Trends in Hospital Admissions Among Children Aged 0–19 Years With Type I Diabetes in The Netherlands

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OBJECTIVE — To determine the number and duration of hospital admissions due to diabetes in children aged 0–19 years between 1980 and 1991.

RESEARCH DESIGN AND METHODS — Secondary analysis of data collected by the SIG Health Care Information was based on the 9th revision of the International Classification of Diseases. The subjects were all children in The Netherlands, aged 0–19 years. The main outcome measures were number and duration of hospital admissions due to type I diabetes (ICD 9 code 250.0–250.9).

RESULTS — The hospital admission rate due to diabetes decreased >30%. This decrease was statistically significant in all age subgroups. The total number of days in hospital due to diabetes decreased dramatically: from 24,961 in 1980 to 11,305 in 1991. The average duration of hospital stay length due to diabetes decreased as well from 14.5 days in 1980 to 11.9 days in 1991.

CONCLUSIONS — The hospital admission rate and the length of hospital stay for diabetes in children aged 0–19 years have decreased, in spite of an increasing incidence. The hospital admission rate may decrease still further if more children with newly diagnosed diabetes can be adequately managed by team management at home in the initial phase.

The incidence of type I diabetes in children aged 0–19 years in The Netherlands has increased from 10.9 per 100,000 in 1978–1980 to 13.2 per 100,000 in 1988–1990 (1). This could have led to an increase in hospital admission, but during this period, care for children with diabetes has improved considerably. Both children and parents are nowadays actively involved in treatment. They monitor blood glucose levels themselves and adjust the insulin dose. They acquire skills, confidence, and autonomy in the management of diabetes. Specialized diabetes nurses have been introduced to provide guidance to patients in self-monitoring and self-management of the disease. These developments were aimed at achieving optimal regulation of diabetes and prevention of dysregulation, thereby minimizing the need for hospital admission. The aim of the present study was to determine the number and duration of hospital admissions due to type I diabetes in children aged 0–19 years between 1980 and 1991, as a measure of care.

RESEARCH DESIGN AND METHODS

— Data on source population size per age subgroup was obtained from The Netherlands Central Bureau of Statistics. Table 1 shows the total number of children per age subgroup for 1980 and 1991.

Annual hospital admission data (number of admissions and duration of hospital stay) were obtained from the SIG Health Care Information. This center maintains a unique register containing data on all patients discharged from hospitals in The Netherlands. The analyses were carried out starting in 1980 since data on the incidence of diabetes for 1980 are available (2).

In 1980, the SIG Health Care Centre covered 94% of the hospital admissions in The Netherlands, gradually rising to 99% in 1986 and onward. Since 1980 all eight academic hospitals as well as all four pediatric hospitals participated in the register.

For the analyses, all patients admitted with International Classification of Diseases, 9th revision (ICD 9), code 250.0–250.9 as principal diagnosis were studied. Within the register, distinction between admissions at diagnosis and readmissions is not possible. Also, no distinction could be made between medical or social reasons for hospitalization. As the ICD 9 codes for hypoglycemia (251.2) and hypoglycemic coma (251.0) also contain admissions not due to diabetes, the number of admissions for hypoglycemia and hypoglycemic coma due to diabetes (code 250.0–250.9) were determined by crossing 251.2 or 251.0 by 250.0–250.9. The average length of hospital stay was calculated using the total number of hospitalization days divided by the number of admissions. Because of limited resources, analyses with respect to the types of admissions and the average length of stay were performed only for the years 1980, 1981, 1985, 1986, 1990, and 1991.

Table 1—*Total number of children in The Netherlands per age subgroup in 1980 and 1991*

Age (years)	1980	1991
0–4	891,752	947,416
5–9	1,135,880	887,217
10–14	1,220,612	903,700
15–19	1,231,291	1,047,831
0–19	4,479,535	3,786,164

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Received for publication 3 February 1995 and accepted in revised form 5 December 1995.

Table 2—*Hospital admission rate per million population by age-group from 1980 to 1991*

	0–4 years	5–9 years	10–14 years	15–19 years	0–19 years
1980	184	287	491	516	385
1981	194	287	492	509	388
1982	122	275	493	476	362
1983	119	315	431	495	360
1984	96	256	407	457	324
1985	91	231	400	442	311
1986	80	210	368	447	296
1987	94	224	347	412	285
1988	107	197	424	394	291
1989	79	210	420	352	271
1990	98	202	380	362	265
1991	117	185	377	323	252
Slope	−6.9	−10.7	−10.6	−17.3	−12.8
SE	2.4	1.6	2.9	1.2	0.9
P value	0.017	<0.001	0.004	<0.001	<0.001

Slope, SE, and *P* values were determined by least-squares regression analysis.

Time trend analyses on hospital admissions were carried out by means of least squares regression. Trends were considered to be statistically significant at $P < 0.05$.

RESULTS — Table 2 shows the hospital admission rate due to diabetes (code 250.0–250.9) per million population per year according to age-group. In nearly all age-groups, hospital admission rate decreased >30%. For all ages together, the admission rate decreased with 12.8 cases per million each year: from 385 to 252 admissions per million per year. This decrease corresponds to the slope parameter in linear trend analysis and was statistically significant ($P < 0.001$). The decrease was statistically significant for boys (slope −10.9, SE 1.4, $P < 0.001$) as well as for girls (slope −15.0, SE 0.9, $P < 0.001$). The decrease was higher for girls (Fig. 1); the difference in slope is statistically significant ($P < 0.001$).

The rate as well as the absolute number of hospital admissions due to ketoacidosis increased. However, the rate and number of hospital admissions due to ketoacidotic coma (ICD 9 code 250.3) decreased (Table 3). The increase in admission rate due to hypoglycemia from 1980 to 1991 was statistically significant (Table 3). The increase was caused by the increase in hypoglycemia in children aged 10–19 years. There was no statistically significant increase in the admission rate due to hypoglycemic coma.

The total number of days in hospital due to diabetes decreased dramatically from 24,961 in 1980 to 11,305 in 1991. The average length of hospital stay for diabetes declined from 14.5 days in 1980 to 11.9 days in 1991 (Table 4). No distinction could be made between admissions at diagnosis and subsequent readmissions; therefore, analysis of the changes in length of hospital stay due to type of admission was impossible.

CONCLUSIONS — Hospitalization has a psychological impact on the patient and his or her family. There is also an economic aspect: the cost of care, which includes the direct costs of hospital care and the indirect costs such as opportunity costs due to the parents' lost work time, traveling expenses, and other costs related to the parents' hospital visits (3).

In many Western countries, the total number of hospital admissions in children has increased while the duration of stay has decreased in the last decades due to changes in morbidity pattern and lower frequencies of many diseases (4). For some specific disorders, however, an increase in incidence has been noted, accompanied by an increase in hospital admission rate (5).

In The Netherlands, the total number of admissions for all diagnoses decreased in children aged 0–19 years from 8,845 per 100,000 in 1980 to 7,124 per 100,000 in 1991 (SIG Health Care Information, personal communication, 1993). At the same time, admissions due to asthma (ICD 9 code 493) increased for boys (0–14 years) from 76 per 100,000 in 1980 to 109 per 100,000 in 1987 and for girls (0–14 years old) from 44 to 67, respectively (7), parallel to a presumed increase in incidence.

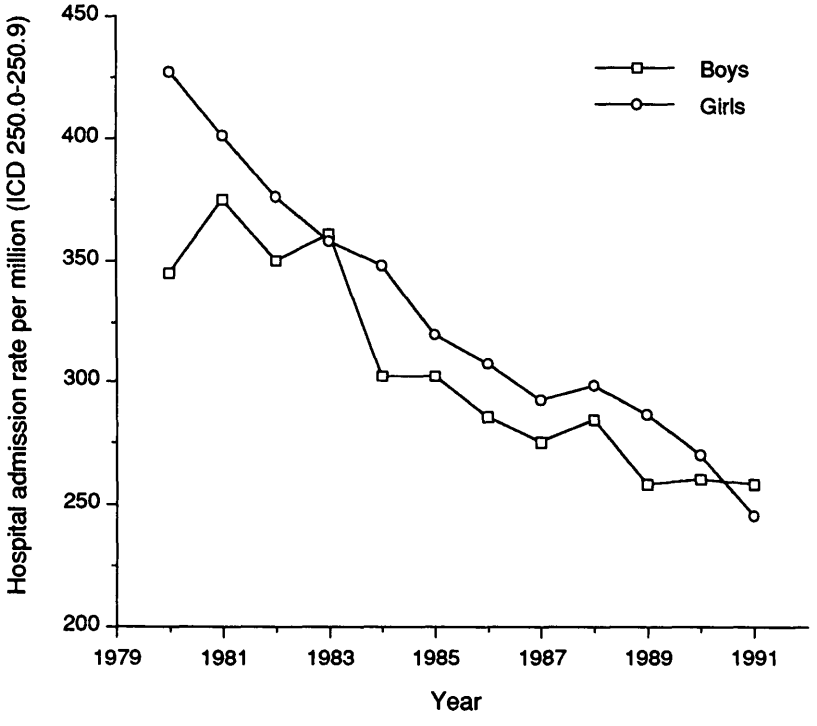

Figure 1—*Hospital admission rate per million by sex from 1980 to 1991 (ICD 9 code 250.0–250.9).*

Table 3—*Hospital admission rate per million population (0–19 years of age) due to diabetes complications*

Complication	1980	1981	1985	1986	1990	1991	Slope	SE	*P* value
Ketoacidosis (250.1)	19 (83)	18 (79)	19 (77)	20 (82)	24 (90)	29 (109)	0.8	0.2	0.02
Ketoacidotic coma (250.3)	21 (94)	14 (63)	10 (43)	14 (56)	9 (34)	6 (21)	−1.1	0.3	0.02
Hypoglycemic coma	2 (7)	4 (18)	2 (10)	3 (11)	2 (9)	4 (15)	0.1	0.1	0.6
Hypoglycemia	4 (16)	5 (22)	4 (16)	8 (32)	12 (44)	9 (35)	0.6	0.2	0.03
Other (250.4–250.8)	6 (26)	3 (12)	4 (18)	5 (21)	6 (23)	4 (14)	0.03	0.1	0.8

The absolute number of admissions is shown in parentheses.

In contrast, our study showed that notwithstanding an increased incidence of type I diabetes (1), the number of hospital admissions due to diabetes has decreased and so has the mean length of hospital stay. This conclusion is based on the data obtained from the SIG Health Care Information, a centralized hospital admission registration. This register is established and maintained for administrative purposes rather than for research, so errors are possible. However, there is no reason to assume that these are of great importance and different between the years studied, as type I diabetes in the 0- to 19-year-old children is a specific disease with no diagnostic and coding problems.

From these data, it is not clear whether this decrease occurs mainly in first admissions or in readmissions or in both, because the register does not distinguish between admission at diagnosis and later admissions for readjustment or treatment for dysregulation or other complications. From data on diabetes cases in the Dutch Paediatric Surveillance Unit (similar to the British Paediatric Surveillance Unit), however, only ~10% of children aged 0–14 years with newly diagnosed diabetes were managed in 1993 without initial hospital admission (8). We therefore assume that in the period 1980–1991 this percentage was similar or even lower and that the decrease in total hospital admissions is mainly due to a lower frequency of readmissions. Since the diagnostic procedures and criteria have virtually remained the same during this period, the most likely explanation for the decrease is the improved care, diabetes education, and self-management. These developments are also stimulated because hospital admissions are very expensive events.

Table 4—*Average length of hospitalization from 1980 to 1991*

	Days of hospitalization	No. of admissions	Average length
1980	24,961	1,724	14.5
1981	24,480	1,718	14.2
1985	18,392	1,291	14.2
1986	15,783	1,205	13.1
1990	12,540	1,013	12.4
1991	11,305	954	11.9
Slope	−1,282.2	−73.4	−0.2
SE	89.2	6.5	0.03
P value	<0.001	<0.001	0.005

The estimated annual saving due to the lower number of days spent in the hospital from 24,961 days in 1980 to 11,305 days in 1991 is ~6 million U.S. dollars. On the other hand, during this period there was a gradual extension of services available for diabetes care on an outpatient basis. This has to be accounted for when measuring the effect on the health economic aspects.

The decreased hospital care did not have any detrimental effect on mortality: the death rate due to diabetes in children decreased simultaneously (R.A.H., F.J. Bohm, H.M.R., Y.B. Oei, G.J. Vaandrager, S.P.V.-V., unpublished observations).

The above-mentioned conclusions are based on the admission rate per million in 0- to 19-year-old children. Of course, it would be more appropriate to use the number of patients with type I diabetes as the denominator. However, the exact number of patients with type I diabetes from 1980 to 1991 is not known. Therefore, we calculated the prevalence from the incidence data by the method of Freeman and Hutchison (10). The numbers of patients with type I diabetes are estimated to be 4,241 (rate 0.95 per 1,000) and 4,067 (1.06 per 1,000) in January 1981 and January 1991, respectively, leading to admission rates of 406 and 235 per 1,000 patients, respectively. With these estimates, the decrease in hospital admission rate seems to be even higher.

Nowadays in The Netherlands only 10% of children with newly diagnosed diabetes are managed without initial hospital admission. Such outpatient care, provided by a team consisting of a pediatrician, diabetes nurse, and parents, has proved to be feasible in the majority of children; in Leicestershire, >80% of children with newly diagnosed diabetes were treated successfully at home (11).

Early diagnosis by increased public and general physician awareness enables the patient to reach the hospital in a milder derangement state, and therefore ambulatory treatment rather than hospitalization can be practiced. With a multidisciplinary approach, there is almost no need for hospitalization (12,13).

Home care could lead to reduction of the hospitalization period (14,15). Short-term initial hospital stay has a similar metabolic outcome compared with long-term hospital stay and does not unfavorably affect the adjustment of the family to diabetes (16).

In addition to the present and future decrease in hospital readmissions as a result of optimal self-care of diabetes, a further reduction (assuming the figures of Leicestershire) may be achieved by team management at home in the initial phase.

Acknowledgments— This study was supported by The Netherlands National Committee for chronically ill people.

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