Trends and rural-urban differences in asthma hospitalizations in Saskatchewan 1970-1989

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A SENTHILSELVAN. Trends and rural-urban differences in asthma hospitalizations in Saskatchewan 1970-1989. *Can Respir J* 1994;1(4):229-234.

OBJECTIVE: To examine the trends in hospitalization rates for asthma in Saskatchewan from 1970 to 1989 and to investigate the differences in asthma hospitalization rates between rural and urban dwellers.

DESIGN: Asthma hospitalization rates were calculated for the age groups 0 to 4, 5 to 9, 10 to 14, 15 to 24, 25 to 34, 35 to 49 and 50 to 64 years for the period between 1970 and 1989. Only the first admission in each year for each person was included in the analysis. As the classification of asthma changed in 1978, trends in asthma hospitalization rates were investigated separately for the periods 1970 to 1978 and 1979 to 1989, respectively. Rate ratios were obtained for male/female and rural/urban comparisons by fitting Poisson regression models.

SETTING: The hospitalization data for respiratory diseases for the province of Saskatchewan were examined by age group, sex and place of residence.

RESULT: No significant increases were observed in asthma hospitalization rates from 1970 to 1978. In the period 1979 to 1989, asthma hospitalization rates increased significantly among children under four years from 4.31/1000 in 1979 to 7.04/1000 in 1989. Among children under 14 years, asthma hospitalization rates were greater in boys than in girls. The converse was true for adults aged 15 and above, with women having a higher hospitalization rate for asthma than men. In adults aged 35 and above, rural dwellers had higher hospitalization rates for asthma than urban dwellers throughout the study period. In other age groups, although rural dwellers had higher asthma hospitalization rates than did urban dwellers during 1970 to 1984, the differences disappeared during 1985 to 1989.

CONCLUSION: Further studies are required to find reasons for the increase in asthma hospitalizations among young children under four years old and for the differences between rural and urban dwellers in the age group 35 years and above.

Key Words: Adults, Asthma, Children, Hospitalization, Morbidity, Rural populations

Tendances et différences rurales et urbaines dans les hospitalisations liées à l'asthme en Saskatchewan de 1970 à 1989

OBJETIF: Examiner les tendances dans les taux d'hospitalisations liées à l'asthme en Saskatchewan de 1970 à 1989 et analyser les différences dans les taux d'hospitalisations liées à l'asthme entre les habitants du milieu rural et ceux du milieu urbain.

MODÈLE: Les taux d'hospitalisations liées à l'asthme ont été calculés pour les groupes d'âge de 0 à 4, 5 à 9, 10 à 14, 15 à 24, 25 à 34, 35 à 49 et 50 à 64 ans, de 1970 à 1989. On a seulement retenu la première hospitalisation de chaque année pour chaque personne dans l'analyse. Comme la classification de l'asthme a été modifiée en 1978, les tendances dans les hospitalisations dues à l'asthme ont été analysées séparément pour les périodes allant respectivement de 1970 à 1978 et de 1979 à 1989. Les rapports des taux ont été obtenus pour une comparaison hommes/femmes et milieu rural/urbain en appliquant les modèles de régression de Poisson.

CONTEXTE: Les données relatives aux hospitalisations causées par des maladies respiratoires dans la province de la Saskatchewan ont été analysées par groupe d'âge, sexe et lieu de résidence.

RÉSULTATS: Aucune augmentation significative n'a été observée dans les taux d'hospitalisations de 1970 à 1978. Entre 1979 et 1989, les taux d'hospitalisations liées à l'asthme ont augmenté de manière significative parmi les enfants de moins de 4 ans en passant de 4,31/1 000 en 1979 à 7,04/1 000 en 1989. Parmi les enfants de moins de 14 ans, les taux d'hospitalisations étaient plus élevés chez les garçons que chez les filles. L'inverse était vrai pour les adultes de 15 ans et plus, les femmes démontrant un taux d'hospitalisation pour cause d'asthme plus élevé que les hommes. Chez les adultes de 35 ans et plus, ceux vivant en milieu rural démontraient un taux d'hospitalisation pour cause d'asthme plus élevé que ceux vivant en milieu urbain pendant toute la durée de l'étude. Dans les autres groupes d'âge, bien que les sujets résidant en milieu rural démontraient des taux d'hospitalisations pour cause d'asthme plus élevés que ceux résidant en milieu urbain de 1970 à 1984, ces différences avaient disparu de 1985 à 1989.

CONCLUSIONS: De nouvelles études s'imposent pour expliquer les raisons de l'augmentation des hospitalisations liées à l'asthme parmi les jeunes enfants de moins de 4 ans ainsi que les différences observées entre les patients vivant en milieu rural comparativement à ceux vivant en milieu urbain dans le groupe d'âge des 35 ans et plus.

ASTHMA MORBIDITY HAS BEEN REPORTED TO BE INCREAS-
ing in various countries including Canada and the
United States (1-8).

Wilkins and co-workers (1) investigated the changes in
asthma morbidity and mortality from 1980 to 1988 in the 10
provinces of Canada and reported that asthma mortality in
Saskatchewan was among the highest in Canada. Asthma
morbidity in Saskatchewan decreased in children under
14 years and increased in adults aged 15 to 34 years (1).
Although several studies have reported significant increases
in hospitalization rates for asthma among children under
four years (3,5-9), no study has investigated the trends in
asthma hospitalizations for children in this age group in
Saskatchewan. In this study, we examined the trends in
asthma hospitalizations among children in the age groups 0
to 4, 5 to 9 and 10 to 14 years, and among adults 15 to 24, 25
to 34, 35 to 49 and 50 to 64 years, and investigated the
differences in asthma hospitalizations between urban and
rural dwellers in Saskatchewan.

METHODS

Separation data: All residents of the province of
Saskatchewan are enrolled in the Saskatchewan Health Ser-
vices Plan (SHSP), which provides hospital care without costs
for in-patient services. The discharge data for all the respira-
tory diseases (International Classification of Diseases, Ninth
Revision, [ICD-9] 460 to 519) were obtained from the Urban
Hospitals Branch of the Saskatchewan Health Department
for all 134 hospitals in the province. For each separation, age,

sex, residence code, date of discharge, primary diagnosis of
admission and length of hospital stay were provided to the
investigator by the health department. Only the first admis-
sion of a patient in each year was included in the analysis.
The population eligible for health coverage from the
Saskatchewan government was also obtained for 1970 to
1989. The registered Native population and the mixed popu-
lation from northern Saskatchewan were excluded from this
study.

Asthma hospitalization rates for children under four years
were compared with those for acute and chronic/unspecified
bronchitis (ICD 466, 490-491) and lower respiratory tract
disease (pneumonia [ICD 480-486], emphysema [ICD 492]
and pleurisy [ICD 511]). The acute and chronic/unspecified
bronchitis category is hereafter referred to as 'bronchitis' in
this article.

ICD-8 coding scheme was used during the period 1970 to
1978 and it was replaced by ICD-9 coding scheme in 1979.
Asthmatic bronchitis was coded under 'bronchitis, unquali-
fied' in ICD-8 and under 'asthma' in ICD-9. As the 'bronchi-
tis, unqualified' category in the ICD-8 coding scheme
included more than one disease group, it was not possible to
reclassify asthmatic bronchitis as asthma from the data ob-
tained from the Saskatchewan Health Department.

Definition of rural/urban dwellers: Saskatchewan is di-
vided into 298 administrative divisions termed Rural Muni-
cipalities (RMs). The municipalities are further divided into
cities and towns. The health department uses a five-digit code
for each municipality, with the first three digits indicating the

TABLE 1

Age specific asthma hospitalization rates (per 1000) for Saskatchewan population, 1970-1989

Year	Age group (years)													
	0-4		5-9		10-14		15-24		25-34		35-49		50-64	
	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
ICD-8														
1970	278	3.57	204	2.08	129	1.29	120	0.75	67	0.70	185	1.25	291	2.22
1971	316	4.24	218	2.34	144	1.46	101	0.63	61	0.65	165	1.14	315	2.38
1972	359	4.96	253	2.89	175	1.80	117	0.72	62	0.65	150	1.06	331	2.49
1973	301	4.28	266	3.31	191	2.00	128	0.80	63	0.65	136	0.99	316	2.37
1974	273	4.07	229	3.05	166	1.76	139	0.84	43	0.43	149	1.10	291	2.17
1975	293	4.34	247	3.42	186	2.02	126	0.74	63	0.60	137	1.02	295	2.18
1976	249	3.57	207	2.89	149	1.67	145	0.81	53	0.47	100	0.74	250	1.84
1977	235	3.30	225	3.15	142	1.66	153	0.84	58	0.48	106	0.79	239	1.75
1978	293	4.09	259	3.63	162	2.00	163	0.88	80	0.63	108	0.80	279	2.04
ICD-9														
1979	312	4.31	230	3.27	155	2.02	183	0.99	80	0.60	129	0.96	280	2.05
1980	470	6.49	293	4.17	147	2.00	147	0.81	83	0.60	131	0.97	280	2.06
1981	366	5.00	242	3.46	144	1.99	174	0.97	83	0.57	120	0.88	245	1.81
1982	475	6.40	285	4.01	181	2.53	158	0.90	87	0.58	124	0.88	275	2.04
1983	441	5.83	309	4.29	207	2.89	168	0.96	115	0.73	114	0.79	228	1.69
1984	471	6.09	271	3.68	148	2.09	181	1.05	115	0.71	115	0.77	247	1.84
1985	449	5.76	246	3.29	153	2.15	145	0.86	106	0.63	119	0.77	252	1.90
1986	459	5.93	282	3.75	168	2.39	204	1.26	131	0.77	139	0.88	245	1.86
1987	595	7.78	324	4.29	224	3.16	189	1.21	135	0.79	161	0.98	215	1.66
1988	520	7.06	266	3.51	182	2.56	193	1.29	143	0.84	143	0.85	273	2.12
1989	504	7.04	254	3.39	177	2.49	198	1.40	128	0.77	140	0.81	210	1.66

Figure 1 Age- and sex-specific hospitalization rates for asthma in Saskatchewan, 1970-89

municipality and the last two digits indicating town or city. Any municipality with a population of 10,000 or more was defined as an urban municipality. There were 10 urban municipalities by this definition: Estevan, Lloydminster, Moose Jaw, North Battleford, Prince Albert, Regina, Saskatoon, Swift Current, Weyburn and Yorkton. The rest of the smaller municipalities were considered as rural. The population of larger municipalities included in the rural category ranged from 4771 to 6040: Melfort (6040), Humboldt (5177), Melville (4983), Kindersley (4826) and Nipawin (4771). Because the population of the largest municipality included in the rural category was well below 10,000, a population of 10,000 seemed to be a reasonable cut-off point for division into rural and urban areas. The subjects residing in urban and rural municipalities were defined as 'urban dwellers' and 'rural dwellers', respectively.

During the study period, there were six base hospitals, seven regional hospitals, seven large community hospitals and 114 community hospitals in Saskatchewan. All 134 hospitals provide acute care services. The populations in the 10 'urban municipalities' are served by six base hospitals, seven regional hospitals and three large community hospitals while the populations in 'rural municipalities' are served by four large community hospitals and 114 community hospitals.

Statistical methods: Age and sex specific asthma hospitalization rates were obtained by dividing the number of hospitalizations for asthma (ICD 493) by the appropriate covered populations for the years 1970 to 1989. Trends in asthma

Figure 2 Age-specific hospitalization rates for asthma for rural and urban dwellers in Saskatchewan, 1970-89

hospitalizations were investigated separately for the two periods 1970 to 1978 and 1979 to 1989 during which ICD-8 and ICD-9 coding schemes were used. The number of hospitalizations in age, sex and time specific category was assumed to have a Poisson distribution with a mean Nr , where N is the population at risk in that category and r is the rate of hospitalization during that period (10). Significance of the trends was tested by fitting an ordinal (independent) variable in the Poisson regression model and then examining the significance of the slope (11). For comparison between rural and urban dwellers, Poisson regression models were fitted for seven age groups 0 to 4, 5 to 9, 10 to 14, 15 to 24, 25 to 34, 35 to 49 and 50 to 64 years, respectively, for four time periods 1970 to 1974, 1975 to 1979, 1980 to 1985 and 1986 to 1989. The dependent variable in the Poisson regression models was the hospitalization rate and the independent variables were sex and an indicator variable to identify the rural/urban populations. The Poisson regression models were fitted using the statistical package generalized linear interaction model (GLIM release 3, Numerical Algorithms Group, Oxford, UK), with hospitalization rate as the Y-variate, log as the link function and covered population as an offset. The error terms were assumed to have a Poisson distribution (10).

RESULTS

The frequencies and rates of hospitalizations for asthma are given in Table 1 for the age groups 0 to 4, 5 to 9, 10 to 14, 15 to 24, 25 to 34, 35 to 49 and 50 to 64 years, respectively.

Figure 3) Mean length of hospital stay for rural and urban dwellers in Saskatchewan, 1970-89

No significant trends were observed during the period 1970 to 1978. In the period 1979 to 1989, a significant trend was observed only in children aged 0 to 4 years. In this age group, asthma hospitalization rates increased significantly from 4.31/1000 in 1979 to 7.04/1000 in 1989 ($P < 0.001$).

The asthma hospitalization rates are shown in Figure 1 for male and female populations. In children aged 0 to 14 years, hospitalization rates were almost double among boys compared with girls. The rate ratio (RR) of hospitalization for asthma for boys compared with girls was 1.8 (95% confidence interval [CI] 1.72 to 1.94) during the period 1985 to 1989. This pattern was reversed in the age groups 15 to 34 and 35 to 64 years, with women having higher hospitalization rates for asthma than men. In the period 1985 to 1989, RRs of hospitalization for asthma for women compared with men were 1.4 (CI 1.31 to 1.59) in the age group 15 to 34 years and 1.5 (CI 1.36 to 1.64) in the age group 35 to 64 years, respectively.

As shown in Figure 2, asthma hospitalization rates were greater among rural than among urban populations in children aged 0 to 14 years and young adults aged 15 to 34 years until 1984, but the differences disappeared from 1985 onwards. In adults over 35 years, the hospitalization rates for asthma were greater among rural than among urban dwellers throughout the study period. In this age group, RRs for rural dwellers in comparison with urban dwellers were 1.5 (CI 1.31 to 1.65) for women and 1.6 (CI 1.38 to 1.84) for men during the period 1985 to 1989. As shown in Figure 3, means

Figure 4) Hospitalization rates for asthma, bronchitis and lower tract respiratory diseases (LTRD) for children aged 0 to four years in Saskatchewan, 1970-89

of length of hospital stay were very similar in rural and urban dwellers in all age groups.

To investigate whether the increases in asthma hospitalization rates in children aged 0 to four years were due to labelling other diseases as asthma, asthma rates in this age group were compared with those for bronchitis and lower tract respiratory diseases (Figure 4). If the increases in asthma hospitalization rates were due to labelling other diseases as asthma, the hospitalizations for bronchitis and lower tract respiratory diseases would be expected to decline throughout the study period. However, the hospitalization rates for bronchitis and lower tract respiratory diseases decreased only until 1983 and increased thereafter.

DISCUSSION

In this study, only children under four years of age had a significant increase in asthma hospitalizations during the period 1979 to 1989. No increases were observed in asthma hospitalizations during 1970 to 1978 in any age group. Several other studies have also reported significant increases in asthma hospitalizations among children under four years during the 1980s (3,5-9). There may be several reasons for the increase in asthma hospitalization rates in this age group. Increases in hospitalizations for bronchitis and lower tract respiratory diseases during the latter part of the study indicates that the increases in asthma hospitalization rates may not be due to labelling other diseases as asthma. An increase in the prevalence of asthma or an increase in the proportion of children with severe asthma seeking hospital admission would result in increased hospitalization rates for asthma.

In the present study, only the first admission of each patient in each year was included and readmissions within each year were excluded. This was done so that the hospitalization rates for asthma would not be inflated by repeated admissions to the hospital by a few subjects with severe

asthmatic attacks. Anderson and co-workers (3) reported that the increase in the frequency of asthma hospitalization was more likely to be due to an increase in the proportion of children with severe asthma attacks than to an increase in the prevalence of asthma. When readmissions were included, the asthma hospitalization rates increased, but the results were similar to those obtained with including only the first admissions.

Indoor air pollution may play an important role in the increases in the asthma morbidity among young children in Saskatchewan. Because of the long winter conditions in Saskatchewan, houses built in the past decade are 'energy efficient' so that outside air does not get in easily. This restricts air circulation and increases the build-up of cigarette smoke and allergens inside the houses. Maternal smoking has also been shown to be a risk factor for wheezing in young children (12,13).

The number of working mothers has increased recently in developed countries. As a result, more young children under four years attend daycare and preschool where they come in contact with children with viral infections. The viral infections are well known triggers of asthma attacks (14,15). The children who attend daycare are at a higher risk of developing asthma. Thus, increases in asthma morbidity among young children may be related to changes in lifestyles of the parents in the past decade.

A negative correlation was recently reported between parental knowledge of asthma and hospitalization of the child (16). Parental knowledge of asthma is required for compliance with medication, for management of severe asthma attacks and for the child to adopt a normal life. With recent changes in asthma diagnosis, medication and management, parental knowledge of asthma is essential for prevention and control of severe asthma attacks in the child. Thus, lack of parental knowledge about new medications and changes in the management of asthma may increase the need for repeated hospitalizations of the child.

Our results are consistent with the previous findings that the hospitalization rates for asthma are greater for boys than girls among children under 14 years of age, and greater for women than for men among adults aged 15 and above (1,17,18).

In adults aged 35 and above, rural dwellers had higher hospitalization rates for asthma than did urban dwellers

throughout the study period. This was true for both men and women. However, among children and young adults, the differences in asthma hospitalizations between rural and urban dwellers were apparent during 1970 to 1984 but disappeared during the period 1985 to 1989. Mitchell (18) investigated differences between rural and urban dwellers in New Zealand and reported that asthma admission rates were greater in rural than in urban dwellers among adults aged 45 and above, and that it was reversed in young adults aged 25 and below, with urban dwellers having greater admission rates for asthma than rural dwellers.

There may be several reasons for the higher hospitalization rates for asthma that we have observed among rural dwellers aged 35 and above in Saskatchewan. In this age group, the main occupation of the rural population in Saskatchewan is grain farming. A recent study investigated risk factors for asthma in a rural population in Saskatchewan and found that grain farming was significantly related to self-reported asthma (19). In another study, use of carbamate insecticides was shown to be associated with self-reported asthma among grain farmers in Saskatchewan (20). These results raise the possibility that grain farming may be related to increased hospitalizations for asthma among rural dwellers aged 35 years and above.

Another possible reason for greater hospitalization rates for asthma among the rural dwellers may be that there are more hospital beds available in rural hospitals than in urban hospitals. Thus, patients with milder asthma may be admitted to the hospital more often in rural than in urban areas. Also, asthmatics among rural dwellers may get admitted to the hospital more often than those among the urban dwellers because the asthmatics in rural areas live a greater distance from the hospital and the asthmatics in urban areas may be managed at home knowing that they are within easy access of a hospital.

CONCLUSION

Asthma hospitalization rates appear to be greater in children under four years than in older children and are greater among rural dwellers than urban dwellers in the age group 35 and above. Further studies are required to determine reasons for the increase in asthma hospitalizations and for the differences in admission patterns between rural and urban dwellers.

ACKNOWLEDGEMENTS: This research was supported by an establishment grant from the College of Medicine, University of Saskatchewan. The author, not the Urban Hospitals Branch of the Saskatchewan Health Department, is responsible for the study and its conclusions.

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