychiatric comorbidity can only exist if a child went to a physician at least twice having the same diagnosis. Thus, we

likely underestimate true psychiatric comorbidity. On the other hand, medical-psychiatric comorbidity only depends on 1 medical visit and 1 psychiatric visit. Finally, these are cross-sectional data and it is impossible to determine which illness came first. Psychiatric disorder is more chronic and it seems reasonable to assume that many of the disorders seen may have been present when the child was enrolled in the study.

CLINICAL IMPLICATIONS

In conclusion, some PDs are associated with various MDs at rates greater than chance. Finding such associations may suggest some common features in the pathophysiological features of both disorders and, thus, may result in new hypotheses being created for one or both of the disorders. This study is unusual in the breadth of MDs that are compared with PDs, a situation arising out of the opportunity to analyze a large data set of MDs and PDs. We chose a wide variety of illnesses, not all possible combinations, but illnesses mainly characterized by their prevalence or by known or suspected associations with a PD. We limited the observed relationships to those seen only at $P<.000$; in doing so, it is likely that the associations seen in our study have some clinical significance, even if the association is not intuitive. Because of the nature of these data, the observations seen are not unequivocal; they should be viewed as relationships needing more formal exploration.

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