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Utilization of Health Care Services in Patients With Severe Obstructive Sleep Apnea

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Summary: We compared the health care utilization of 97 obese patients diagnosed with obstructive sleep apnea (OSA) and 97 matched control subjects. Over a 2-year period that ended 2 years prior to initial diagnosis, the OSA group had 251 nights in hospital, compared to 90 nights for the control group. During the same 2-year period, total expenditures from physician claims were $82,238 (Canadian dollars) in the OSA patients versus $41,018 in the control group ($p < 0.01$). Depending upon which assumptions one uses for the calculation of hospital costs, during the same 2-year period, the 97 OSA patients utilized between $100,000 and $200,000 more in services than their control counterparts. We conclude that sleep apnea patients are already heavy consumers of health care services prior to any specific evaluation and treatment for apnea. **Key Words:** Sleep—Obstructive sleep apnea—Medical economics.

Sleep apnea is a condition in which people stop breathing during sleep. The most common type, obstructive sleep apnea (OSA), occurs primarily in middle-aged men and less frequently in women and in other age groups. The disorder is frequently associated with obesity; many patients have arterial hypertension and are thought to be at increased risk for cardiovascular disease. Although the impact of this disorder on the patient's physiology and psychological state has been studied extensively (1), little has been published about the impact of this disorder on the health care system. We compared the utilization of medical resources by obese OSA patients to a matched control group from the general population of the Canadian province of Manitoba.

METHODS

Selection of obese OSA patients and control subjects

For this study we selected all Manitoba residents seen in the Sleep Disorders Center between 1993 and 1994 who had polysomnographically proven OSA and a body mass index (BMI) of more than 35. (This laboratory also assesses patients from the provinces of Ontario, Saskatchewan, and the Northwest Territories.) These patients were matched to control subjects using the Manitoba Health database (see below), which is described in greater detail elsewhere (2). Each patient was matched to an individual chosen at random but matched exactly for year of birth and gender. All patients and control subjects were registered with the provincial health insurance plan between January 1, 1989 and November 30, 1994. We only studied patients from Manitoba because this province maintains a detailed database of all medical services performed on patients (see below). This project was approved by the Human Ethics Committee of the University of Manitoba and by the Manitoba Ministry of Health. As a condition of this study, all patient identifiers were "scrambled" so that one would be unable to link an individual patient with his/her health care utilization. This is done to protect patient confidentiality.

All patients meeting the above criteria and evaluated in 1993 and 1994 were selected. For some analyses, patients were subdivided into groups based on apnea index (AI; the number of events per hour of sleep) and subjective sleepiness [based on the Epworth scale (3,4)]. We examined patient and control subject health care utilization over a 2-year period, ending with the calendar year 2 years prior to the year in which the

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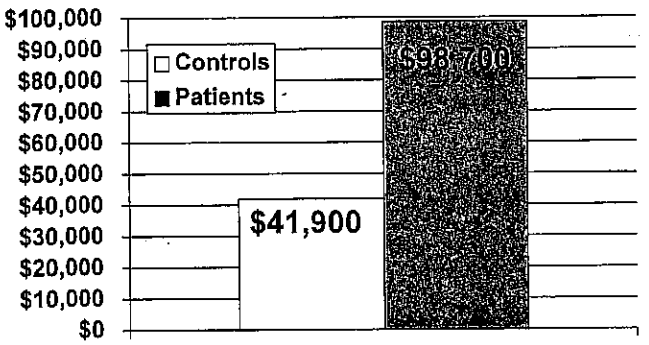

FIG. 1. Hospital costs (estimated from RDRGs) for 97 patients versus control subjects over a 2-year period 2 years before evaluation for sleep apnea.

patient was evaluated. Thus, as an example, for a patient evaluated in the calendar year 1993, patient and matched control subject utilization data for 1990 and 1991 were used for the analyses. This was done to avoid including the year of sleep laboratory evaluation, which may have artifactually skewed the utilization data.

The costs for the acute inpatient hospital stays in this study were estimated using refined diagnostic related group (RDRG) weights, developed for Manitoba acute care hospitals, and utilizing the appropriate hospital's average cost per weighted case (5). (Fig. 1). Manitoba RDRG weights were developed by combining charge data from the state of Maryland for the years of 1991 and 1992 with Manitoba average-length-of-stay data (5). RDRGs, which augment the older diagnostic related group (DRG) classifications with the addition of various levels of acuity, are determined using the most responsible diagnosis on the patient's discharge abstract (6). To estimate the case costs, the appropriate RDRG weight was multiplied by the average cost per weighted case for the hospital that provided the patient's care. RDRG weights are based on an average length of stay for that RDRG; with exceptionally long stays a daily marginal cost weight was applied. This adjustment was necessary for only two cases.

As stated above, the average cost per weighted case for each hospital was calculated using 1991–1992 hospital cost data; because admissions occurred over three fiscal years (1990–1991 to 1992–1993), an adjustment was necessary. The Statistics Canada Consumer Price Index (CPI) was used to adjust costs for the years preceding and following 1991–1992.

RESULTS

The patients had a mean age of 47.1 ± 10.4 (standard deviation, SD) years, a BMI of 43.0 ± 7.5, and an apnea index of 45.6 ± 34.7. The mean Epworth scale score was 14.1 ± 5.4. There were 71 males and 26 females who were matched to their control subjects as outlined above. Although all of the patients were obese (BMI >35), only 31 of the 97 had received a diagnosis of "obesity" on the claim forms filled in by their physicians.

TABLE 1. *Hospitalizations over 2 years*

	Patients n = 97	Control subjects n = 97
Individuals with any admissions	35	19
Number of "day" admissions[a]	28	11
Number of "inpatient" admissions	38	14
Total nights in hospital	251	90

[a] "Day" admissions are mainly for outpatient procedures. "Inpatient" admissions involved at least one overnight stay in a hospital bed. An individual patient could have more than one admission of each type.

Hospital admissions

Each hospital admission (Table 1) was categorized as a "day" admission (usually an admission resulting in a procedure and a discharge on the same day) or as an "inpatient" admission (at least one overnight stay in a hospital bed). Outpatient clinic visits were not counted as admissions but were recorded separately as part of physician visits. No attempt was made to estimate nonphysician costs related to the "day" admissions because those data are not available. Thirty-five of the patients, compared to 19 of the control subjects, had at least one admission over the 2-year period ($p = 0.015$ by McNemar's test). The 35 OSA patients had many more admissions (66 vs. 25) and many more inpatient nights (251 vs. 90) than the control group. Removing cancer-related admissions for both the patients and the control subjects (one in each group) did not change the results significantly. If each overnight hospital day is valued at $1,000 (Canadian dollars), then the 97 patients, in the course of 2 years, utilized $161,000 more in resources than the control group. Calculating the costs of hospital stays from their RDRGs indicated that patients generated about $58,000 more in expenditures than their controls counterparts.

Physician claims

Over the 2-year period, 95 of the 97 patients generated at least one physician claim: this was true for 91 of the 97 control subjects. The patients were much heavier users of medical services (Table 2). Over the 2-year period, patients incurred an average $847 in costs, whereas control subjects incurred only $422 ($p < 0.001$ by paired t test). Even patients with apnea indices of <20 and patients with Epworth scores <15

TABLE 2. *Total physician claims over 2 years*

Patient characteristics	n	Claims by patients	Claims by matched control subjects	p value
All	97	$82,238 (847.82 ± 87.50)[a]	$41,018 (422.87 ± 70.2)	<0.001[b]
Females	26	$30,267 (1,164.12 ± 129.22)	$10,567 (407.826 ± 79.98)	<0.001
Males	71	$51,971 (731.99 ± 104.66)	$30,451 (428.89 ± 91.60)	<0.05
Epworth score ≥15	45	$36,982 (821.83 ± 125.80)	$13,311 (295.80 ± 44.16)	<0.001
Epworth score <15	52	$45,255 (870.30 ± 121.58)	$27,707 (532.83 ± 123.82)	<0.05
AI ≥20	68	$49,130 (722.50 ± 96.99)	$26,566 (390.68 ± 88.05)	<0.001
AI <20	29	$33,109 (1,141.68 ± 172)	$14,452 (498.36 ± 112.70)	<0.001

[a] The value in parentheses is the expenditure mean ± standard deviation of the mean for each patient over a 2-year period.
[b] Paired *t* test.
AI, apnea index (apneas per hour); the Epworth scale is a subjective measure of sleepiness, with values ranging from 0 (no sleepiness) to 24 (sleepiness in most situations) (2).

had substantially more utilization compared to their control counterparts. Table 3 shows how many patients and control subjects had a physician claim in each diagnostic class and the sum spent during the 2-year period. Table 4 compares the type of physician claims and associated costs between patients and control subjects.

Utilization of services by the patients escalated with time. Figure 2 shows the mean annual expenditures for 3 years up to the year before diagnosis. Comparing 3 years of total physician claim expenditures for patients and control subjects shows that the difference between the two groups in 1991 increased over time. In 1990, expenditures for the patients were double those for the control subjects. Over the 3-year interval, mean expenditures for the control subjects increased by $41, whereas mean expenditures for the patients increased by $152.

Table 5 shows an estimate of the total expenditures

TABLE 3. *Diagnostic class and expenditure from physician claims over 2 years*

Diagnostic class	Patients[a]	Control subjects[a]	χ^2 value from McNemar's test[b]	Patient fees	Control subject fees
Diseases of the nervous system and sense organs	66	58	1.361	$6,443.28	$3,639.40
Diseases of the respiratory system	64	36	15.188	$6,757.97	$1,822.93
Factors influencing health status and contact with health service	58	44	3.841	$5,050.50	$3,709.24
Symptoms, signs and ill-defined conditions	57	26	18.367	$8,060.21	$1,856.86
Endocrine, nutritional and metabolic diseases, and immunity disorders	50	16	23.674	$7,716.26	$2,090.17
Diseases of the circulatory system	40	24	5.625	$6,524.51	$3,651.46
Diseases of the musculoskeletal system and connective tissue	38	34	0.225	$4,973.47	$3,528.34
Laboratory services	38	31	0.706	$3,516.39	$1,539.39
Diseases of the digestive system	35	23	3.184	$6,190.65	$2,366.82
Diseases of the skin and subcutaneous tissue	34	26	1.167	$3,153.57	$1,223.55
Injury and poisoning	33	34	0.000	$2,391.90	$2,059.94
Chiropractic services	27	23	0.265	$3,397.10	$1,485.28
Mental disorders	27	14	4.364	$10,843.56	$5,887.04
Diseases of the genitourinary system	22	18	0.281	$3,343.89	$2,686.58
Neoplasms[c]	16	1	11.529	$2,914.54	$2,319.08
Infectious and parasitic diseases	8	9	0.000	$320.23	$451.05
Diseases of the blood and blood-forming organs	3	3	0.167	$101.35	$76.38
Complications of pregnancy, childbirth, and the puerperium	1	1	0.500	$538.90	$385.20

[a] This refers to the number of subjects out of the 97 who had at least one physician claim in a diagnostic class. One subject may have had more than one claim.
[b] This evaluates whether there was a difference between the proportion of patients and their matched control counterparts who had at least one diagnosis in the diagnostic class. Values >3.84 are significant at $p < 0.05$.
[c] Three patients had malignant neoplasms (breast, colon, floor of the mouth); in the remaining 13 patients who had neoplasms, the tumors were benign, involving skin or gastrointestinal tract. One control subject had carcinoma of the esophagus.

TABLE 4. *Type of procedure, visit, or test and expenditure from physician claims over 2 years*

Type of procedure, visit, or test	Patients[a]	Control subjects[a]	χ^2 value from McNemar's test[b]	Patient fees	Control subject fees
Regional history and examination	93	78	11.529	$27,989.85	$14,675.34
Laboratory	73	54	7.200	$10,685.56	$3,080.40
Complete history and examination	67	52	5.026	$4,867.71	$3,217.75
Consultation	53	42	2.041	$7,667.36	$3,696.25
Heart tracing	48	34	3.841	$1,749.09	$1,051.70
Diagnostic/therapeutic services	39	20	7.902	$1,728.43	$835.38
Other tests and examinations	39	14	16.457	$3,702.12	$760.41
Optometrist—eye test	30	32	0.028	$1,212.15	$1,103.70
Subsequent visit	30	21	1.730	$2,210.24	$500.00
Chiropractor—subsequent visit	27	23	0.265	$3,397.10	$1,485.28
X-ray, chest	25	13	4.321	$828.09	$439.95
Anesthesia—surgical	25	13	4.033	$2,210.22	$941.31
Eye test	23	16	1.440	$793.95	$607.47
Surgery	21	14	1.440	$5,690.52	$4,635.18
Immunization	20	11	2.783	$110.35	$57.00
Special call (special trip)	17	12	0.640	$961.87	$430.59
Hospital calls	17	7	3.682	$1,749.89	$951.57
Laboratory smear	12	12	0.083	$68.77	$64.97
X-ray, lower extremities	12	5	2.769	$410.57	$216.90
X-ray, abdomen	7	3	0.900	$543.53	$332.10
X-ray, special	7	2	3.200	$824.05	$156.25
X-ray, upper extremities	6	9	0.308	$283.52	$297.22
X-ray, spine, pelvis	5	10	1.231	$261.60	$520.54
Injection	5	3	0.167	$51.49	$72.83
Allergy care	5	2	0.800	$1,028.20	$128.80
Surgical assistant	4	1	0.800	$478.45	$227.10
Concomitant care	3	1	0.250	$115.30	$9.05
X-ray, head, neck	2	2	0.250	$71.40	$107.98
Obstetrics	1	1	0.500	$212.00	$229.25
X-ray, radium	1	0	0.000	$334.90	$0.00

[a] This refers to the number of subjects out of the 97 who had at least one physician claim. One subject may have had more than one claim.

[b] This evaluates whether there was a difference between the proportion of patients and their matched control counterparts who had at least one procedure, visit, or test. Values >3.84 are significant at $p < 0.05$.

for patients compared to their matched control counterparts over a matched 2-year period. Table 5A estimates the cost of 1 day in hospital as $1,000 or (about $730 U.S.). Table 5B uses RDRGs, basing these figures on costs in the various hospitals where the patients were admitted. The 97 patients utilized between $100,000 and $200,000 more in services than their control counterparts, depending on which assumption one uses for hospital costs.

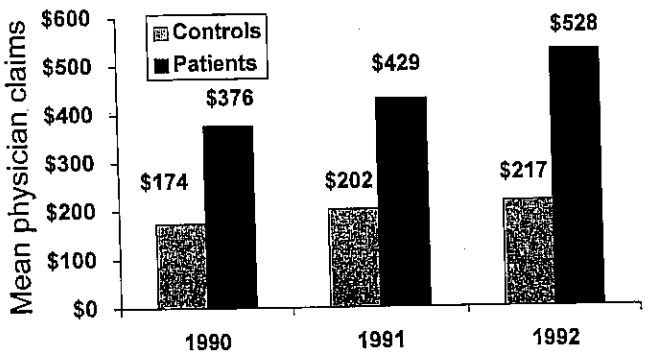

FIG. 2. Mean annual expenditures (physician claims) per patient, compared to matched control subjects, over 3 years.

DISCUSSION

For several years before being evaluated and diagnosed with sleep apnea, the patients were already very heavy consumers of medical services. These expenditures 2 years before evaluation are not surprising. Clinically, although most patients with sleep apnea present around the age of 50, symptoms by medical history have often been present for 5 to 10 years.

The patients in this sample were all "classical" po-

TABLE 5. *Total expenditure over 2 years*

	Patients	Control subjects
	A[a]	
Hospitalizations	$251,000	$90,000
Physician claims	82,238	41,018
	$333,238	$131,018
	B[b]	
Hospitalizations	$98,700	$41,900
Physician claims	82,238	41,018
	$180,938	$82,918

[a] This assumes $1000 per hospital day, and does not include day admissions or cost of medications.

[b] This is estimated from RDRGs, and does not include day admissions or cost of medications.

TABLE 6. *Examples of average fee for medical services in the patients*

Description	Average per claim, Canadian dollars	Average per claim, U.S. dollars
Regional or subsequent visit	$16.34	$11.77
Psychotherapy	$85.88	$61.84
Consultation	$68.93	$49.63
Complete history and physical examination	$33.33	$24.00

The value for U.S. dollars was calculated from the exchange rate of $100 Canadian for $72 U.S.

lysomnographically proven sleep apnea patients who were unambiguously obese (minimum BMI = 35). Some of the greater health care utilization in these patients is likely to be related to their known co-morbidities (arterial hypertension and obesity). To help sort out these issues, we plan to obtain information from the Manitoba Health database on control groups matched for age, gender, area of residence, etc. These control groups will include 1) patients who have all received the diagnosis of obesity; and 2) a matched control group in which 31% of the population would be diagnosed as being obese (equivalent to the proportion of our known obese patients diagnosed to be "obese"), but without the diagnosis of hypertension. A third control group will involve patients who are hypertensive but not obese. Comparing these control groups to patients may provide a better sense of which of the co-morbidities, or apnea itself, are responsible for the patients' higher utilization of health care resources.

This study was designed to compare patients to their matched control counterparts and not to directly compare costs of specific patient groups. There are several findings within patient groups that warrant comment. We found that OSA patients with an Epworth score of $\geq$15 did not generate more physician claims than patients with an Epworth score <15. This is not surprising because there may be a discrepancy between subjective and objective measures of sleepiness in these patients (7,8). A more interesting finding was that patients with AI values of <20 had greater mean physician claims than those with AI values $\geq$20. This is related to the fact that in this sample there was a large difference ($p < 0.001$ by unpaired t test) in AI between men (53.0 $\pm$ 4) and women (25.4 $\pm$ 5.8), but women generated far higher mean physician claims than the males. That women may have a lower AI than men when matched for age and BMI has been reported (9). Future research involving large groups of patients will examine the issue of costs related to gender in OSA.

Estimating utilization and costs

In Manitoba's single-payer health care system the payments are made directly to the provider; all basic medical acts are covered without limitation. These data may be difficult to compare with those from systems having more than one payer or a reimbursement system other than direct billing and payment to the physician.

Table 6 shows the value of the most common medical treatments to these patients and their reimbursement level. With no disincentive to seek medical care, these sleep apnea patients used many more health care resources 2 years before diagnosis than their control counterparts. This includes virtually all of the major categories of physician visits and hospitalizations. These patients were probably "sicker" 2 years before they were finally diagnosed, and they were using health care services because of either sleep apnea or their co-morbidities. Future research will examine prospectively whether treatment of apnea reduces health resource utilization in sleep apnea patients.

Our results almost certainly underestimate true utilization. First, as noted, we did not include any estimates for the hospital costs associated with the "day" (outpatient) admissions because these data are not available. Second, the sleep apnea patients had a higher rate of cardiovascular disease and respiratory disease than the control subjects, and many of these patients were probably using medications. Although medications are supplied to the patient at no cost (once they exceed a deductible), pharmaceutical data were not linkable for the study years. Our figures likely underestimate the differences between the patients and the control subjects for some tests performed in institutions. A professional is paid "sessional fees" for doing a set number of tests, and the physician does not bill for that service. These data are excluded from the database. Similarly, the technical component of a test may be blended into an institution's global budget so that, again, that figure would not appear independently in the database.

Conclusions

Severe sleep apnea patients were very heavy users of health care resources in a single-payer system 2 years before evaluation. Future research will determine how far back in time they were excess users, what co-morbidities may explain the excess usage, and whether treatment might reduce this cost. Our data suggest that undiagnosed or untreated apnea may have severe financial consequences on the health care system in addition to the known adverse effects on physiology.

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