Benefits of swimming pools in two remote Aboriginal communities in Western Australia: intervention study

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Abstract

Objective To determine the health impact of swimming pools built with the aim of improving quality of life and reducing high rates of pyoderma and otitis media.

Design Intervention study assessing prevalence of ear disease and skin infections before and at six monthly intervals after opening of swimming pools.

Setting Two remote Aboriginal communities in Western Australia.

Participants 84 boys and 78 girls aged <17 years.

Main outcome measures Changes in prevalence and severity of pyoderma and perforation of tympanic membranes with or without otorrhoea over 18 months after opening of pools.

Results In community A, 61 children were seen before the pool was opened, and 41, 46, and 33 children were seen at the second, third, and fourth surveys. Equivalent figures for community B were 60, 35, 39, and 45. Prevalence of pyoderma declined significantly from 62% to 18% in community A and from 70% to 20% in community B during the 18 months after the pools opened. Over the same period, prevalence of severe pyoderma fell from 30% to 15% in community A and from 48% to 0% in community B. Prevalence of perforations of the tympanic membrane fell from 32% in both communities to 13% in community A and 18% in community B. School attendance improved in community A.

Conclusion Swimming pools in remote communities were associated with reduction in prevalence of pyoderma and tympanic membrane perforations, which could result in long term benefits through reduction in chronic disease burden and improved educational and social outcomes.

Introduction

Indigenous Australian children have very high rates of pyoderma (known locally as "skin sores") and otitis media. Prevalences as high as 70% have been reported for pyoderma in remote Aboriginal communities.¹ The major pathogen of pyoderma, group A streptococcus, is associated with chronic renal failure, which is very prevalent in Aboriginal communities.^{2 3} The high prevalence of pyoderma is also the most likely reason for some Aboriginal communities having

the highest reported incidence of acute rheumatic fever worldwide.⁴

Impaired hearing can seriously affect performance at school, subsequent employment, and social circumstances in adulthood. Between 10% and 67% of Aboriginal school age children have perforated tympanic membranes, and 14-67% have some degree of hearing loss; remote communities have the highest prevalence.⁵

Some reduction in skin infections was reported after a swimming pool opened in an Aboriginal community in the Northern Territory.⁶ An audit of Aboriginal communities in central Australia has also found health and social benefits of pools.⁷ Furthermore, communities within easy access of places to swim have been reported to have lower prevalence of otitis media than those further away.⁸ These reports are in contrast to concerns about pool related infections in areas with low prevalence of infectious diseases.⁹

After publication of these reports suggesting that Aboriginal children may benefit from access to swimming pools, the Western Australian government built 25 metre, part shaded, salt water pools in three remote Aboriginal communities. In view of possible beneficial or potentially deleterious effects on health and the lack of previous evaluation of such an intervention, we assessed the health impact of swimming pools in the first two communities to have a functioning pool, particularly with regard to skin infections and middle ear disease in children. A secondary objective was to determine whether social benefits might result from pools in these remote communities. Financial constraints precluded inclusion of the third community.

Methods

Setting

We compared disease prevalences before and after swimming pools were opened in two isolated Aboriginal communities (total population about 180 in community A and 250 in community B) located in a semi-arid environment more than 1000 km north of Perth. Daily temperatures range from 15°C to 45°C during the summer, falling to freezing at night in winter. Health services in community A have been erratic, with one nurse or Aboriginal health worker present

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most of the time and a physician visiting every two to four weeks. Community B has two nurses, two doctors, and two Aboriginal health workers. The swimming pools were opened in September 2000 and are open annually from September to April.

Surveys

We examined children four times at approximately six month intervals between July 2000 and March 2002. All children aged under 17 years present in the community were eligible for inclusion in the study if informed consent was obtained. At each survey a paediatrician examined all enrolled children who could be located, and children who moved into the communities were also given the opportunity to enrol.

We graded pyoderma according to severity (the "sore score"), on the basis of the total number and severity of sores (crusty, pussy, or dry flat lesions).¹⁰ We classified a sore score of 1-4 as non-severe and ≥ 5 as severe. We also recorded the presence and severity of scabies, abscesses, and fungal lesions. Experienced paediatricians did otoscopic examinations. If otorrhoea was present the ear was irrigated with 1:20 betadine solution to obtain a good view of the tympanic membrane.¹¹ The paediatricians recorded the colour and position (retracted, bulging, or normal) of the tympanic membrane, as well as the presence of wax, cholesteatoma, perforations, and otorrhoea. They also noted pathology indicative of past disease (for example, healed perforations and tympanosclerosis). During the first survey two ear, nose, and throat specialists examined children with serious ear disease or to confirm a paediatrician's diagnosis.

To identify any pool related injuries or disease outbreaks, the research team examined data held at the local clinic and obtained information from pool managers. Pool managers keep a daily record of any incidents occurring at the pools.

As parents were concerned about truancy, the communities introduced a "no school, no pool" policy as an incentive for children to attend school. In addition to having swimming lessons at school, children attending school are given passes permitting them to use the pool after school. We collected school attendance records for the school term immediately before each of our surveys. School attendance rate was the number of days attended/number of days enrolled.

During the fourth visit to community A, in a house to house survey, we asked family members a series of questions to document their impressions of the pool and any perceived benefits and concerns they may have had regarding the pool. Time did not permit interviews in community B.

Analysis

We entered all data into Filemaker Pro version 5 and exported them to SPSS version 10.1 for Windows. We used the χ^2 test and Fisher's exact test to compare groups of interest and the χ^2 for trend to investigate trends in prevalence over time. Small numbers precluded more formal statistical analysis.

Results

In community A we saw 83 children (48% boys) at least once (61 enrolled during the first survey), 51 (61%) twice, 36 (43%) three times, and 12 (14%) four times.

During the first survey, 20% were aged under 5 years, 66% were aged 5-11, and 15% were 12-16 years old. In community B, we saw 79 children (56% boys) at least once (60 enrolled during the first survey), 48 (61%) twice, 30 (38%) three times, and 23 (29%) four times. During the first survey, 37% were aged less than 5 years, 42% were aged 5-11, and 22% were 12-16 years old.

Skin infections

In community A, during the winter before the pool opened (July 2000), 38 (62%) children had pyoderma; 18 (30%) had severe pyoderma. Children aged 12-16 years had significantly less pyoderma (2/9, 22%) than younger children (36/52, 69%, $\chi^2 = 7.4$, 2df, $P = 0.02$). Figure 1 shows a marked reduction in pyoderma during the 18 months of follow up (χ^2 for trend = 24.88, 1df, $P < 0.0001$). The result was almost exactly the same for children aged under 12. The prevalence of severe pyoderma also fell significantly over time (in children aged under 12, χ^2 for trend = 8.46, 1df, $P = 0.004$). During the first survey, other skin infections included abscesses in 5 (8%) children, fungal infections in 15 (25%) children, and uncomplicated scabies in 3 (5%) children. The prevalences of any skin infection at the four consecutive surveys were 64% (39), 51% (21), 43% (20), and 18% (6) (χ^2 for trend = 17.32, 1df, $P < 0.0001$).

In community B, a scabies epidemic was occurring at the time of the first survey (August 2000); 42 (70%) of 60 children had pyoderma, and 29 (48%) had severe pyoderma. Prevalence and severity of pyoderma did not vary with age. The swimming pool was closed for six weeks before the second survey and for a total of three months during that summer owing to a structural fault. Prevalence of pyoderma fell significantly over time (χ^2 for trend = 17.03, 1df, $P < 0.0001$, fig 1). A reduction in severity also occurred, with 29 (48%) children having severe pyoderma before the pool opened, 12 (31%) one year later, and none at the fourth survey. The prevalences of any skin infection at the four consecutive surveys were 78% (47), 43% (15), 69% (27), and 20% (9) (χ^2 for trend = 25.16, 1df, $P < 0.0001$).

We saw 29 children in community A and 25 children in community B at all of the first three surveys. No significant difference in prevalence or severity of sores existed during successive surveys between children seen three times and those seen less often.

Fig 1 Proportion of children with severe, non-severe, or no pyoderma during four surveys before and after installation of swimming pools in two communities (N=number of children examined)

Middle ear disease

Table 1 shows the otoscopic findings during the first survey for those children in whom both tympanic membranes were fully visualised (54 in each community). Only five children in community A and 12 children in community B had no evidence of past or current disease—that is, bilateral intact tympanic membranes, normal position of the tympanic membranes, and no tympanosclerosis or healed perforations. We saw no cholesteatoma throughout the study.

Figure 2 shows the prevalence of perforations of the tympanic membrane and otorrhoea through tympanic membrane perforations during the four surveys. Although no reduction in prevalence of tympanic membrane perforations occurred during the first summer after the pools opened (March 2001), a gradual decline occurred thereafter to 13% (8/44) in community A (χ^2 for trend=4.32, 1df, $P=0.04$) and 18% (4/31) in community B (χ^2 for trend=2.18, 1df, $P=0.14$) in the fourth survey. No significant change in prevalence of otorrhoea through perforated tympanic membranes occurred in either community. Results were similar when we considered all ears that were successfully examined (total of 113, 81, 88, and 62 ears in community A and 112, 66, 76, and 91 ears in community B, during the four surveys): during the 18 months of follow up, tympanic membrane perforation rates declined from 19% (21/113) before the pools were opened to 8% (5/62) (χ^2 for trend=3.88, 1df, $P=0.05$) in community A and from 23% (26/112) to 15% (14/91) (χ^2 for trend=2.5, 1df, $P=0.11$) in community B. Stratification by age made no difference to our findings in either community.

In community A, the prevalence of tympanic membrane perforations declined more rapidly in children seen on each of the first three surveys than in those seen less often. After the second survey, the prevalence of tympanic membrane perforation in children seen regularly was 21% (6/29) compared with 64% (7/11) in those seen less frequently (Fisher's exact test, $P=0.02$); equivalent figures during the third survey were 10% (3/29) and 43% (6/14) ($P=0.04$). No such differences existed in community B.

School attendance

In community A, 50, 47, 57, and 61 children were enrolled during the school terms preceding surveys 1, 2, 3, and 4. The proportion of children with attendance

Otosopic findings during first survey before pools were opened. Values are numbers (percentages)

	Community A (n=54)	Community B (n=54)
Bilateral normal tympanic membranes	5 (9)	12 (22)
Abnormal signs:		
Unilateral or bilateral dry perforation of tympanic membrane	12 (22)	8 (15)
Otorrhoea through a tympanic membrane perforation with or without contralateral dry perforation	5 (9)	9 (17)
Bulging tympanic membrane with no contralateral perforation	2 (4)	3 (6)
Healed perforations or tympanosclerosis with none of above	5 (9)	10 (19)
Retracted tympanic membrane with none of above	25 (46)	12 (22)
Total abnormal tympanic membranes	49 (91)	42 (78)

rates of at least 70% rose from 42% (21) during the term before the pool opened to 51% (24), 65% (37), and 67% (41) during the terms preceding the second, third, and fourth surveys (χ^2 for trend=8.70, 1df, $P=0.003$). In community B, 79, 60, 58, and 85 children were enrolled during the terms preceding the four consecutive surveys; 52% (41), 40% (24), 33% (19), and 54% (46) of children had attendance rates of at least 70% during the terms preceding consecutive surveys, significantly lower during the terms preceding the second and third surveys than during those preceding surveys 1 and 4 ($\chi^2=8.32$, 3df, $P=0.04$).

Pool related incidents and social impact of pools

No disease outbreaks have been reported, and only two reports of faecal contamination of the pools were made. One pool related trauma (broken arm or mild concussion) occurred in each community.

The 12 extended family groups interviewed in community A during the last survey were almost unanimous in their support of the swimming pool. People generally thought that children looked happier and healthier and were learning to swim. Some comments were: "Fun, enjoy, stop getting bored, health improved," "Keeps kids out of mischief, some place for kids to go, no other pools around, it's clean," and "Not breaking in and being a mischief at home." One person felt that there had been no benefit: "Kids have broken into the pool, still play money hole [gamble] and use gings [slingshots]."

Parents were pleased that their children were encouraged to attend school through the "no school, no pool" policy. We contacted the local police by telephone, and they commented that they had noted a marked decline in petty crime.

Discussion

We have found significant improvements in health after the introduction of swimming pools in two remote Aboriginal communities. Swimming in a salt water pool provides the equivalent of a nasal and ear washout and cleans the skin. Prevalence of pyoderma declined from over 60% to around 20% during the study period. In the short term this is likely to reduce the clinical workload and prescription of antibiotics; in the longer term it may help to reduce the enormous burden of chronic renal and cardiac diseases in Aboriginal communities.²⁻⁴

Chronic suppurative otitis media is very uncommon in first world countries, and a prevalence over 4% in children is considered to be a massive public health

Fig 2 Prevalence of dry perforations and otorrhoea through a perforation (wet) during four surveys before and after installation of swimming pools in two communities (N=number of children with both tympanic membranes examined)

problem.¹² During our first survey, 9% of children in community A and 17% in community B had otorrhoea through large perforations of the tympanic membrane (well known to be chronic from a young age in these Aboriginal communities^{5 11}). Despite intervention and published guidelines, ear health among Australian Aboriginal children has not improved for over two decades.^{5 11 13} In 1986 a tympanic membrane perforation rate of 31% was reported in community B, with 17% otorrhoea (S Weeks, unpublished report, 1986). These rates remained unchanged over 14 years, as reflected in our pre-pool data. Thus the reduction in tympanic membrane perforation rates in our study from 32% to 18% in community B, although not statistically significant, is the first documented successful preventive intervention for otitis media in the past 15 years. This should lead to improvements in language development and literacy.

A limitation of this study was the poor follow up of individual children due to the high mobility of the population. Nevertheless, at each survey, virtually all enrolled children attending school had a clinical examination. Of interest was the more rapid decline in prevalence of tympanic membrane perforations in community A among resident children compared with those who were more mobile. Whether this is because more permanent residents used the pool more or because of differences in social circumstances between the more and less mobile groups is unknown. We did not see a similar finding in community B, which may be owing to closure of the pool for a total of three months during the first summer. Children in community B tend to move between the local school and a boarding school 500 km away, which in part explains the lower attendance rate we found in the middle of the study period.

A further limitation was the lack of a control community. This was neither logistically nor ethically possible: no comparable communities were nearby, and a control community would have been appropriate only if it had been possible to offer them a pool if the intervention proved to be effective. To our knowledge no other activities were taking place during the study period that might have reduced the burden of skin infections and ear disease. However, we cannot exclude the possibility that our four very brief visits to the communities over 18 months may have had an impact on the burden of ear disease through paediatric consultation and training of health and education staff, including dissemination of best practice guidelines. Ongoing monitoring of the impact of these pools is necessary, and funding for this has been secured.

The pools are being used for educational and recreational functions. Virtually all school age children use the pools, thus benefiting from regular exercise and instruction in swimming and resuscitation techniques, which are important to reduce rates of drowning in this population. In the Northern Territory, 93% of drowning in Aboriginal children occurs in open waterways.¹⁴ Drowning rates are higher in Aboriginal than in non-Aboriginal children in Western Australia,¹⁵ but until now supervised swimming lessons have not been available for children in remote Aboriginal communities, which is in contrast to other areas of Western Australia where access to swimming pools and lessons is taken for granted.

What is already known on this topic

The very high prevalence of otitis media and its long term sequelae can seriously affect quality of life of Aboriginal children and adults

Pyoderma is endemic in many Aboriginal communities and contributes to the high prevalence of chronic renal disease and rheumatic heart disease

Rates of drowning are high in Aboriginal communities

What this study adds

Introduction of swimming pools in two remote Aboriginal communities was associated with reduced prevalence of pyoderma and tympanic membrane perforations

Swimming pools provide important social capital in disadvantaged communities

The pools have been well managed by the Royal Life Saving Association. Water quality is regularly monitored according to government regulations. To date no outbreaks of infectious disease have occurred, but the ongoing success of the pools will depend on adequate funding to maintain high safety and environmental standards.

In conclusion, the pools have resulted in significant health and social gains. The community's enthusiasm for the intervention and support for the study have been key to the success of the project. Programmes to improve the health of Aboriginal Australians living in isolated communities should certainly focus on better housing, sanitation, nutrition, education, and access to health care,¹⁶ but consideration should also be given to building and maintaining swimming pools. The costs involved will be a small price to pay for the reduction in severe chronic disease and improved health, educational, and social outcomes in this seriously disadvantaged segment of Australian society.

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Contributors: FJS and DL initiated the project. DL, MTT, DMcA, and DTS developed the study design. MTT, DTS, DMcA, and DL conducted the field work. HC and FL provided ear, nose, and throat examination, training, and advice. MTT and DL did the data analysis. All authors contributed to writing the paper. DL is the guarantor.

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- 1 Currie BJ, Carapetis JR. Skin infections and infestations in Aboriginal communities in northern Australia. *Australas J Dermatol* 2000;41:139-45.
- 2 Hoy WE, Mathews JD, McCredie DA, Pugsley DJ, Hayhurst BG, Rees M, et al. The multidimensional nature of renal disease: rates and associations of albuminuria in an Australian Aboriginal community. *Kidney Int* 1998;54:1296-304.
- 3 Goodfellow AM, Hoy WE, Sriprakash KS, Daly MJ, Reeve MP, Mathews JD. Proteinuria is associated with persistence of antibody to streptococcal M protein in Aboriginal Australians. *Epidemiol Infect* 1999;122:67-75.
- 4 Carapetis JR, Currie BJ, Kaplan EL. Epidemiology and prevention of group A streptococcal infections: acute respiratory tract infections, skin infections, and their sequelae at the close of the twentieth century. *Clin Infect Dis* 1999;28:205-10.
- 5 Morris PS. A systematic review of clinical research addressing the prevalence, aetiology, diagnosis, prognosis and therapy of otitis media in Australian Aboriginal children. *J Paediatr Child Health* 1998;34:487-97.
- 6 Carapetis JR, Johnston F, Nadjamerrek J, Kairupan J. Skin sores in Aboriginal children [letter]. *J Paediatr Child Health* 1995;31:563.
- 7 Peart A, Szoek C. Recreational water use in remote indigenous communities. In: *Swimming pools in remote indigenous communities: some basic information for planning a pool*. Technical Report (Indigenous Health Papers). Canberra: The National Centre for Epidemiology and Population Health, The Australian National University, 2000:25-69.

- 8 Hudson HM, Rockett IR. An environmental and demographic analysis of otitis media in rural Australian Aborigines. *Int J Epidemiol* 1984;13:73-82.
- 9 Barwick RS, Levy DA, Craun GF, Beach MJ, Calderon RL. Surveillance for waterborne-disease outbreaks—United States, 1997-1998. *MMWR CDC Surveill Summ* 2000;49:1-21.
- 10 Carapetis JR, Connors C, Yarmirr D, Krause V, Currie BJ. Success of a scabies control program in an Australian Aboriginal community. *Pediatr Infect Dis J* 1997;16:494-9.
- 11 Couzos S, Murray R. Ear health. In: *Aboriginal primary health care: an evidence-based approach*. Oxford: Oxford University Press, 1999:240-320.
- 12 Prevention of hearing impairment from chronic otitis media. Report of a WHO/Ciba Foundation Workshop, 19-21 November 1996, London. (WHO/PDH/98.4.). Geneva: World Health Organization, 1998:32.
- 13 The NSW Health Department Working Party on Ear Disease in Aboriginal Children. Guidelines on the prevention and control of otitis media and its sequelae in Aboriginal children. *Med J Aust* 1996;164(suppl):S1-17.
- 14 Silva DT, Ruben AR, Wronski I, Stronach P, Woods M. Excessive rates of childhood mortality in the Northern Territory, 1985-94. *J Paediatr Child Health* 1998;34:63-8.
- 15 MacKellar A. Deaths from injury in childhood in Western Australia 1983-1992. *Med J Aust* 1995;162:238-42.
- 16 Hunter EM, Ellis RG, Campbell D, Fagan PS. The health of indigenous peoples. *Med J Aust* 1992;156:575-7.

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Review of research on aboriginal populations in Canada: relevance to their health needs

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Abstract

Objective To determine if research has adequately examined the health needs of the aboriginal population of Canada.

Design Review.

Study selection Medline search of journal articles published during 1992-2001. The search terms used were "Canada" and various synonyms and categories for Canadian aboriginal people. Each paper was categorised according to the aboriginal group, age-sex group, comparison group, geographic location, and type of research topic (health determinant, health status, or health care).

Results Of 352 citations found, 254 were selected after elimination of those without abstracts, not containing data on Canada, or not focusing on health issues. The proportion of papers does not reflect the demographic composition of aboriginal people in Canada, with severe under-representation of Métis, urban aboriginal people, and First Nations people not living on reserves and over-representation of the Inuit. Children and women received less attention proportional to their share of the population. A few prolific research groups have generated a disproportionate amount of publications from a few communities and regions. 174 papers dealt with health determinants (for example, genetics, diet, and contaminants), 173 with health status, and 75 with health care. Injuries, which account for a third of all deaths, were studied in only 8 papers. None of the health care papers examined rehabilitation.

Conclusion Researchers have not adequately examined several important health needs of the aboriginal population.

Introduction

Despite tremendous progress, the health of the aboriginal population of Canada continues to lag behind that of the national population.¹ Health research may hold the key to why such disparities exist and to solutions for eliminating them. In 1990 the Commission on Health Research for Development recognised the close links between health research and equity in development and promoted the concept of "essential national health research."² Since then the "10/90 gap" (less than 10% of global spending on health research is devoted to diseases that account for 90% of the global disease burden) has become recognised.³ The Global Forum for Health Research advocates setting priorities on health research on the basis of analyses of disease burden, health determinants, current knowledge, cost effectiveness, and available resources.

This paper aims to review health research conducted among Canadian aboriginal people and to determine if research has examined the health needs of the population. While recent international studies have used a common "currency" (such as disability adjusted life years) to measure disease burden and impact,⁴ which would facilitate considerably the priority setting process, such an approach cannot yet be used for the Canadian aboriginal population.

According to the 2001 Canadian census, just under one million (3.3%) Canadians identified themselves as

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Sixty six of the 254 references appear on bmj.com as examples of the articles reviewed