



Project Summary

Epidemiological Studies of Otitis Externa: Report of a Prospective and of a Retrospective Study of Otitis Externa Among Swimmers

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Two epidemiological studies of otitis externa were conducted. One was a prospective study conducted in the summer of 1979 comparing boy scouts at camp who swam in a fresh water lake with boy scouts at another camp who swam in a chlorinated swimming pool. The other was a retrospective study conducted at Yale University during the summer of 1980. In the prospective study 3 percent of the children reported ear complaints in the week following camp, but none had otitis externa confirmed by a physician; the retrospective study compared 29 cases with 29 controls who were matched by age and sex.

In the prospective study a higher relative humidity at the camp where the boy scouts swam in a chlorinated pool was associated with a greater degree of abnormal flora colonization of the ear (Gram-negative bacteria and *S. aureus*). In the retrospective study, positive association was demonstrated with cases of otitis externa for ambient air temperatures, water temperature, less than 18 years of age, being female, swimming, and length of time spent swimming. There was no association between cases of otitis externa and water quality as

measured by fecal coliforms, enterococci and *P. aeruginosa* or between abnormal flora colonization of the ear with bacterial indices of water quality.

This Project Summary was developed by EPA's Health Effects Research Laboratory, Cincinnati, OH, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

In 1921, the Committee on Swimming Pools of the American Public Health Association surveyed physicians and health officers to determine diseases spread by bathing waters. Among the major diseases listed was otitis externa or, as it is more commonly known, "swimmers ear." Otitis externa is an inflammation of the outer ear canal, characterized by pain, swelling, drainage and occasionally fever.

As part of the United States Environmental Protection Agency's studies on recreation water quality and indicators of water quality, a series of studies were conducted to determine if there was a direct relationship between the incidence of otitis externa,

swimming and the quality of the recreational water. If such a relationship did exist, what would be the indicator of choice and what, if any, should be the standard or guideline?

The first of these studies, a prospective study, was conducted during the summer of 1977, and involved swimming pools and fresh water ponds in the State of Rhode Island. Although there were no confirmed cases of otitis externa, ear complaints were recorded and there appeared to be a slight correlation with swimming, abnormal flora, high humidity and individuals less than 20 years of age.

The second study conducted by the government was based on the results of the Rhode Island study and was also a prospective study. It was conducted in the New Orleans area. The third study was a retrospective study and was carried out by the Department of Epidemiology and Public Health, School of Medicine, Yale University. The following summarizes the results of the New Orleans study and the Yale Study.

The New Orleans Study

In the summer of 1979, a second study on otitis externa was undertaken. The year prior to the study was spent visiting various Boy Scout camps in the southern United States to evaluate their suitability for study. Sites for visitation were evaluated by the following criteria:

- (1) approximately 800 or more campers enrolled in the camp during the summer;
- (2) swimming a major part of the camp's activities;
- (3) swimming in a body of water with high densities of *P. aeruginosa*; and
- (4) the water not contaminated by known sources of pollution.

Two campsites in the New Orleans Areas Boy Scout Council were chosen using the above criteria. The first, Salmen Reservation, was in a wilderness area around a man-made lake. Samples taken during August 1978 showed that the lake had high concentrations of *P. aeruginosa*. The second, Camp Salmen was a well established "conventional" camp having a chlorinated swimming pool. This

selection seemed to be ideal as it would afford two types of recreational water, two levels of *P. aeruginosa* and two comparable study groups to be analyzed for the incidence of otitis externa.

Samples of water for microbial analyses were collected from both sites (the lake and swimming pool) during camper swimming activities. All samples were examined for *Escherichia coli*, enterococci and *P. aeruginosa*. Water temperature, air temperature and relative humidity were measured daily. At the time when the swimming pool water samples were collected, the free residual chlorine levels and the pH were determined. All campers who entered camp at noon on Sunday were enrolled in the study as part of their medical check in. Each camper filled out a questionnaire concerning age, race, and previous ear infection experience. Upon leaving camp, all campers were given postage paid cards to fill out one week after leaving camp. These cards asked if there were any ear problems after leaving camp. Persons returning cards marked "yes" were contacted by telephone to determine if they had visited a physician and if so, they were queried about the physician's diagnosis and treatment. Both right and left ears of all campers were cultured during their Sunday check in and on Saturday when they checked out. Isolates considered as normal flora were noted as such (alpha-hemolytic streptococci, corynebacteria, and non-*S. aureus* staphylococci). The results of the ear cultures were classified into three categories as follows:

- (1) Normal flora - both ears had normal flora as described above or one ear had normal flora and the other showed no growth,
- (2) No growth - nothing was recovered from either ear,
- (3) Abnormal flora - isolates cultured from one or both ears that could not be classified as normal flora.

A total of 444 subjects were cultured during the three camp sessions at the lake. There was a significantly higher number of *Enterobacter*, *Acinetobacter* and *Bacillus* isolates in final ear cultures than initial ear cultures. There were no confirmed cases of otitis externa, but 10 complaints of subsequent earaches according to mail

and telephone follow-up were ascertained.

A total of 426 subjects were cultured at the swimming pool camp. There were significantly more *Enterobacter*, *Acinetobacter*, *P. aeruginosa*, *Bacillus* and other *Pseudomonas* species isolated in final ear cultures than in initial ear cultures. No confirmed cases of otitis externa were documented, but there were 14 ear complaints according to mail and telephone follow-up. At the swimming pool camp there was a higher frequency of abnormal isolates cultured than at the lake camp. This difference did not appear to be associated with water temperature, air temperature or water bacterial indices. The relative humidity was significantly higher at the swimming pool camp than at the lake camp.

The Yale Study

The inability to collect information on cases of otitis externa in the Rhode Island and the New Orleans studies prompted a retrospective approach. A third study was undertaken by Yale University using participants of a comprehensive health care plan. The epidemiological design of this third study consisted of examining persons with otitis externa, the swimming exposures determined and the water quality assessed retrospectively. These findings would be compared with data collected from selected controls.

Two questionnaires were developed for this study. The first was to be filled out by the subject or subject's parent concerning prior swimming episodes and prior ear infections. The second was designed to be filled out by the attending health professional. Basic demographic data were obtained as well as information concerning symptoms of otitis externa.

The subjects were chosen from subscribers to the Yale Health Plan, a health maintenance organization whose members are primarily faculty, staff, employees and students of Yale University and their families. Only cases diagnosed clinically by a physician as being otitis externa were included. A control group was selected from healthy individuals coming to the clinics for routine physical examinations. Controls were matched according to age (± 2 years) and sex.

Cultures from right and left ears were obtained separately from each control. The cultures were processed according

to standard laboratory procedures by the Yale Health Plan medical laboratory.

Data were collected noting the locations where cases and controls had been swimming during the prior seven days. If the sites were accessible for collecting a water sample, samples were obtained for analyses within 48 hours of the subjects visit to the clinic. At each site the air temperature, water temperature, relative humidity and pH of the water were measured and recorded. All sites were analyzed for fecal coliforms, enterococci and *P. aeruginosa*. Swimming pools were also analyzed by total plate counts and for staphylococci.

During the nine-week study period from July 7th to September 6th, data on 29 cases and 29 matched controls were collected. All cases came from the Adolescent and Pediatric Clinic with an age range of 4 to 17 years. Twenty-one of the cases were female compared to seven males. Similar to the findings of the Rhode Island study, the frequency of cases correlated positively with the average weekly temperature. There was no association with relative humidity.

The proportion of swimmers among diagnosed cases was significantly higher than the proportion of swimmers among controls. When comparing only swimmers, the average time spent swimming during a one-week period was significantly higher in cases than in controls. As to the quality of water, there were no significant differences between cases and controls concerning fecal coliforms, enterococci, *P. aeruginosa*, *Staphylococcus* or total plate counts. The range of organisms isolated was greater in cases than in controls, and, with the exception of *Pseudomonas stutzeri*, there were no Gram negative isolates from controls. The distribution of Gram positive isolates was similar for both cases and controls.

Conclusions

1. Otitis externa appears to be a disease associated primarily with people under 18 years of age. Otitis externa in adults does occur, but was not found in these studies.
2. Hot and humid air appears to be associated with otitis externa. This association may be indirect rather than direct. Hot and humid air may affect a person's swimming habits during such periods of extreme weather.

3. Swimming appears to be associated with otitis externa but, more importantly, seems to be associated with the amount of time spent actually swimming.

4. Otitis externa does not appear to be associated with bacterial indicators of recreational water quality, such as fecal coliforms, enterococci, or *P. aeruginosa*. This suggests that bacterial indices involving these organisms as measures of recreational water quality may be of little use in evaluating the potential risk of acquiring otitis externa in swimmers bathing in these waters.

5. While *P. aeruginosa* may be the most commonly isolated organism from cases of otitis externa, the role of other organisms as etiological agents, *Acinetobacter*, *Klebsiella*, *Enterobacter* and *Staphylococcus*, should not be excluded when studying otitis externa.

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The complete report, entitled "Epidemiological Studies of Otitis Externa: Report of a Prospective and of a Retrospective Study of Otitis Externa Among Swimmers," (Order No. PB 81-226 136; Cost: \$6.50, subject to change) will be available only from:

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