Contact lens wear and its complications
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CHAPTER II

ININCIDENCE OF CONTACT LENS-ASSOCIATED MICROBIAL KERATITIS AND ITS RELATED MORBIDITY
ABSTRACT

Background.
Microbial keratitis, a potentially blinding disease is the severest complication of cosmetic contact lens (CL) wear. Because the incidence rates for CL-associated microbial keratitis are controversial, and its related morbidity and costs in the general CL population are not known, we examined these issues.

Methods.
To acquire the numerators for estimate of incidence rates, we surveyed all practicing ophthalmologists to prospectively identify all new cases, during a three-month period in 1996 in the Netherlands. Follow-up telephone calls were made to examine the morbidity and the costs due to microbial keratitis. To obtain the denominators, we performed annual nationwide telephone surveys between 1994 and 1997 to estimate the number of individuals who wore specific types of CLs.

Findings.
The annualized incidence of microbial keratitis was estimated to be 1.1 per 10,000 (95% CI 0.6-1.7) daily-wear rigid gas-permeable, 3.5 per 10,000 (2.7-4.5) daily-wear soft and 20.0 per 10,000 (10.3-35.0) extended-wear soft CL users (P<0.00001 for comparison between all groups). Five of the 92 (5.4%) case patients achieved a final visual acuity of ≤20/70, including 1 case with light perception due to Acanthamoeba requiring two corneal transplantations. Pseudomonas and Serratia were the commonest organisms isolated. Pseudomonas keratitis accounted for the largest mean diameter of corneal ulcers (3.8 mm), the highest mean hospitalized days (3.3), the most mean outpatients visits (10.3), the highest mean missed working days (29.5), and poor visual acuity outcome (≤20/70 in 3 of 8 patients). The minimal costs associated with microbial keratitis was estimated at US$ 2,809 per case patient and 75 US$ cents per CL user per year for the whole CL population.

Interpretation.
Five of the 92 case patients ended with a dramatically decreased visual acuity. Serratia keratitis seemed to be more prevalent than reported earlier. Pseudomonas and Acanthamoeba keratitis caused severe visual morbidity and economic impact. The incidence rate for extended-wear soft CLs in the Netherlands is similar to those reported nine years ago in the USA. The fact that the awareness of the risk factor in addition to improvement in CL materials and care products has not led to a drop in the incidence rate argues in favour of a strong discouragement of overnight wear.
INTRODUCTION

Microbial keratitis is the most devastating complication of contact lens (CL) wear\(^1\) and may result in permanent visual loss from corneal scarring or perforation. This inflammatory process is presumed to be microbial in origin, mostly due to bacteria and rarely to fungi and acanthamoebae.\(^2\) The number of CL wearers (28 million in the USA\(^3\) and 1.7 million in the UK\(^4\)) has grown steadily in the past decade. Ninety-seven percent of the CL wearers use lenses for refractive purposes as an alternative to spectacles (cosmetic CL wearers) rather than for therapeutic reasons (treatment of ocular surface diseases) or the correction of aphakia.\(^5\) Studies in the USA\(^6\) and the UK\(^7\) have shown that CLs are now the primary associated cause of, and have the highest relative risk for all cases of microbial keratitis. Microbial keratitis rarely occurs in the healthy eye.\(^8\) Since millions of CL wearers are at risk, this complication becomes an important public issue.

Up to now, two prospective epidemiological studies of microbial keratitis among cosmetic CL wearers have been carried out in the USA\(^9\) and Sweden.\(^10\) The incidence rates for this disease differed significantly in these countries.

Despite numerous case series,\(^1,11,12\) describing the morbidity to CL-associated microbial keratitis, there have been no population-based investigations to estimate both the magnitude of the morbidity and the costs related to this disorder. Also, because the incidence rates for CL-associated microbial keratitis are controversial, we conducted a prospective epidemiological study to estimate the incidences of risk, and its ocular morbidity and associated costs in the CL population in the Netherlands.

METHODS

Survey of Ophthalmologists

All practicing ophthalmologists were requested to identify the cases of microbial keratitis that occurred during the study period. Four hundred forty ophthalmologists were identified from the registration of the Dutch Ophthalmological society (Nederlands Oogheelkundig Gezelschap, NOG). In the Netherlands virtually all ophthalmologists are members of this society. All ophthalmologists were personally asked for participation during the annual congress of NOG in March 1996, and to report cases that met the inclusion criteria: a person who wore cosmetic CLs of any type and wearing pattern, was 12 years of age or older, had a corneal epithelial defect with an underlying stromal infiltrate, received antibiotic treatment for presumed microbial keratitis and had the disorder first diagnosed between April 1 and
June 30, 1996. Three one-page preprinted forms concerning each study month, three preaddressed, postage paid envelopes and one definition list were given. The definition list included the terms as cosmetic CL wearer (see Introduction); wearing pattern: daily-wear (less than 24 hours wear) or extended-wear (continuous wear for a minimum of 24 hours, often for 1-2 weeks); replacement regimen: disposable lenses (replacement within one month), conventional lenses (replacement at least monthly); CL-associated microbial keratitis (see the inclusion criteria) and sterile (nonmicrobial) keratitis (superficial punctate keratitis with a small infiltrate without significant pain or anterior chamber reaction, no discharge, and spontaneous healing after discontinuing CL wear). They were asked to complete the one-page form at the end of each month, indicating whether they had diagnosed a case of microbial keratitis. For each case, they were asked to record the name of the patient, date of birth, sex, and the city of residence, lens type: rigid gas-permeable (RGP) or soft, the actual wearing pattern, the largest diameter of the ulcer and distance of the centre of the ulcer to the limbus, the aspects of the corneal ulcer and the most probable clinical diagnosis (microbial or sterile keratitis), the visual acuity at presentation, and any corneal, conjunctival or lens-care products culture results. Ophthalmologists who could not be reached during the meeting or did not attend the congress, were contacted by trained interviewers or ophthalmologist-investigators by telephone. After their confirmation for their participation, the same standardised questionnaires were sent to them. Telephone calls were made to remind the participating ophthalmologists who did not return the form by the beginning of the following month. Also, inquiries were immediately made from the reporting physicians by telephone if the form had not completely been filled in or if there was a slightest doubt about the diagnosis of microbial keratitis. For the morbidity study, a follow-up telephone call to the treating physicians was made nine to ten months (if indicated also twenty-four months) after the diagnosis. They were asked whether the patient was admitted for medical treatment, if so, how many hospitalized days, the total outpatient visits related to microbial keratitis, any therapy received (including antibiotics, phototherapeutic excimer laser, corneal transplantation), how many missed working days (exclusive weekends) due to keratitis (mostly dependent on the time required for complete healing of the epithelial defect) and the ultimate visual acuity result. These data were obtained from the medical records. Of the 440 ophthalmologists, 27 (most were posterior segment surgeons) did not treat or whose practices did not include patients with corneal diseases were excluded, and another 11 who were not at work (because of vacation or illness). Twenty-three refused after a second request. Thus, 379 of the remaining 402 (94.3%) physicians participated. To complement the mail survey, a senior ophthalmologist resident at each teaching eye hospital was
asked to coordinate the study among the residents and was called to report the results at the end of the study period.

**Total costs of CL-associated microbial keratitis**

To calculate the costs (in 1996, 1 US$ = 1.70 Dutch guilders) due to microbial keratitis, the following estimations were made: costs of bacterial identification and sensitivity testing was $80 per corneal ulcer; topical antibiotics treatment (assuming that all patients were treated with 3 commercially available antibiotics) $33 per patient; one hospitalized day (included only nursing, caring and medication) $554; per corneal transplantation $3,158; per conjunctival flap graft $1,253; per phototherapeutic excimer laser $1,765; one missed working day $183 per patient; one initial outpatient visit $34.1 and one follow-up outpatient visit $21.2. The expenses of the above mentioned diagnostic and therapeutic interventions were determined reflecting the real use of resources (real costs). The total costs represented the sum of the direct and indirect costs. The direct costs were based on the real costs of manpower (physicians, nurses, laboratory workers), materials utilised in diagnosis and treatments, and overheads (operation rooms, hospitals). The indirect costs are defined as the actual economic production losses to society due to absence from work, calculated using the friction cost method.

**Population surveys**

Since 1994, we have performed annual telephone surveys to estimate the prevalence of CL use among the inhabitants of 12 years and older in the Netherlands. The telephone numbers were chosen randomly and were provided in computer diskettes by the Dutch Telephone Company. An eligible respondent was defined as any inhabitant 12 years or older. The interview started with a brief explanation of the aim of the study. An initial interview question asked if any individual who was at least 12 years old and whose birthday came at first among persons using the selected telephone number. The respondent was asked if he or she wore CLs. If no, the interview ended after asking the age and sex. If the answer was yes, the respondent was asked: the age, sex, lens type, the actual wearing pattern and the replacement regimen using a short structured questionnaire. All telephone surveys were carried out from October 1, through December 15. Interviews were conducted from 6 pm to 8 pm. To obtain a high precision with small confidence intervals, a goal was set to reach as many as 5000 interviews per annual survey. The results of the telephone surveys conducted from 1994 to 1997 were evaluated. Since the same method was used and no statistically significant
differences were observed within these four years, the collected data were pooled. Subsequently, the mean of each item of the questionnaire was calculated. During 4 years, a total of 38,100 individuals was contacted. Interviews were completed with 20,000 (4x5000) of them, from whom information was obtained. The mean percentage of cooperation of the four surveys was 53%. Of these 20,000 interviewed-persons, 1983 wore CLs.

**Statistical analysis**

We estimated the annual incidence of microbial keratitis for each lens type and its wearing pattern, using the expression: \( I = \frac{4C}{N} \), where \( I \) denotes the estimated incidence; \( C \) the number of cases of microbial keratitis identified through the survey of ophthalmologists; \( N \) the mean of the total CL population at least 12 years of age between 1994 and 1997, who wore the specific lens type and wearing pattern. For each year, the total CL population wearing the specific lens type and pattern, was calculated by extrapolating the data based on the telephone survey to the total Dutch population of 12 years and older (data from the Central Office of Statistics, 1995-1998) after correction for age and sex. The factor 4 was used to rescale the incidence for the three-month study period towards an annual incidence. Furthermore, the relative risk of keratitis for the different groups was calculated by the ratio of the incidence for each group. Wearers of RGP were used as the referent with a baseline risk of 1.0.

**RESULTS**

**Characteristics of the study population**

From 1994 to 1997, the mean Dutch population at least 12 years of age was 13,188,000. The mean number of CL users was as follow: 639,000 daily-wear RGP, 713,000 daily-wear soft and 24,000 extended-wear soft contact lens (SCL) wearers (total CL wearers: approximately 1.4 million). Virtually all extended-wear CL users wore 1 or 2-weekly disposable soft lenses. No extended-wear RGP lens users were found.

During the study period of April 1 to June 30, 1996, 111 incident cases of keratitis were reported by ophthalmologists. Of these, 19 cases were excluded because of correction of aphakia (1), sterile keratitis (13), herpetic keratitis (2), and cases presenting outside the study period (3). Thus, 92 cosmetic CL wearers with microbial keratitis were included of whom 17 were daily-wear RGP, 63 daily-wear SCL and 12 extended-wear SCL users (table 1).
The incidence, expressed as annualized rates per 10,000 individuals who used the specified lens, was estimated to be 1.1 per 10,000 (95% CI 0.6-1.7) daily-wear RGP lens wearers, 3.5 per 10,000 (2.7-4.5) daily-wear SCL wearers, and 20.0 per 10,000 (10.3-35.0) extended-wear SCL wearers (table 2). The differences were significant between all groups (P<0.00001). The relative risk for microbial keratitis was 18.9 (8.2-41.8) times greater for extended-wear SCL users and 3.3 (1.9-6.1) times greater for daily-wear SCL users than for daily-wear RGP lens users (Table 2).

**Microbiology**

In 65 of 92 (70.7%) cases, microbial cultures of the ulcer or the conjunctiva, and when available, of the CLs or the lens-care products were performed. Thirty cases (46.2%) were culture-positive (table 3), 12 (18.5%) showed normal ocular flora and 23 (35.4%) yielded no growth. In 7 of the culture-positive cases, more than one organism could be isolated. *Pseudomonas* spp (30%) and *Serratia* spp (26.6%) were the commonest bacteria isolated whereas *Acanthamoeba* was found in 1 case. No fungal organisms were recovered.

**Morbidity**

To investigate the morbidity caused by CL-associated microbial keratitis, the cases were divided into five groups on the basis of the results of the microbiologic examinations. Group 1 and 2 consisted of patients with culture-proven *Pseudomonas* spp and *Serratia* spp respectively, group 3 comprised patients with other organisms isolated, group 4 included patients whose cultures were negative or yielded normal ocular flora, and group 5 contained patients where no culture was performed. The mean diameter of the ulcers was largest (3.8 mm) in the *Pseudomonas* group and smallest (1.5 mm) in the ‘no culture performed’ group (table 4). Also, both mean

<table>
<thead>
<tr>
<th>Lens type and wearing pattern</th>
<th>Number(%)</th>
<th>Male/female</th>
<th>Mean (SD) age in years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily-wear RGP</td>
<td>17(18.5)</td>
<td>7 / 10</td>
<td>40.6 (10.2)</td>
</tr>
<tr>
<td>Daily-wear soft</td>
<td>63(68.5)</td>
<td>35 / 28</td>
<td>29.0 (11.1)</td>
</tr>
<tr>
<td>Extended-wear soft</td>
<td>12(13.0)</td>
<td>5 / 7</td>
<td>28.4 (9.2)</td>
</tr>
</tbody>
</table>

RGP=rigid gas-permeable.
Table 2: Estimated annualized incidence of microbial keratitis per 10,000 cosmetic CL wearers and estimated relative risk of microbial keratitis

<table>
<thead>
<tr>
<th>Lens type and wearing pattern</th>
<th>Incidence of keratitis (95% CI)</th>
<th>Relative risk* (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily-wear RGP</td>
<td>1.1 (0.6-1.7)</td>
<td>1.0 †</td>
</tr>
<tr>
<td>Daily-wear soft</td>
<td>3.5 (2.7-4.5)</td>
<td>3.3 (1.9-6.1)</td>
</tr>
<tr>
<td>Extended-wear soft</td>
<td>20.0 (10.3-35.0)</td>
<td>18.9 (8.2-41.8)</td>
</tr>
</tbody>
</table>

* The risk shown is relative to the risk when using daily-wear RGP.
† The relative risk is by definition 1.0.
Abbreviation as for table 1.

Outpatient visits and mean missed working days (10.3 and 29.5 respectively) were highest in the Pseudomonas group and lowest in the no culture performed' group (6.1 and 7.7 respectively). In total, 5 patients were hospitalized of whom 3 had Pseudomonas keratitis, 1 had Acanthamoeba infection and 1 had a sterile culture. In the Pseudomonas group, phototherapeutic excimer laser was required to remove severe corneal scars in 1 patient and corneal transplantation was indicated in 3 patients because

Table 3: Microbial isolates of ulcerative keratitis in cosmetic CL wearers

<table>
<thead>
<tr>
<th>Culture-positive keratitis (n=30)</th>
<th>Number of isolates (polymicrobial)</th>
<th>(%)*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Organisms</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Gram-negative</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pseudomonas aeruginosa</td>
<td>7</td>
<td>(23.3)</td>
</tr>
<tr>
<td>Pseudomonas maltophilia</td>
<td>2 (1)</td>
<td>(6.7)</td>
</tr>
<tr>
<td>Serratia marcescens</td>
<td>7 (1)</td>
<td>(23.3)</td>
</tr>
<tr>
<td>Serratia liqueformis</td>
<td>1</td>
<td>(3.3)</td>
</tr>
<tr>
<td>Enterobacter spp</td>
<td>5</td>
<td>(16.7)</td>
</tr>
<tr>
<td>Klebsiella spp</td>
<td>3 (2)</td>
<td>(10.0)</td>
</tr>
<tr>
<td>Acinetobacter calcoaceticus</td>
<td>(1)</td>
<td>(3.3)</td>
</tr>
<tr>
<td>Escherichia coli</td>
<td>(1)</td>
<td>(3.3)</td>
</tr>
<tr>
<td><strong>Gram-positive</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Staphylococcus spp</td>
<td>6 (2)</td>
<td>(20.0)</td>
</tr>
<tr>
<td>Streptococcus spp</td>
<td>4 (1)</td>
<td>(13.3)</td>
</tr>
<tr>
<td>Aerobic spore-forming bacil</td>
<td>1</td>
<td>(3.3)</td>
</tr>
<tr>
<td>Corynebacterium diphtheriae</td>
<td>(1)</td>
<td>(3.3)</td>
</tr>
<tr>
<td>Amoeba</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acanthamoeba</td>
<td>1</td>
<td>(3.3)</td>
</tr>
</tbody>
</table>

*Percentage of culture-positive cases. Total is greater than 100% because of polymicrobial infections.
Table 4: Morbidity and the total costs (US$) of 91 cases with CL-associated microbial keratitis

<table>
<thead>
<tr>
<th>Microbiologic examination</th>
<th>Mean ulcers diameter (mm)</th>
<th>Mean hospitalized days</th>
<th>Mean outpatient visits</th>
<th>Microbiologic examination and antibiotic treatment</th>
<th>Intervening treatments</th>
<th>Mean missed working days*</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Pseudomonas</em> organisms (n=8)</td>
<td>3.8</td>
<td>3.3 ($14,404)</td>
<td>10.3 ($1,840)</td>
<td>($640) ($264)</td>
<td>1 Excim. ($1,765)</td>
<td>29.5 ($43,188)</td>
</tr>
<tr>
<td><em>Serratia</em> organisms (n=7)</td>
<td>1.9</td>
<td>0 ($0)</td>
<td>9.6 ($1,509)</td>
<td>($560) ($231)</td>
<td>--- ($0)</td>
<td>14.7 ($18,849)</td>
</tr>
<tr>
<td>Other organisms (n=15)</td>
<td>1.7</td>
<td>0.4 ($3,324)</td>
<td>7.9 ($2,714)</td>
<td>($1,200) ($495)</td>
<td>2 Cor. Tr. ($6,316)</td>
<td>12.9 ($35,502)</td>
</tr>
<tr>
<td>Culture-negative or normal flora (n=35)</td>
<td>1.8</td>
<td>0.3 ($6,694)</td>
<td>6.8 ($5,514)</td>
<td>($2,800) ($1,155)</td>
<td>1 Con.Fl. ($1,253)</td>
<td>9.6 ($62,952)</td>
</tr>
<tr>
<td>No culture performed (n=27)</td>
<td>1.5</td>
<td>0 ($0)</td>
<td>6.1 ($3,704)</td>
<td>($2,080) ($858)</td>
<td>--- ($0)</td>
<td>7.7 ($36,417)</td>
</tr>
<tr>
<td>Total (n=91 cases)</td>
<td></td>
<td>($23,822)</td>
<td>($15,281)</td>
<td>($10,283)</td>
<td>($9,334)</td>
<td>($196,908)</td>
</tr>
</tbody>
</table>

The direct costs: $23,822 + $15,281 + $10,283 + $9,334 = $58,720.
The indirect costs: $196,908.
The total costs is $255,628, amounting to $2,809 per case patient and $1,033,712 for the approximately 1.4 million CL wearers in the Netherlands per year.
*Weekends excluded.
†All data of one patient with a ulcer diameter of 10 mm were excluded because this patient also had psychiatric disorder who refused adequate treatment.
of significant loss of vision. After a follow-up of 2 years, keratoplasties had not yet been performed. Of all cases, 5 of 92 (5.4%) achieved a final visual acuity of 20/70 or less, including 3 of 8 (37.5%) patients with *Pseudomonas* keratitis (table 5). In 1 patient with *Acanthamoeba* infection the ultimate visual acuity was limited to light perception despite two corneal transplantations. Eventually, a conjunctival flap graft was performed (table 4).

The direct medical costs amounted to $58,720 whereas the indirect costs were $196,908 (table 4). The total costs were estimated to be $255,628 amounting to $2,809 per case patient and $1,033,712 for the approximately 1.4 million CL wearers in the Netherlands per year (table 4).

**DISCUSSION**

Our results show that five of the 92 (5.4%) cosmetic CL wearers with microbial keratitis had a dramatically decreased visual acuity. In contrast to a remarkable similarity of the estimated incidence rates for microbial keratitis among SCL wearers in this study, to those reported in the USA, the estimate for RGP lens users was much higher (4.0 per 10,000) in the latter study. The smaller risk of keratitis in RGP lens wearers in our population may be a more reliable estimate in view of our larger sample of wearers of RGP lenses. This premise is supported by the results of a case-control study, which estimated the incidence for daily-wear RGP lenses as 1 per 10,000. This figure is the same as that found in our study (table 2). Although the incidences for daily-wear RGP lenses and daily-wear SCLs in our study are comparable with those observed in Sweden, its estimate for extended-wear disposable SCLs is substantially lower (10.0 per 10,000). Because of the few case patients reported, the Swedish figure for extended-wear SCLs may be of doubtful value. Despite a number of differences
observed between these three incidence studies, there is a common agreement in that overnight use of SCLs was the principal risk factor for microbial keratitis. In spite of the public and health care awareness of the risks associated with extended-wear, the incidence of ulcerative keratitis in this group is still the same as compared to nine years ago.9

Potential limitations of our study are the use of a clinical case definition, sampling bias in the population survey, cases treated by general practitioners or treated outside the Netherlands, and seasonal variation in the development of microbial keratitis.

We used a clinical case definition because many clinically suspected cases of microbial keratitis had negative cultures. Moreover, use of clinical criteria for microbial keratitis has been shown to be justified for epidemiological studies. In our study, the validity of the clinical criteria for microbial keratitis was strengthened by the morbidity (follow-up) study in which the use of antibiotics was ascertained and the self-limiting course of the small corneal lesions (nonmicrobial keratitis) were excluded.

In the population surveys the telephone numbers were randomly selected. Analysis of the collected data showed no significant differences between North, East, South, and West of the Netherlands regarding the number of individuals interviewed and the trend in rates for all items of the standardised questionnaire, indicating that persons interviewed were representative of the study population. However, we did not know whether the nonrespondents differed from the respondents in the prevalence of CL use. We have no reason to suspect that there were systematic differences between these groups in the CL use.

We might have missed some mild microbial keratitis cases, which were treated by general physicians. The more serious cases will not have been missed since the practice guidelines for general practitioners as well as contactlens practitioners prescribe immediate referral of a patient with symptoms suggestive of keratitis to an ophthalmologist.

Frontier inhabitants might cross the boundary to consult a physician. However, boundary-crossing problems will be minimal because during the study period, we did not encounter patients who lived outside the study area. Assuming that the frequency of boundary-crossing medical visits in the surrounding countries will be similar, the treatment of the Dutch patients outside the Netherlands is likely to be negligible. Furthermore, the Dutch insurances do not or partly (only the acute phase of the disease) cover the medical treatment given by non-Dutch physicians.

In our study the incidence rates for microbial keratitis are annualized rates for a three-month period, not actual annual rates. Seasonal variation in bacterial keratitis has probably not influenced our data since a number of studies addressing this issue have either reported a weak or absent relation.
Our culture-positive rate of 46.2%, with a predominant identification of *Pseudomonas aeruginosa*, is consistent with that observed in other studies.\(^1\)\(^{11}\)\(^{16}\) Interestingly, the next most common isolate was *Serratia marcescens*. Both bacteria are commonly isolated from the contaminated care systems of asymptomatic CL wearers.\(^1\)\(^{18}\)\(^{19}\) *S. marcescens* can survive in solutions preserved with chlorhexidine and benzalkonium chloride.\(^2\)\(^{20}\) Although *P. aeruginosa* can produce fulminating infections,\(^8\)\(^{11}\) *S. marcescens* is associated with both severe\(^2\)\(^{21}\) and mild\(^2\)\(^{22}\) keratitis. Variability in virulence among strains of *Serratia* may alter the clinical course of the disease.\(^23\) The severity of *Serratia* keratitis in the present study (table 4) was intermediate between keratitis caused by *Pseudomonas* spp and those caused by ‘other’ pathogenic organisms (excluding one patient with *Acanthamoeba*).

Despite of early diagnosis and treatment, the most disastrous keratitis developed in one patient due to *Acanthamoeba*, resulting in unilateral near blindness. The patient claimed to have good CL corrected vision before the infection. CL wear is the main risk factor for *Acanthamoeba* keratitis.\(^24\) Recently, a sharp increase of *Acanthamoeba* keratitis cases has been found using tandem scanning confocal microscopy, suggesting that this disease may be more prevalent than previously reported.\(^25\)

Earlier studies concerning the morbidity of CL-associated microbial keratitis included referred or hospital-based patients\(^1\)\(^{11}\)\(^{12}\). In the current report, the morbidity was investigated in the general CL wearing population. Thus, the cases represent the spectrum of primary community-acquired microbial keratitis. *Pseudomonas* and *Acanthamoeba* keratitis accounted for the most severe morbidity and high disease costs. The estimated cost of illness is minimal because costs such as patient’s travel time and travel costs, and reduced productivity at work (less efficiently working due to decreased vision) are not incorporated.

Our results are important because they provide more precise data on the incidence of CL-associated microbial keratitis and information about the long-term follow-up of this preventable disease. The public should know that CL use can lead to profound and permanent visual loss in otherwise healthy eyes. Although CLs offer certain visual and cosmetic advantages over spectacles, the major risk factor for infection is overnight wear, which should be discouraged.
REFERENCES


