

# BATHER MORBIDITY FROM RECREATIONAL EXPOSURE TO SEA WATER

Y. E. R. Von Schirnding\*, N. Strauss\*, P. Robertson\*,  
R. Kfir\*\*, B. Fattal\*\*\*, A. Mathee\*\*, M. Franck\*\* and  
V. J. Cabelli†

\* *Research Institute for Environmental Diseases, Medical Research Council,  
South Africa*

\*\* *Division of Water Technology, Council for Scientific and Industrial Research,  
South Africa*

\*\*\* *Division of Environmental Sciences, Graduate School of Applied Science and  
Technology, Hebrew University of Jerusalem, Israel*

† *Department of Microbiology, University of Rhode Island, USA*

## ABSTRACT

Rapid urbanisation in the coastal areas of South Africa has led to increasing concern about the potential health effects on bathers resulting from exposure to contaminated seawater. Water quality criteria in South Africa are not epidemiologically derived; consequently a major programme has been launched to develop health-related criteria and policies pertaining to wastewater and stormwater management in the coastal areas of South Africa. In the first phase of the project, an epidemiological-microbiological study was carried out at a moderately polluted beach and a relatively clean beach, in the Western Cape. Individuals present at the beach in family groups were interviewed and follow-up telephone interviews were conducted 3 - 4 days after the beach outing. Water quality indicators measured on the same day as the beach interviews revealed significantly higher levels of enterococci and faecal coliforms at the moderately polluted beach. Symptom rates for gastrointestinal, respiratory and skin effects were substantially higher among swimmers relative to non-swimmers at the polluted beach, although they did not reach statistical significance.

## KEYWORDS

Marine pollution, bather morbidity, seawater, epidemiology, guidelines.

## INTRODUCTION

With massive urbanisation in the coastal areas of South Africa and the accompanying disposal of wastewater into the sea, marine pollution and the potential effects on human health have become the focus of increasing concern. It has been well documented that the wide variety of pathogenic micro-organisms present in sewage and stormwater run-off may, under certain circumstances, pose a potential health risk (Cabelli, 1983; Shuval, 1986). Increased risk of infections have been shown to be associated with direct contact recreation (bathing, diving, surfing), as well as with indirect exposure through seafood consumption. Potentially contractible diseases include gastroenteritis, respiratory, ear, eye and skin infections, hepatitis A, cholera and typhoid.

In South Africa, water quality guidelines based on faecal coliform densities are not derived from epidemiological data (Lusher, (1984) and available data are not sufficient to predict health risk. A major research program has consequently been launched to develop appropriate water quality criteria and policies pertaining to wastewater and stormwater management in coastal areas. A preliminary study at two beaches in Cape Town was conducted to test the feasibility of a prospective epidemiological-microbiological study being carried out under South African conditions. The results were suggestive of some relationship between swimming-associated illness and water quality, and the methodology followed proved appropriate (Von Schirnding *et al.*, 1992). A full-scale epidemiological study was consequently conducted over the 1990/91 bathing season in Cape Town, the aim of which was to assess the health risk associated with recreational exposure to sea water at test and control beaches.

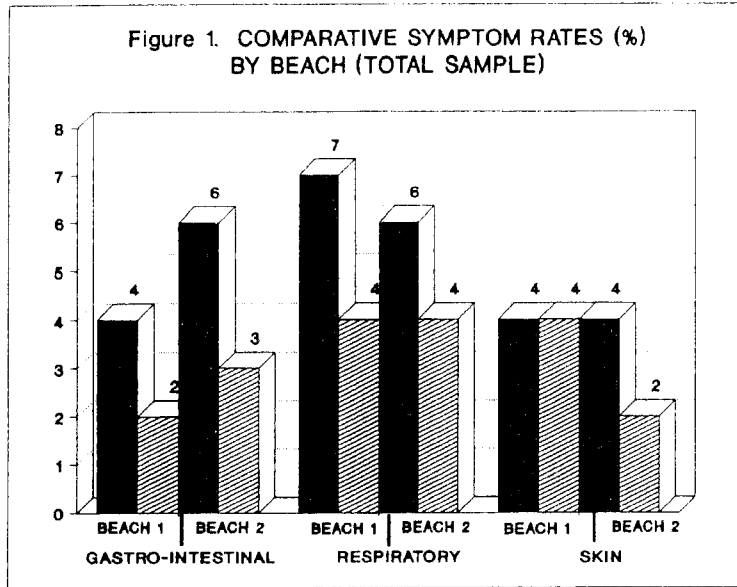
## MATERIALS AND METHODS

A series of discrete prospective trials were carried out at a "clean" and a moderately polluted beach over the peak holiday period, following a methodology similar to that devised by Cabelli in the USA. Interviews were conducted with participants present at the beach in family groups (with at least one child under ten years of age), to obtain information on individuals' swimming activities, as well as socio-demography and other relevant data. "Swimmers" were defined as those individuals who entered the water to waist height or beyond. "Non-swimmers" were defined as those individuals who entered the water to ankle or knee height, or who did not enter the water at all. Altogether 5 551 people were sampled, comprising around 1 400 family groups. Follow-up telephone interviews were conducted 3 - 4 days after the beach outing, and respondents were asked to note the presence of any gastrointestinal, respiratory, skin effects and other symptoms. Composite water samples were collected during maximum swimming activity, on trial days at three sites along each beach. Samples were analysed for faecal coliforms (and *E. Coli*), enterococci, coliphages and staphylococci.

Table 1 Microbiological Measurements  
(per 100 ml)

	Beach 1 (Control)				Beach 2 (Test)			
	FC	EC	EN	ST	FC	EC	EN	ST
Sample size	63	32	63	63	63	31	61	63
Mean	31.5	41.8	8.6	40.1	53.9	46.8	17.4	52
Median	8	34.8	3	14	20	43	9	8
Minimum	ND	ND	ND	ND	ND	ND	ND	ND
Maximum	308	100	83	410	436	100	163	577
Lower quartile	3	18.5	1	4	7	21	4	3
Upper quartile	27	63.5	7	37	45	67	21	54

FC - Faecal coliforms    EC - *E. coli*    ND - Not Detectable  
EN - Enterococci        ST - Staphylococci



**Table 2. Estimates of Relative Risks (Total sample)**

SYMPTOMS	BEACH	VALUE	95% CONFIDENCE BOUNDS
G	1	1.5	0.89 - 2.63
G	2	2.2	1.18 - 4.15
R	1	1.8	1.17 - 2.66
R	2	1.6	0.90 - 2.73
S	1	1.3	0.79 - 1.96
S	2	1.8	0.84 - 3.91

**Table 3. Estimates of Relative Risks (Whites)**

SYMPTOMS	BEACH	VALUE	95% CONFIDENCE BOUNDS
G	1	1.6	0.77 - 3.29
G	2	2.5	1.13 - 5.62
R	1	2.1	1.05 - 4.19
R	2	1.0	0.97 - 1.04
S	1	1.7	0.56 - 4.90
S	2	5.2	1.47 - 18.46

**Table 4. Estimates of Relative Risks (Coloureds)**

SYMPTOMS	BEACH	VALUE	95% CONFIDENCE BOUNDS
G	1	1.5	0.65 - 3.34
G	2	1.8	0.64 - 4.85
R	1	1.6	0.97 - 2.67
R	2	4.1	1.39 - 12.26
S	1	1.2	0.70 - 1.90
S	2	0.6	0.18 - 1.92

G = Gastro-intestinal    R = Respiratory    S = Skin

As can be seen from Table 1, significant differences were found with respect to the water quality at the two beaches, with higher densities of faecal coliforms and enterococci at the test beach relative to the control beach. These differences were statistically significant at the 5% confidence level.

Overall (Table 2), the relative risk (incidence rate among swimmers divided by the incidence rate among non-swimmers) for developing respiratory symptoms associated with swimming, was similar at both beaches. The relative risk for gastro-intestinal symptoms was higher at the test beach than at the control beach, whilst the relative risk for skin symptoms was slightly higher at the test beach.

Differences with respect to ethnic group were found in relation to individual symptom groups (Tables 3 & 4 and Figure 1). For gastrointestinal symptoms (diarrhoea, nausea, stomachache, vomiting), whilst among both whites and coloureds (people of mixed race) the relative risk was moderately higher at the test beach relative to the control beach, this trend was more pronounced among whites. Amongst coloureds the relative risk for respiratory symptoms (cough, cold, sore throat, runny/stuffy nose) was higher at the test beach than at the control beach, but this did not hold for whites. The relative risk for skin symptoms (skin rash/welts, itchy skin) was significantly higher among whites at the test beach than at the control beach, but not among coloureds. Confidence intervals in most cases were wide, however.

More detailed analyses of epidemiological data are being conducted by days of "high" and "low" levels of microbial pollution at the respective beaches, and using alternative definitions of "swimmers". Further epidemiological studies will be performed once a pipeline has been installed at the test beach, to determine the impact on water quality and associated health risks.

#### REFERENCES

- Cabelli, VJ (1983). Health Effects Criteria for Marine Recreational Waters (EPA - 600/1-80 -031). Washington DC: Environmental Protection Agency, 1-97.
- Shuval, HI (1986). Thalassogenic Diseases. UNEP Regional Seas Reports and Studies 1986. 79, 1-45.
- Lusher, JA (1984). Water Quality Criteria for the South African Coastal Zone. South African National Scientific Programmes Report No 94, 1-13.
- Von Schirnding, Y E R , Kfir, R, Cabelli, V, Franklin, L, Joubert, G (1992). Morbidity Among Bathers Exposed to Polluted Seawater: A Prospective Epidemiological Study. South African Medical Journal, Vol. 81, No. 11, 543-546.