THE CHOLERA EPIDEMIC OF 2000/2001 IN KWAZULU-NATAL: IMPLICATIONS FOR HEALTH PROMOTION AND EDUCATION

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ABSTRACT

This study was a cross-sectional, descriptive and comparative study conducted in the province of KwaZulu-Natal in the months of November and December 2001 in order to make a comparison between health districts stricken with cholera and districts not stricken with cholera with regards to well-known risk factors for cholera. Random samples of 979 and 441 participants were drawn from health districts that were not stricken with cholera and health districts that were stricken with cholera respectively. The two groups of participants in the study had similar distributions of age, gender and literacy rate. Out of the 979 people that were not stricken with cholera, 72% of them had access to tap water, 10% owned water tankers, 10% used dam or river water, 50% knew how to purify water by use of disinfectants such as JIK, 75% practised boiling drinking water, 70% used protected toilets. Out of the 441 people that were stricken with cholera, 54% of them had access to tap water, 3% owned water tankers, 38% used dam or river water, 38% knew how to purify water by use of disinfectants such as JIK, 66% practised boiling drinking water, 51% used protected toilets. Results from the binary logistic regression analysis showed that cholera sickness was significantly influenced by failure to boil drinking water, lack of knowledge of water purification methods, lack of access to tap water, as well as failure to practice proper personal hygiene. A recommendation is made to implement health promotion and education programmes in health districts stricken with cholera using primary health care principles and community-based approaches.

OPSOMMING

'n Dwarssnit, beskrywende en vergelykende studie met verwysing na bekende risikofaktore vir cholera het in die KwaZulu-Natal Provinsie tussen November en Desember 2001 plaasgevind om 'n vergelyking te maak tussen gesondheidsdistrikte wat deur cholera geteister word en distrikte wat nie deur cholera geteister word nie. Ewekansige groepe van 979 en 441 deelnemers is onderskeidelik uit die ongeaffekteerde en geteisterde gesondheidsdistrikte gekies. Beide groepe deelnemers in die studie het dieselfde digtheid ten opsigte van ouderdom, geslag en geletterdheid gehad. Uit 979 persone wat nie met cholera besmet was nie het 72% toegang tot kraanwater gehad, 10% van wateropgaartenks gebruik gemaak en 10% het dam- of rivierwater gebruik. Vyftig persent het geweet hoe om gebruik te maak van middels soos JIK, 75% het water vir drinkwater gekook en 70% het toegang tot geslote toilette gehad. Uit 441 persone besmet met cholera het 54% toegang tot kraanwater gehad, 3% het van watertenks gebruik gemaak, 38% het dam- of rivierwater gebruik, 38% het kennis van watersuiwering met behulp van middels soos JIK beskik, 66% het gekookte water gebruik en 51% het geslote toilette gebruik. Uitslae van die binêre logistieke regressie-analise toon dat cholera aansienlik beïnvloed word deur nie drinkwater te kook nie, 'n gebrek aan kennis van metodes vir watersuiwering, 'n tekort aan toegang tot kraanwater, asook 'n gebrek aan goeie persoonlike gesondheidssorg. Dit word dus aanbeveel dat gesondheidsbevordering- en opvoedingsprogramme in cholerageteisterde gesondsheidsdistrikte geimplementeer moet word en dat primêre gesondheidsorgbeginsels en gemeenskapsgebaseerde benaderings in hierdie programme in gedagte gehou moet word.

INTRODUCTION

Although it is over a hundred years since Robert Koch (Deshpande, 2003:190) outlined how the spread of cholera can be prevented by following basic primary health care principles (protecting the source of drinking water, boiling water, protecting toilets, personal hygiene and proper waste disposal), the cholera epidemic of 2000 and 2001 in the province of KwaZulu-Natal (KZN) has demonstrated that rural communities are still at risk of cholera. Most of the victims of the cholera epidemic in KZN were rural illiterate people with little or no access to basic health services and primary health care.

The risk factors and control measures for cholera are fairly well known, but cholera continues to puzzle epidemiologists and public health managers and defies the control measures of numerous public health managers and governments (Glass, Becker & Huq, 1982:116; Heymann & Rodier, 2001:345-353; Faruque, Chowdhury, Kamruzzaman & Ahmed, 2003:1116).

The outbreak of cholera in KZN was first reported from the rural area of Ndabayanake in the district of Lower Umfolozi on 20 August 2000. Thereafter, the epidemic quickly spread to five other districts of KZN and other provinces of South Africa namely Mpumalanga, Limpopo, Eastern Cape, Gauteng, and North West (five out of nine provinces). The epidemic resulted in 105 000 cases of cholera as well as 220 deaths in KZN between August 2000 and July 2001. Of all reported cases, 97% were from KZN, and the case fatality rate of the epidemic in the province was 0.22% (KwaZulu-Natal Department of Health, 2001:19-26). Half of the health districts of KZN were affected with cholera until July 2001. Health districts that were not affected by the cholera epidemic were Pietermaritzburg, Ladysmith, Durban, New Castle and Jozini (referred to as Group 1). Health districts that were affected by the cholera epidemic were Lower Umfolozi, Eshowe/Nkandla, Ulundi, Stanger and Port Shepstone (Group 2).

A cholera epidemic is considered a sensitive indicator of severe under-development (Ackers, Quick & Drasbek, 1998:330). Historically, the majority of large cholera outbreaks have occurred in environments of extreme poverty (Durrheim, Spreare & Billinghurst, 2002:597; Sack, Nair & Siddique, 2004:223-233). Green and Kreuter (1991:14) have shown that harmful cultural traditions and practices promote the spread of cholera and diarrhoeal diseases in rural communities.

As early as in 1971, South Africa was considered to be at risk of cholera due to its hot, humid summers, seaports, overcrowded communities with low standard of environmental sanitation and scanty, restricted and unprotected water supplies in certain areas (Kustner & Du Plesis, 1991:539). A study conducted in Lebowa by the Department of Health, Welfare and Pensions (Sinclair, Mphahlele, Duvenhage, Nichols, Whitehorn & Kustner, 1982:753) to determine the mode of transmission of cholera found that consumption of open river water was positively associated with an increased risk of contracting the disease, and that cholera outbreaks were associated with rainfall pattern and temperature.

According to the WHO (World Health Organization, 1996:55), simple preventative measures such as safer disposal of human excreta, particularly of babies and people with diarrhea, hand-washing after defecation and handling babies' faeces and before feeding, eating and preparing foods, and maintaining drinking water free from faecal contamination in the home and at the source (World Health Organization, 1996:70) are enough to curb the spread of cholera in rural communities. However, lack of access to safe drinking water is a major cause of spread of cholera in most African rural communities including KZN. The study by Shapiro, Otieno, Adcock, Phillips-Howard, Hawley, Kumar, Waiyaki, Nahlen and Slutsker (1999:271-276) shows how Vibrio Cholerae O1 spread rapidly among the rural population of western Kenya as a result of infection in Lake Victoria. Curtis (2003:2028) argues that one of the most effective methods of curbing the spread of cholera in the World's least developed and poor rural communities is the protection of sources of drinking water.

Based on research work carried out in cholera-prone countries such as Bangladesh, Indonesia, India and some of the least developed nations of Africa, the most cost effective and feasible approach to curb the spread of cholera in rural KZN is the promotion of health education at the household level by community health workers. This point of view is widely corroborated by results from similar studies (Palmer, 2003:91-93; Zeman, Byrd, Sinca, Vlad & Dapken, 2005:36-47; Daniels, Simons, Rodrigues, Gunnlaugsson, Forster, Wells, Hutwanger, Tauxe & Mintz, 1999:1051-1055).

BACKGROUND

Although the risk factors for cholera in rural KZN have been known to public health professionals working in the province, the spread of cholera and waterborne diseases remains an endemic health problem affecting the rural population of KZN during heavy winters and prolonged rainy seasons. The rural population of the province lacks access to safe water as well as basic health and primary health care services. Illiteracy, poverty and unemployment affect almost half of the rural population of the province. Many rural households do not know how to prepare oral re-hydration solutions at home. Drinking water is consumed without being boiled by rural households due to lack of knowledge and/or shortage of firewood. The extent and content of coverage of health education on environmental sanitation and personal hygiene is grossly inadequate. As a result, the population of rural KZN is vulnerable to communicable diseases such as cholera in heavy winters and prolonged rainy seasons.

AIM

The objective of this study was to describe the socio-economic, demographic and health-related characteristics of people living in health districts affected by the cholera epidemic of 2000 and 2001 in KZN. The study described demographic and sanitary characteristics of rural inhabitants of KZN that were affected by cholera in terms of the availability of safe water supplies, protected toilets, knowledge of personal hygiene and the provision of basic health education. A comparison was made between inhabitants of health districts that were affected by cholera and inhabitants of health districts that were not affected with regards to access to safe water supply, access to basic health services, personal hygiene and proper sanitation at the household level.

METHODS AND MATERIALS

Study design, sample and data collection

This was a descriptive, cross-sectional and comparative study based on rural households in KZN. A simple random sample of 979 participants drawn from health districts that were not affected by cholera (Group 1) was compared with a simple random sample of 441 participants drawn from health districts that were affected by cholera (Group 2) with regards to factors that affect the spread of cholera. Both samples were drawn using a sampling frame consisting of enumeration areas and the list of households provided by the GIS unit of the KZN provincial health office. After eligible households were identified, face-to-face interviews were conducted with the heads of households or health care providers using a structured and pre-tested questionnaire. Data collection was done in November and December 2001 by fieldworkers recruited from the University of Durban-Westville, and trained by the Provincial Department of Health. Data were collected at the household level on several demographic, socio-economic, health-related and sanitary variables such as household source of water, practice of personal hygiene, the provision of basic health services, the availability of protected toilet facilities, knowledge and practice of water purification and proper waste disposal.

Variables of study

The study consisted of the following variables: age, gender, level of education of participants, source of domestic water supply (tap, carrier/tanker, dam/river, rain water, spring and windmill), knowledge and practice of water purification methods (boiling of water up to boiling point, knowledge of adding one teaspoon of the disinfectant JIK into 25 litres of water, hand washing with soap after toilet use), availability and use of protected toilet facilities, type of toilet facilities used by household (pit latrine, flush toilet, VIP toilet), practice of personal hygiene and the provision of basic health services.

Methods of data analysis

Frequency tables, summary statistics, Pearson's chi-square tests of association and binary logistic regression analysis were used for data analysis. Pearson's chi-square tests of association were used to select 13 variables that were strongly associated with cholera sickness. Binary logistic regression analysis was performed to rank the top five influential variables in order of their strength. Significant effects were characterised by p–values smaller than 0.05. The adequacy of the fitted logistic regression model was assessed using diagnostic measures such as the classification table, the Hosmer-Lemeshow goodness-of-fit test, sensitivity and specificity tests, a normal probability plot of re-

siduals and the ROC (receiver operating characteristics) plot.

Data analysis was done using the statistical package STATA version 8.

Research ethics

Ethics approval for this study was obtained from the Research Ethics Committee of the Faculty of Health Sciences of the University of Pretoria. Permission for data collection and the training of field workers was obtained from the KZN Provincial Department of Health. Each respondent in the study participated voluntarily, and interviews were conducted in Zulu where necessary. Results of interviews were kept confidential.

RESULTS OF STUDY

Data were obtained from 979 households that were not affected by cholera (Group 1) and 441 households that were affected by cholera (Group 2). Table 1 shows the distribution of age and level of education of participants in Groups 1 and 2. The table shows that there is no significant difference between the groups with regards to age and level of education. In both groups, female participants (70%) predominated male participants (30%). Eighty-three percent of the participants in Group 1 and 86% of the participants in Group 2 were literate. Almost a third of all participants had post-matric education (33% in Group 1 and 31% in Group 2). Seventeen percent of the participants in Group 1 and 14% of participants in Group 2 had no education. Thirty-nine percent of participants in Group 1 and 38% of participants in Group 2 had between six and 10 years of schooling.

Sources of domestic water

Table 2 shows that tap water is the most common source of domestic water supply, followed by dam or river water. Rainwater is the least common source of domestic water supply.

Table 3 shows that Groups 1 and 2 differ significantly with respect to knowledge and practice essential for purifying drinking water at home.

Table 4 shows that the two groups differ significantly with regards to ownership of toilet facilities and use of toilets.

Results from binary logistic regression analysis

Pearson's chi-square tests of association were used to select 13 important variables that affect cholera sickness. Binary logistic regression analysis was subsequently done on the 13 important variables in order to rank them in order of their strength of association with cholera sickness. Logistic regression analysis led to the identification of 8 highly influential factors that affect cholera sickness. Table 5 shows estimated odds ratios, p-values and 95% confidence intervals for each of these eight influential factors affecting cholera sickness.

The measure of effect in logistic regression analysis is the odds ratio, exp (â) where â denotes the estimated regression coefficient. The odds ratio measures the likelihood of cholera sickness corresponding to each of the predictor variables used for logistic regression analysis. Influential factors are characterised by estimated odds ratios that deviate from 1 significantly, p-values that are smaller than 0.05 and 95% confidence intervals that do not contain 1. At the Ü= 0.05 level of significance, eight of the 13 predictor variables used for logistic regression analysis turned out to be highly influential over cholera sickness. These variables are: the practice of boiling water, knowledge of using the disinfectant JIK for water purification, availability of tap water, use of water from river or dam for drinking, availability of disinfectants in the household, the practice of washing the hands with soap after using the toilet, availability of VIP latrines, and knowledge of boiling water. The odds of cholera sickness are increased by a factor of 3.32 when drinking water is not boiled. Failure to use the disinfectant JIK increases the odds of cholera sickness by a factor of 2.61. Lack of access to tap water at home increases the odds of cholera sickness by a factor of 1.74. Use of river or dam water for drinking in rainy seasons increases the odds of cholera sickness by a factor of 1.69. Lack of knowledge on how to use disinfectants to purify water increases the odds of cholera sickness by a factor of 1.63. Failure to practice hand washing with soap increases the odds of cholera sickness by a factor of 1.56. Lack of access to VIP

Table 1: Distribution of ages and education of participants

Characteristics	Group 1 (n=979)	Group 2 (n=441)
	%	%
Age in years		
≤ 15	4	2
15 to 24	32	34
25 to 34	21	20
35 to 44	17	17
45 to 54	11	12
55 to 64	9	7
≥ 65	6	7
Education (Years of schooling)		
None	17	14
1 to 5 years	13	15
6 to 10 years	39	38
Post matric	31	33

Table 2: Sources of domestic water

Source of water	Group 1 (n=979)	Group 2 (n=441)	
	%	%	Difference
Tap	72	54	18 (P<0.05)
Carrier or tanker	10	3	7 (P<0.05)
Dam or river	10	38	-28 (P<0.05)
Rain	1	0	1 (P<0.05)
Spring	3	1	2 (P<0.05)
Windmill	4	4	0 (P≥0.05)

Table 3: Knowledge and practice of water purification

Knowledge and practice of water purification	Group 1 (n=979)	Group 2 (n=441)	Difference	Significance
	%	%	%	
Boiling of water to boiling point	75	66	9	P<0.05
Adding one teaspoonfull of JIK in 25 litres of water	84	72	12	P<0.05
Using JIK regularly	50	38	12	P<0.05
Washing hands with soap after toilet use	34	30	4	P<0.05

Table 4: Availability and use of toilet facilities

Variable	Group 1 (n=979)	Group 2 (n=441)	Difference	Significance
	%	%	%	
Availability of any kind of toilet	75	73	2	P≥0.05
Pit latrine	35	43	-8	P<0.05
Flush toilet	12	7	5	P<0.05
VIP toilet	28	23	5	P<0.05
Use of toilet by all family members	70	51	19	P<0.05

Table 5: Results from binary logistic regression analysis

Variable	Odds Ratio	P-value	95% Conf. Int.
Not boiling drinking water	3.32	0.000	[1.177, 6.601]
Failure to use the disinfectant JIK for purifying drinking water	2.61	0.000	[2.044, 3.379]
Lack of access to tap water at home	1.74	0.000	[1.221, 2.462]
Use of river or dam water for drinking in rainy seasons	1.69	0.000	[1.161, 2.225]
Lack of knowledge on how to use disinfectants to purify water	1.63	0.000	[1.159, 2.215]
Failure to practice hand washing with soap	1.56	0.000	[1.153, 2.203]
Lack of access to VIP latrines	1.49	0.001	[1.114, 2.173]
Lack of knowledge on the advantages of boiling drinking water	1.38	0.002	[1.101, 2.062]

latrines increases the odds of cholera sickness by a factor of 1.49. Lack of knowledge on the advantages of boiling drinking water increases the odds of sickness by a factor of 138.

The adequacy of the fitted logistic regression model was assessed in four different ways

The percentage of overall correct classification was 89.18%, a figure that is fairly high. The p-value for the Hosmer and Lemeshow goodness-of-fit test is 0.201 ≥ á = 0.05, and this shows that there is no reason to doubt the adequacy of the fitted model. The area under the ROC (receiver of characteristics) curve was as high as 89.05%. The normal probability of residuals resembles an S-shape along the diagonal, thereby confirming that the estimated residuals were distributed normally with mean 0 and constant variance ó^2. Hence, results from this study were reliable.

DISCUSSION

Findings of this study suggested that inhabitants of those health districts that suffered from the cholera epidemic of 2000 and 2001 had poor knowledge of water purification methods and personal hygiene. They also had poor access to basic health and sanitary fa-

cilities such as tap water and protected toilets. Most of the participants who took part in the study were adult females. The two groups of participants were similar with regards to age, gender and level of education. Stratification by these variables did not alter the significance of estimated odds ratios, thereby confirming that variables such as age, gender and level of education were not potential confounding or effect modifying variables. The proportion of people with post-matric education had improved from 8% in 1995 to above 30% in 2001 (Central Statistical Services, 1998:48). This finding implies that an increase in the proportion of people with post-matric education is not necessarily an indicator of adherence to personal hygiene, environmental sanitation or the practice of primary health education at the household level. There is a greater need for enhancing basic primary health education activities in the rural communities of KZN in collaboration with the private sector as well as non-governmental organisations involved with missions related to primary health care and alleviation of poverty and illiteracy among the rural population of KZN.

The proportions of people with access to safe water supply (tap water and tanker/carrier water supply) in Groups 1 and 2 are 82% and 57% respectively. Of great concern is the sizeable proportion (18% in Group 1 and 43% in Group 2) of households that use unsafe water from dams, rivers, rainwater, springs and windmill. Historically, lack of access to safe water supply in rainy seasons has been one of the key factors responsible for the spread of cholera and diarrhoeal diseases in KZN (Sinclair *et al*. 1982:753-755).

As many as 30% of participants in Group 1 and 49% of participants in Group 2 have no toilet facilities at the household level. Access to hygienic toilet facilities such as VIP toilets is less than adequate in both groups. Given the absence of toilets at households, residents are expected to use any available open space around the household for defecation, thereby contaminating their surroundings and increasing the likelihood of the transmission of cholera and diarrhoeal diseases especially in rainy seasons.

In 1996, the proportion of households with piped water in KZN was 39.8% (Central Statistical Services, 1998:48). Relative to this figure, access to tap water has improved in rural communities in KZN. This study has shown that there is a significant difference between Groups 1 and 2 with regards to access to safe water supply.

Although there is no perfect method of measuring practice of good personal hygiene observing inhabitants in their living environment and asking them relevant questions is generally accepted to be a fairly reliable tool for having an insight into factors that affect personal hygiene among rural people at the household level (World Health Organization, 1996:55-57). Green and Kreuter (1991:12) argue that health promotion programmes should be based on local practices and culture in order to yield positive changes in health behaviour. Similar community-based studies conducted in Africa and Asia have shown that community based health education programmes positively influence behaviour and the practice of personal hygiene in rural communities of developing nations, and that the prevalence of diarrhoeal diseases and cholera in rural communities can be effectively reduced by way of providing regular health education on personal hygiene, water purification and proper waste disposal to the rural population (Haggerty, 1994:1050; Pant, 1996:533; Tayeh, 1996:1205).

Eighty-four percent of participants in Group 1 and 72% of participants in Group 2 knew how to boil water for drinking purposes. Respondents in Group 2 have fared less well than participants in Group 1 in terms of boiling drinking water, purifying household water by use of affordable disinfectants such as JIK, and washing the hands with soap after toilet use. The proportion of people who regularly practiced boiling drinking water up to 100°C is 75% in Group 1 and 66% in Group 2. The proportion of people who knew how to purify drinking water by adding one teaspoon full of JIK in 25 litres of water is 84% in Group 1 and 72% in Group 2. In view of the fact that health promotion activities have not been adequately conducted in rural areas severely affected by the cholera outbreak, it can be argued that victims of the cholera outbreak have been rural inhabitants with limited or no access to basic primary health care services. The study also shows that most victims of cholera are characterised by low socio-economic status, poor literacy, poor environmental sanitation, poor access to safe drinking water and protected toilet facilities. Shortage of firewood and lack of electricity have been responsible for the failure of the majority of victims of cholera to boil drinking water. Most victims in

the study did not listen to health messages transmitted via radio and TV. There was poor adherence to basic personal hygiene such as proper waste disposal and washing the hands with soap after toilet use and before cooking food among victims of cholera.

Curtis (2000:22) has shown that knowledge and practice of washing the hands with soap after contact with stool is a simple and inexpensive tool for the reduction of diarrhoeal morbidity. The proportions of participants who practiced hand washing with soap after toilet use in Groups 1 and 2 are as low as 34% and 30% respectively. This shows that there is a dire need for providing rural communities in KZN with health education on basic personal hygiene and primary health care principles.

The use of toilet facilities by all family members was higher in Group 1 (70%) compared to Group 2 (51%). Ownership of VIP toilets was small in both groups (28% in Group 1 and 23% in Group 2), while ownership of flush toilets was even smaller in both groups (12% in Group 1 and 7% in Group 2).

CONCLUSION

The study has shown that cholera sickness was strongly influenced by the practice of boiling drinking water, knowledge of water purification methods such as the use of JIK, access to safe water supply (tap water), ownership of protected toilets, washing the hands with soap after toilet use, the practice of keeping personal hygiene and proper waste disposal. Victims of cholera sickness were significantly different from others with regards to socio-economic characteristics, knowledge and practice of personal hygiene, access to safe water supply, and ownership of protected toilets. There is a measurable gap in the provision of basic health services between the two groups of people, and this could be addressed by way of conducting health promotion and education programmes as part of basic primary health care services. Findings from this study could be useful as baseline information for future planning, monitoring and evaluation of ongoing health promotion, education and developmental activities.

LIMITATIONS OF STUDY

- Households with no head or health caretaker were excluded from the study. No attempt was made to revisit such households due to shortage of resources.
- Data collected from households may have been influenced by recall bias.
- Information was obtained only from heads of households or caretakers, and not from individual members of the households in the study.

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