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Pitout JDD, Church DL, Gregson DB, Chow BL, McCracken M, Mulvey M, Laupland KB (2007). Molecular epidemiology of CTXM-producing *Escherichia coli* in the Calgary Health Region: emergence of CTX-M-15-producing isolates. *Antimicrob. Agents Chemother.* 51: 1281-1286.

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Review

Epidemiological model of influenza a (H1N1) transmission in Ashanti Region of Ghana, 2012

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The pandemic potential of influenza A (H1N1) has required decision makers to act in the face of uncertainties. A deterministic susceptible-exposed-infectious-recovered model was developed to study the spread of H1N1 using population data from the Ashanti region of Ghana. We assumed the population to be constant with birth rate equals death rate and they interact freely (homogeneous mixing). We determined the equilibria and stability of the equilibria with the aim of finding threshold conditions under which the disease spread or die out and illustrate the outcome with numerical solutions. Our results suggest that vaccinating 0.64% of the susceptible population can significantly control the spread of the disease.

Key words: Vaccination, stability, basic reproduction number, homogeneous mixing.

INTRODUCTION

Influenza is a viral infection that affects mainly the nose, throat, bronchi and occasionally, lungs. Infection usually lasts for about a week, and is characterized by sudden onset of high fever, aching muscles, headache and severe malaise, non-productive cough, sore throat and rhinitis” (World Health Organization (WHO)/Influenza). Influenza is caused by Ribonucleic acid (RNA) virus in the family of Orthomyxoviridae. The virus is divided into three main types (A, B, and C) which are distinguished by differences in two major proteins; hemagglutinin (HA) and neuraminidase (NA). Influenza Type B infects humans, producing a milder disease that can cause epidemics. Type C apparently infects only humans and typically produces either a very mild illness indistinguishable from a common cold or no symptoms at all. Type C does not cause epidemics. Influenza type A is the most dangerous; it infects a wide variety of mammals and birds. It causes the most cases of the disease in humans and is the type most likely to become pandemic. Influenza A is further divided into subtypes based on differences in the

membrane protein HA and NA, which are the most important targets for the immune system. Influenza type A has 16 hemagglutinin subtypes (H1 to H16) and 9 neuraminidase subtypes (N1 to N9) known in birds. Only H1, 2, and 3 and N1 and 2, are commonly found in humans (Stephenson and Democratis, 2006). There are currently two subtypes circulating in humans: H1N1 and H3N2 (Stephenson and Democratis, 2006). An antigenic shift in the influenza A virus can produce a pandemic affecting most of the world within a matter of months.

Influenza A (H1N1) is transmitted from person to person through large respiratory droplets expelled directly through coughing or sneezing, indirectly through contact with respiratory droplets or secretions, followed by touching the nose or the mouth, and one needs not to be more than one meter to be infected (Racaniello, 2009). Preventing transmission requires removing one or more of the conditions necessary for transmission for example, blocking and or minimizing the ways by which the virus can get to a susceptible host, inhibiting or killing the virus

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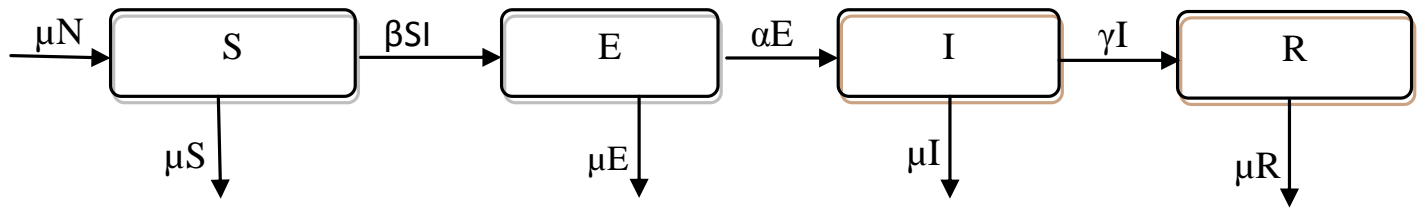


Figure 1. Flowchart for SEIR model.

(Tietjen et al., 2003). People infected with H1N1 first pass through latent and incubation period where they are not infectious and do not have the symptoms. The period of incubation for H1N1 is 1 to 4 days and the infectious period for a confirmed case is defined as 1 day prior to the onset of symptoms to 7 days after onset (Gu et al., 2009). The symptoms of influenza A (H1N1) are: cough, nausea, diarrhea, fever and chills, headache, sore throat, muscle aches, runny nose, shortness of breath, joint pains etc. (Eccles, 2005).

The H1N1 virus had infected more than one million people worldwide (World Health Organisation 2009). Ashanti Region is no exception to the menace of the influenza virus H1N1. The region was first hit by the influenza A (H1N1) pandemic on August 31, 1918, on a ship arriving from Freetown, Sierra Leone and it spread across Ghana along the main lines of communication, killing at least 100,000 people. This has been followed by so many influenza outbreaks, for instance the 1957 to 1958 Asian Flu (H2N2) and 1968 to 1970 Hong Flu (H3N2). In April, 2005, outbreak of influenza A H5N1 and March, 2010, confirmed first case of pandemic Influenza A (H1N1) (Ghana Health Service, Kumasi, 2009).

The H1N1 poses public health and developmental challenges similar to challenges posed by communicable and chronic diseases. This has required decision makers to act in the face of substantial uncertainties. Even though vaccines are available for many infectious diseases, these diseases still cause suffering and mortality in Ghana and Ashanti region in particular. It is against this backdrop that this research is called for to ascertain the wide spread of the influenza A (H1N1) virus.

MODEL FORMULATION

The model we decided to use in studying the H1N1 virus is the susceptible-exposed-infectious-recovered compartmental model, or more commonly the SEIR model (Anderson and May, 1991). This model is the same as the SIR model, except that before the individual becomes infectious, of course he/she will be exposed to the environment. For the model, we consider four basic classes:

1. Susceptible (S);
2. Exposed (E);
3. Infectious (I);
4. Recovered (R).

Susceptible class are individuals in the population who are at risk of becoming infected with H1N1 virus. The exposed class are individuals who have been infected with the H1N1 virus but not infectious (show no symptoms and cannot pass on the disease). Infectious class are individuals who have been infected with the H1N1 and can pass it on to susceptible persons. Lastly, the recovered class are individuals who have recovered or been removed from H1N1 infection (Uhavax, 2001). For the model, we assume births and deaths occur at equal rate and that all newborns are susceptible (no inherited immunity). We denote the average birth and death rate by μ . The rate at which individuals are born

into the susceptible class with no passive is μS . We also assume the population mix homogeneously, with no restriction of age, mobility or other social factors. Once infected, you become exposed to the environment before becoming infectious. The rate at which susceptible enters the exposed class without been infectious is βSI and the rate at which an exposed person becomes infectious is αE . The rate at which an infected individual may recover and will remain until death is γ . The transmission coefficient is $\beta > 0$, the latency coefficient $\alpha > 0$, the recovery coefficient $\gamma > 0$ and the capital death rate $\mu > 0$. The flow diagram for the SEIR model is given in Figure 1.

The following system of ordinary differential equations (ODEs) is used to represent this model:

$$S' = \mu N - \mu S - \beta SI$$

$$E' = \beta SI - (\mu + \alpha)E,$$

$$I' = \alpha E - (\gamma + \mu)I,$$

$$R' = \gamma I - \mu R,$$

The ODEs satisfy

$$S' + E' + I' + R' = 0$$

And hence;

$$S + E + I + R = N$$

The ODEs above have a disease-free equilibrium (DFE) and an endemic equilibrium (EE), one can show that independently from biologically meaningful initial conditions,

$$(S(0), E(0), I(0), R(0)) \in \{(S, E, I, R) \in [0, N]^4 : S \geq 0, E \geq 0, I \geq 0, R \geq 0, S + E + I + R = N\}$$

It holds that: $R_0 \leq 1 \Rightarrow \lim_{t \rightarrow +\infty} (S(t), E(t), I(t), R(t)) = DFE$

$$R_0 > 1, I(0) > 0 \Rightarrow \lim_{t \rightarrow +\infty} (S(t), E(t), I(t), R(t)) = EE$$

Expressing the ODEs as a proportion of the population we obtain:

$$s(t) = \frac{S(t)}{N}, e(t) = \frac{E(t)}{N}, i(t) = \frac{I(t)}{N}, r(t) = \frac{R(t)}{N}$$

And with $r(t) = 1 - s(t) - e(t) - i(t)$, we have the ODEs as a reduced three dimensional system;

$$\begin{aligned} s' &= \mu - (\mu + \beta i)s \\ e' &= \beta si - (\mu + \alpha)e \\ i' &= \alpha e - (\gamma + \mu)i \end{aligned}$$

The probability to survive the latency and to enter the infectious period equals to $\frac{\alpha}{\alpha + \mu}$ (Bjørnstad, 2005), therefore for this model, the

basic reproduction number is;
$$R_0 = \frac{\beta \alpha}{(\mu + \gamma)(\mu + \alpha)}$$

$$\begin{aligned} \mu - (\mu + \beta i)s &= 0 \\ \beta si - (\mu + \alpha)e &= 0 \\ \alpha e - (\gamma + \mu)i &= 0 \end{aligned}$$

Setting the differential equations equal to 0 gives;

At $i = 0$, from the first equation we have $s = 1$, also $e = 0$. Hence the infection-free equilibrium $(s, e, i) = (1, 0, 0)$

To determine the endemic state we set $e = \frac{\gamma + \mu}{\alpha} i$ in the third equation. We then substitute e into the second equation and we obtain $s = \frac{1}{\beta \alpha} (\mu + \alpha)(\gamma + \mu) = \frac{1}{R_0}$. Putting the value of s into the first equation we have $i = \frac{\mu}{\beta} (R_0 - 1)$ and

$$e = \frac{\gamma + \mu}{\alpha} i = \frac{\mu(R_0 - 1)}{R_0(\mu + \alpha)}$$

Thus the endemic equilibrium point is given by;

$$(s^*, e^*, i^*) = \left(\frac{1}{R_0}, \frac{\mu(R_0 - 1)}{R_0(\mu + \alpha)}, \frac{\mu(R_0 - 1)}{\beta} \right)$$

We calculate the local stability of these steady states by linearizing the ODEs. The Jacobian matrix is found to be

$$J = \begin{bmatrix} -\mu - \beta i & 0 & -\beta s \\ \beta i & -(\mu + \gamma) & \beta s \\ 0 & \alpha & -(\gamma + \mu) \end{bmatrix}$$

The Jacobian at the disease-free equilibrium is;

$$J_{DFE} = \begin{bmatrix} -\mu & 0 & -\beta \\ 0 & -(\mu + \alpha) & \beta \\ 0 & \alpha & -(\gamma + \mu) \end{bmatrix}$$

We have; $\det(J - \lambda I) = \lambda^3 + a_1\lambda^2 + a_2\lambda + a_3$

Where;

$$a_1 = (3\mu + \gamma + \alpha)$$

$$a_2 = [(\mu + \gamma)(\mu + \alpha) - \beta\alpha + \mu(2\mu + \gamma + \alpha)]$$

$$a_3 = \mu[(\mu + \alpha)(\mu + \gamma) - \beta\alpha]$$

From Routh-Hurwitz stability criterion if $a_1 > 0$, $a_3 > 0$ and $a_1a_2 - a_3 > 0$ are true, then all the roots of the characteristic equation have negative real part which means stable equilibrium (Flores, 2013). The disease-free equilibrium is stable when $R_0 < 1$ otherwise unstable. Next we have the Jacobian at the endemic equilibrium point;

$$J_{EE} = \begin{bmatrix} -\mu R_0 & 0 & \frac{-(\mu + \alpha)(\mu + \gamma)}{\alpha} \\ \mu(R_0 - 1) & -(\mu + \alpha) & \frac{(\mu + \alpha)(\mu + \gamma)}{\alpha} \\ 0 & \alpha & -(\gamma + \mu) \end{bmatrix}$$

We have; $\det(J - \lambda I) = \lambda^3 + b_1\lambda^2 + b_2\lambda + b_3$

Where;

$$b_1 = \alpha + \gamma + (2 + R_0)\mu$$

$$b_2 = \mu R_0(2\mu + \alpha + \gamma)$$

$$b_3 = \mu(R_0 - 1)[\mu^2 + \mu(\alpha + \gamma) + \alpha\gamma]$$

From Routh-Hurwitz stability criterion, if the coefficient of the characteristic equation $b_1 > 0$, $b_3 > 0$ and $b_1b_2 - b_3 > 0$ are true, then all the roots of the characteristic equation have negative real parts which means a stable equilibrium (Flores, 2013). The first two conditions are true for $R_0 > 1$ as b_1 and b_3 are both positive quantities. The third condition

$b_1b_2 - b_3 > 0$ given by $\mu[R_0\{(3\mu + \alpha + \mu R_0)(\alpha + \gamma) + \mu^2(3 + 2R_0) + \gamma^2\} + \mu^2 + \mu(\alpha + \gamma) + \alpha\gamma]$ is greater than zero (for all parameter values and $R_0 > 1$), hence it is also true. Thus the endemic steady state is stable when $R_0 > 1$ by the Routh-Hurwitz criteria.

We proposed the herd immunity threshold (H_1) as the sole immunization strategy. The herd immunity threshold is the percentage of the population that needs to be immune to control transmission of the disease. It protects directly the immune individuals from reinfection but also provides an indirect protection to susceptible population. The equation given by Diekmann and Heesterbeek (2000) for estimating the herd

immunity threshold is;
$$H_1 = 1 - \frac{1}{R_0}$$

Model analysis

We used Ashanti regional data, and had $N = 4725042$, $\beta = 0.3016$, $\alpha = 0.5$, $\gamma = 0.2857$ and $\mu = 0.0088$. The basic reproduction number was found to be $R_0 = 1.0064$. The disease-free equilibrium $(s, e, i) = (1, 0, 0)$ was unstable for $R_0 < 1$ and the endemic equilibrium $(s^*, e^*, i^*) = (0.994, 0.000109, 0.000187)$ was stable for $R_0 > 1$. The herd immunity threshold was found to be $H_1 = 0.0064$.

Table 1. Sensitivity analysis of the disease-free equilibrium state.

Nature of steady state	μ	β	α	γ	R_0
Unstable	0.0088	0.4	0.5	0.2857	1.3347
Stable	0.0088	0.175	0.5	0.2857	0.5839
Stable	0.0088	0.3016	0.5	0.5	0.5825
Unstable	0.0088	0.3016	0.5	0.105	2.6044

Table 2. Sensitivity analysis of the endemic equilibrium point.

Nature of steady state	μ	β	α	γ	R_0
Stable	0.0088	0.4000	0.5	0.2857	1.3347
Unstable	0.0088	0.1750	0.5	0.2857	0.5839
Unstable	0.0088	0.3016	0.5	0.5000	0.5825
Stable	0.0088	0.3016	0.5	0.1050	2.6044

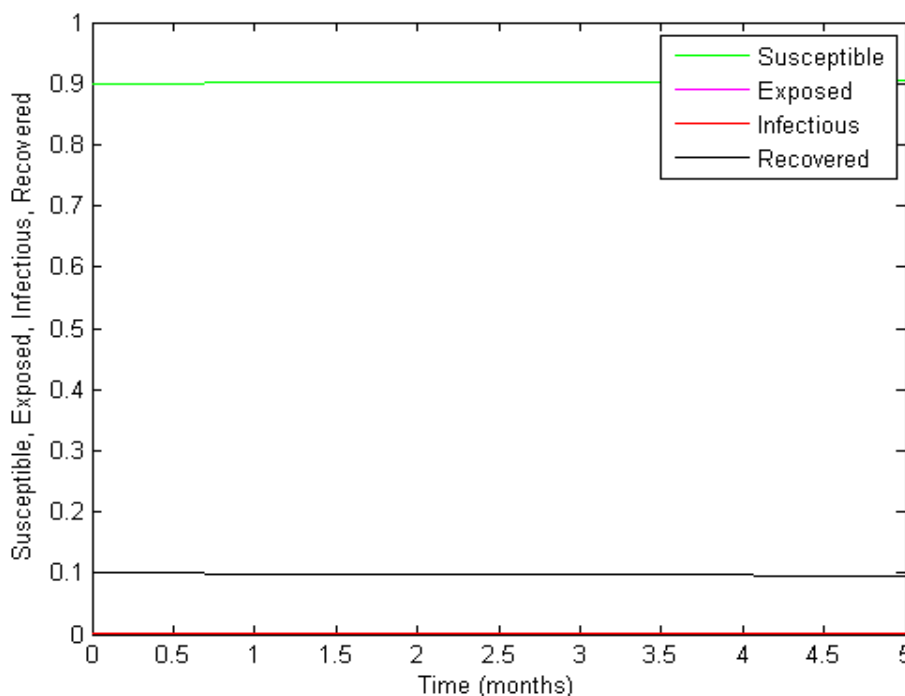


Figure 2. Dynamics of the various compartments at the initial outbreak of H1N1.

Sensitivity analysis was performed for both the disease-free and the endemic equilibrium point. The results were shown in Tables 1 and 2.

From Table 1, as the transmission rate or the recovery rate was increased or decreased, respectively the $R_0 > 1$ and the disease-free equilibrium was found to be unstable. This means in the cause of an outbreak, the disease will spread. On the other hand, as the transmission rate or the recovery rate was reduced or increased, respectively $R_0 < 1$ and the disease-free equilibrium was found to be stable, meaning the disease failed to spread. From Table 2, as the transmission rate or the recovery rate was increased or decreased, respectively the $R_0 > 1$ and the endemic equilibrium point was stable. On the other hand, as the

transmission rate or the recovery rate was decreased or increased, respectively the $R_0 < 1$ and the endemic equilibrium was unstable. We ran a simulation for a period of 5 months for interaction between susceptible, infectious and recovered patients using the parameter values given. The Ashanti regional data showed that at the month of March $S(0) = 4725042, E(0) = 2, I(0) = 2$ and $R_0 = 0$.

Dividing through by the total population of Ashanti region which was 4725046 (Ghana statistical service, 2010), we had; $s(0) = 0.99999915, e(0) = 4.232763025 \times 10^{-7}$
 $i(0) = 4.232763025 \times 10^{-7}$ and $r(0) = 0.0$. From the

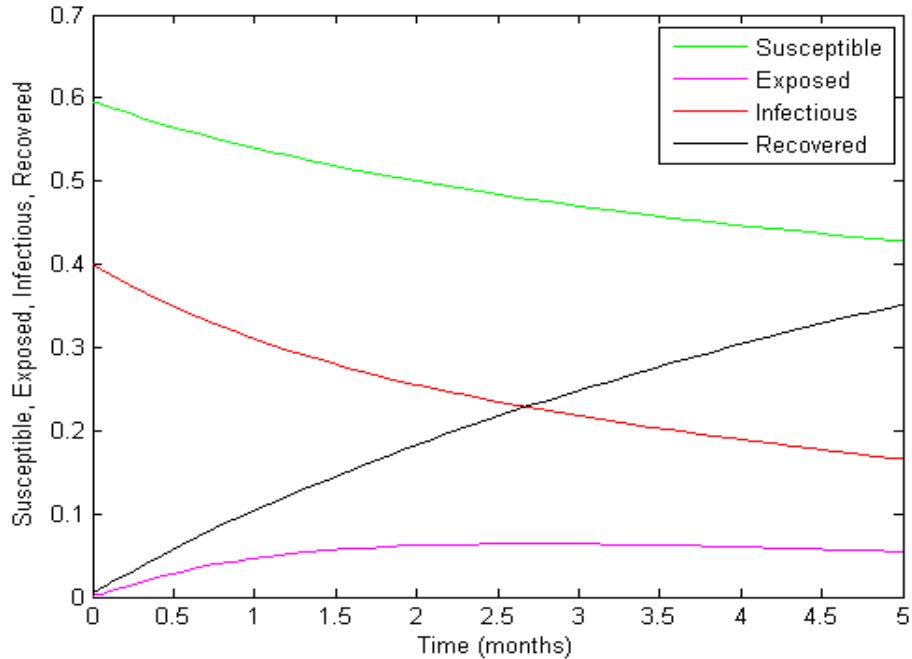


Figure 3. Graph of an increased in the proportion of infectives (5 months period) on various compartments.

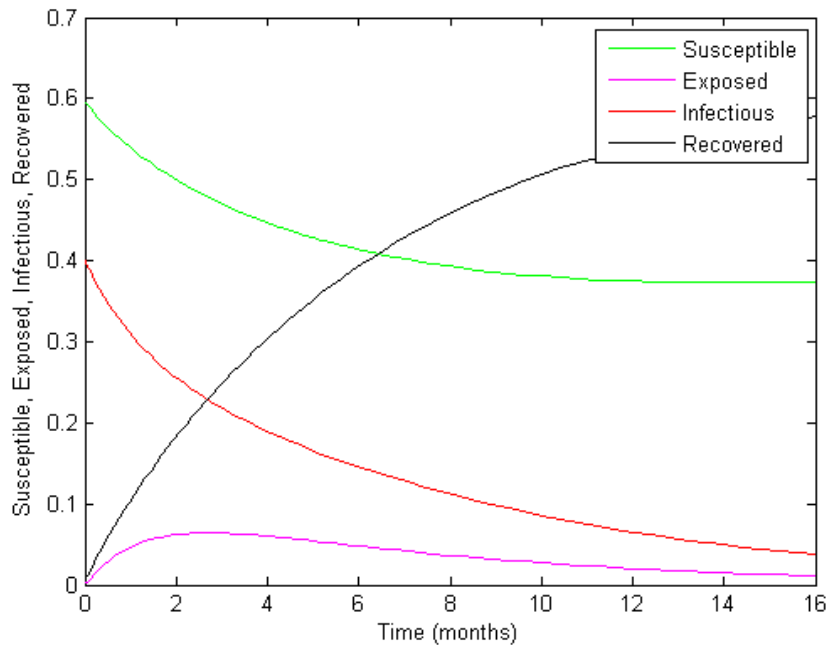


Figure 4. Graph of an increased in proportion of infectives (16 months period) on various compartment.

simulation we obtain Figure 2.

From Figure 2, the initial proportion of infectives has minimal or no effect on the susceptible population, hence we had disease-free state. We varied the proportion of infectives (taken $i(0) = 0.4$) around the neighbourhood of the endemic equilibrium point for a

period of 5 and 16 months. This is illustrated in the Figures 3 and 4, respectively. From Figure 3, when the proportion of infectives was increased to 0.4 around the neighborhood of the endemic equilibrium, the proportion of exposed individuals initially increased from 0, reaches a peak of 0.06 in the second month then declines gradually to a minimum value of 0.05 by the fifth month. The

proportion of susceptible on the other hand declines from a value of 0.6 during the first month to a minimum value of 0.44 by the fifth month. The proportion of recovered on the other hand increases exponentially with time and reaches a maximum value of 0.35 by the fifth month. Also, the recovered population equals the infective around the third month of the outbreak.

From Figure 4, when the proportion of infectives was increased to 0.4 around the neighborhood of the endemic equilibrium point, the proportion of exposed individuals initially increased from zero, then reached a peak of 0.06 in the second month and declined gradually to a minimum value of 0.01 by the sixteenth month. The proportion of susceptible on the other hand declined from a value of 0.6 during the first month to a minimum value of 0.38 by the sixteenth month. The proportion of recovered on the other hand increased exponentially with time and reached a maximum value of 0.58 by the sixteenth month. Also, the recovered population was equal the infective around the third month of the outbreak at a value of 0.23 and the susceptible around the seventh month at a value of 0.41.

DISCUSSION

From the results, the reproduction number for the SEIR epidemiological model estimated indicated that $R_0 > 1$. This means the disease will spread in the cause of an outbreak. The sensitivity analysis revealed that whenever the transmission rate is increased or the recovery rate is reduced, the disease spread, but whenever the transmission rate is reduced or the recovery rate is increased, the disease dies out. From the simulation (Figure 2) we found out that the initial proportion of infectives had no effect on the various compartments. As the proportion of infective was increased to 0.4 as shown in Figures 3 and 4 around the neighborhood of the endemic equilibrium state, the SEIR model exhibited a decline in the proportion of susceptible. This means that as more and more people are infected with the H1N1 virus, the disease will become endemic in the region. Furthermore, the recovered proportion of the population increases exponentially with time. This is as a result of a relatively high recovery rate such that even though the susceptible population was infected, a high amount of them recovered quickly, providing herd immunity. The herd immunity threshold was estimated to be 0.0064, meaning about 0.64% of the Ashanti region population has to be vaccinated in order to bring the disease under control in case of an outbreak.

REFERENCES

- Anderson RM, May RM (1991). Population biology of infectious diseases: Part 1. *Nature* 820:361-367.
- Bjørnstad O (2005). SEIR models. www.stat.colostate.edu/~rdavis/ey680/sir.pdf (Accessed: 13th Nov., 2011)
- Diekmann O, Heesterbeek JAP (2000). *Mathematical Epidemiology of Infectious Diseases: Model Building, Analysis and Interpretation*. Wiley Series in Mathematical and Computational Biology.
- Eccles R (2005). Understanding the symptoms of the common cold and influenza. *Lancet Infect. Dis.* 5(11):718-25.
- Flores JD (2013). Routh-Hurwitz criteria, Math-735: Mathematical modelling. http://sunburst.usd.edu/~jflores/Math735/MMChapter4_4p5.pdf
- Gu Y, Komiya N, Kamiya H, Yasui Y, Taniguchi K, Okabe N (2009). Pandemic (H1N1) 2009 transmission during presymptomatic phase, Japan. *Emerg infect diseases* volume 17, number 9 – September 2011. http://wwwnc.cdc.gov/eid/article/17/9/10-1411_article.htm [Accessed: 20th August, 2011]
- Racaniello V (2009). Virology blog about viruses and viral disease, influenza virus transmission. <http://www.virology.ws/2009/04/29/influenza-virus-transmission/>[Accessed: 20th March, 2012]
- Stephenson I, Democratis J (2006). Influenza: current threat from avian influenza, *British medical bulletin* Volume 75-76, Issue 1 Pp. 63-80. <http://bmb.oxfordjournals.org/content/75-76/1/63.full>
- Tietjen L, Bossemeyer D, McIntosh N (2003). Infection prevention, guidelines for healthcare facilities with limited resources <http://www.medcol.mw/commhealth/publications/IP%20JHEPEIGO%20MANUAL.pdf>
- Uhavax (2001). History of epidemics and plagues. <http://uhavax.hartford.edu/bugl/histepi.htm> [Accessed: 14th February, 2012]
- Vardavas R, Breban R, Blower S (2010). A universal long – term flu vaccine may not prevent severe epidemics. *BMC research notes*. <http://www.biomedcentral.com/1756-0500/3/92>
- WHO/Influenza <http://www.who.int/topics/influenza/en/> [Accessed 27th March, 2013]
- World health organization (WHO) (2009). Influenza (seasonal), Media centre, fact sheet No. 211, <http://www.who.int/mediacentre/factsheets/fs211/en/> [12th April, 2011]

Full Length Research Paper

Prevalence of vaginitis and vaginosis among University of Calabar female students

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The prevalence of vaginosis and vaginitis among the female students of the University of Calabar was studied between September and December, 2005. High vaginal swabs were collected from each respondent. Questionnaires were administered to the respondents and collected together with the specimen. A total of 1000 respondents aged between 15 and 35 years were examined. The survey revealed that 70% were infected with vaginosis and vaginitis, among these, 51% had single infection while 19% had mixed infections. On the other hand, 330 (64.71%) had candidiasis while 180 (35.29%) had bacterial vaginosis. Genital discharges, 400 (51.28%) was the commonest symptom while a combination of itching, burning and genital discharge 170 (21.79%) was the least. Contraceptive related prevalence shows that condom (54.72%) was the most common contraceptive used while injectable (1.89%) was the least. Statistical analysis of the data revealed a significant difference ($P < 0.05$) between sexually active (aged groups 21 to 30) and sexually inactive (age group 15 to 20 and 31 to 34). The findings of this study show that there is high prevalence rate of vaginitis and vaginosis among the study population and a significant number of asymptomatic patients being vaginitis and vaginosis positive. This reveals the sanitary conditions of the female toilets in the hostels.

Key words: Vaginosis, candidiasis, bacterial vaginosis, contraceptives, vaginitis.

INTRODUCTION

Bacterial vaginosis (BV) is a polymicrobial superficial vaginal infection involving loss of the vaginal lactobacilli and an over growth of anaerobes (Hill, 1993; Curran, 2010). In the United States, BV is currently the most cause of vaginitis, accounting for 40 to 50% cases in women of childbearing age (Hill, 1993; Hay, 1998). This infection is believed to be caused by proliferation of a number of organisms including *Gardnerella vaginalis*, *Mobiluncus* species, *Mycoplasma hominis* and *Peptostreptococcus* species (Kent, 1991; Hill, 1993). Bacterial vaginosis is so named, because no polymorphonuclear cells are present in the vaginal discharge, but a decrease in the normal vaginal flora and a rise in vaginal

pH. This leads to overgrowth of *G. vaginalis* and vaginal anaerobic bacteria causing white or grey discharge with amine odor.

Determining the prevalence of BV is difficult, because one third to three quarters of affected women are asymptomatic (McCue, 1989; Sobel, 1990; Schwebke, 2007). In addition, reported prevalence varies based on the population studied. BV has been reported in 15 to 19% ambulatory gynecological patients, 10 to 80% pregnant patients and 20 to 41% of patients in sexually transmitted clinics (Sobel, 1997; Bump and Buesching, 1985).

Vulvovaginal candidiasis is the second most common cause of vaginitis in the United States and the most

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common cause in Europe (Kent, 1991). An estimated 75% of women have vulvovaginal candidiasis at some time in life and approximately 5% of women who have current episodes (Monif, 1985; Foxman, 1990; Sobel, 1993). *Candida albicans* is the infecting agent in 80 to 90% patients (Sobel, 1997; Horowitz and Mardh, 1997).

Risk factors for uncomplicated vulvovaginal candidiasis have been difficult to determine (Sobel, 1993). Establishing *Candida* species as the cause of vaginitis is difficult because 50% of asymptomatic women have *Candida* spp. as part of their endogenous vaginal flora (Sobel, 1993; Egan and Lipsky, 2000). Trichomoniasis is considered the most common curable sexually transmitted disease. About 70% of the infected women do not develop symptoms. This is a serious problem in pregnant women, because it can lead to preterm delivery.

Unsanitary conditions of toilets and bathrooms and the large female student's population in the hostels can be sources of vaginitis and vaginosis. With the high number of candidiasis and pelvic inflammatory diseases reported by the students who visited area medical facilities, no meaningful research has been carried out to determine the etiology of these infections and the prevalent rate in this university community. This research work is therefore aimed at determining the level of vaginitis and vaginosis, the prevalent rates and the age groups of the female students affected most, importantly the percentage of asymptomatic students who develop the disease. The results of this research could be used in the intervention of the development of good toilet facilities and the need for regular medical check up by the students.

MATERIALS AND METHODS

Study area

This study was carried out in the University of Calabar Medical Center, Calabar Cross River State. Laboratory analysis was carried out in the pathology laboratory of the University of Calabar Teaching Hospital.

Subjects for the study and location

Both symptomatic and asymptomatic student patients who visited the University Medical Center were examined. These included sexually active (age groups 21 to 30) and sexually inactive (age groups 15 to 20 and 31 to 35).

Ethical approval

The individual student's consent was sort for and those who consented were included in the study. Also, the Hospitals Management Board of Cross River State and University of Calabar Medical Center ethical approval was sort for and approval was obtained before the research.

Administration of questionnaires and sample collection

The questionnaire was designed to obtain information on the

students sexual history, use of contraceptives, personal vaginal hygiene such as douching, washing with soap, use of suppositories, use of fragrance, washing with water only, or non-of the above. Also, types of toilets used such as septic tank flush system, pit toilet, bush and the cleanliness of the different toilet facilities. Immediately after filling the questionnaires, specimens were collected from the patients by a medical doctor and other health workers. These students come from different social and economic backgrounds.

Sample collection

Vaginal wall swab samples were collected from 1000 female students that made up the study population of aged between 15 and 35 years, who must have had sex at least once and were either symptomatic or non-symptomatic. Health workers (nurses and medical laboratory scientists and including a medical doctor) were recruited as field assistants to help in collection of samples. Two vaginal swabs were collected using sterile Evepon (Evepon Industries Ltd, Nigeria) swab sticks for each respondent. Disposable specula were used by carefully inserting into the vagina and pressing on the vaginal wall to keep the vagina open for the specimen to be taken. A sterile swab stick was then introduced through the speculum and used to swab the vaginal wall directly. The samples were properly labeled bearing code number, data and time of collection.

Laboratory analysis

A drop of isotonic saline solution was introduced into each pack of the sterile swab stick and was mixed by shaking vigorously to wet the swab. A drop of the mixture of each sample was placed on a clean grease free slide, covered with cover slip and examined microscopically under 10 and 40x objectives (Cheesebrough, 1992), potassium hydroxide (KOH) preparation and whiff test were done.

Ten percent of KOH solution was added to the second swab stick containing specimen of the vaginal discharge and mixed by shaking vigorously to wet the swab. A drop of the mixture of the sample was placed on a clean grease free slide covered with covered slip and air dried or flame-dried before examination under 10 and 40 x objectives (Reilly, 1991).

During the preparation of KOH slide, a whiff test was preformed. This was done by dropping KOH solution to the vaginal secretion (Hill, 1993).

Litmus testing

The pH level was determined by placing litmus paper in the pooled vaginal secretion, the colour change of the litmus paper was compared to the colour in the standard chart and their corresponding pH were recorded (Carr et al., 1998).

Gram staining

Smears of the vaginal swab samples were prepared and gram stained. The slides were viewed under the microscope.

Culture of specimens

Each vaginal swab sample was cultured on brain heart infusion agar, blood agar, modified Thayer-Martin agar and Sabouraud Dextrose Agar (SDA) using streaking technique (Cheesebrough, 1992). All cultures were incubated at 37°C for 18 to 24 h except

Table 1. Prevalence rate among total population studied.

Age	No. examined	Single infection	Mixed infection	Total infected (%)	Total un-infected (%)
15-20	150	60	30	90 (60.00)	60(40.00)
21-25	550	310	110	420 (76.4)	130 (23.6)
26-30	250	130	40	170 (68.00)	80 (32.00)
31-35	50	10	10	20 (40.00)	30 (60.00)
Total (%)	1000	510 (51)	190 (19)	700(70)	300 (30)

Table 2. Prevalence of single infection.

Age	No. examined	No. infected	Candidiasis	<i>G. vaginalis</i>
15-20	150	60	20	40
21-25	550	310	210	100
26-30	250	130	90	40
31-35	50	10	10	0
Total	1000	510 (51)	330 (64.71)	180 (35.29)

Table 3. Prevalence of mixed infection.

Age	No. examined	No. infected	Candidal vaginitis/Bacterial vaginosis	Trichomoniasis candidiasis	<i>G. vaginalis/T. vaginalis</i>
15-20	150	30	20	0	10
21-25	550	110	50	40	20
26-30	250	40	30	10	0
31-35	50	10	10	0	0
Total	1000	190 (19)	110 (57.89)	50 (26.32)	30 (15.79)

Table 4. Symptom related prevalence.

Age	No. examined	No. infected (%)	Itching burning (%)	Genital discharge (%)	Itching burning and genital discharge (%)	No. of symptom (%)
15-20	150	90 (60)	20	50	20	60
21-25	550	490 (89.09)	140	250	100	60
26-30	250	170 (68.00)	40	80	50	80
31-35	50	30 (60.00)	10	20	0	20
Total	1000	780 (78)	210 (21)	400 (40)	170 (17)	220 (22)

culture on SDA which were incubated at 27°C for 48 h and modified Thayer-Martin plates incubated at 35°C in candle jar for 18 to 24 h.

Statistical analysis

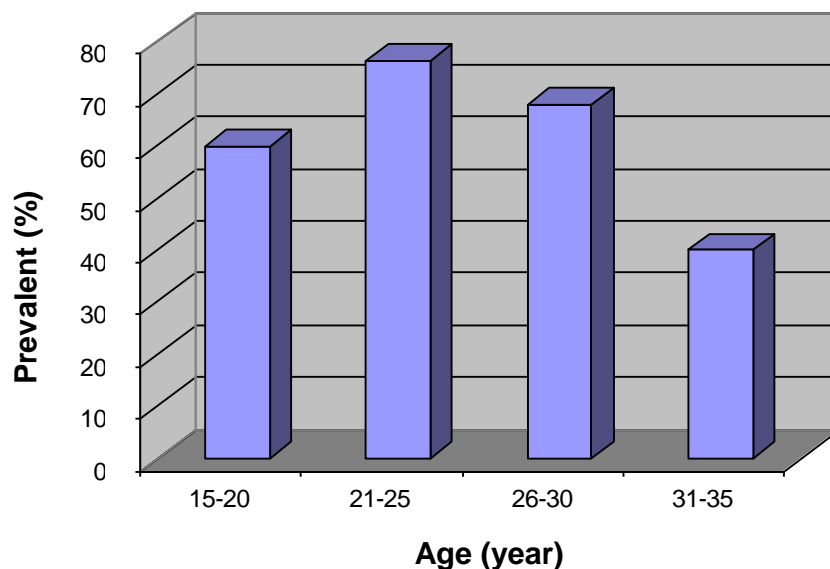
Data were obtained from sample collected and information supplied in the questionnaire, data obtained from users and non users of contraceptive and an overall prevalence of the infections amongst female students of the University of Calabar was subjected to Chi square statistical analysis as described by Phillips (1993). SSPA ver.11.50 was used. Results were reported as significant or non-significant.

RESULTS

The findings of this study are presented in Tables 1 to 5 and Figure 1. As shown in Table 1, among the 1000 students population studied, 70% of the respondents were infected with both single and mixed infections, 51% had single infection while 19% had mixed infections. Table 2 shows the infection rates of *C. albicans* and *G. vaginalis*. A total of 330 (64.71%) had candidiasis vaginitis while only 180 (35.29%) had bacterial vaginosis caused by *G. vaginalis*. The highest prevalence of the infection (76.36%)

Table 5. Contraceptive related prevalence.

Age	No. examined	Contraceptive employed	Oral contraceptive	Condom	Suppository	Injectible	IUD
15-20	150	50 (33.33)	20	30	0	0	0
21-25	550	300 (54.55)	80	170	50	0	0
26-30	250	100 (64.00)	50	80	20	10	0
31-35	50	20 (40.00)	10	10	0	0	0
Total	1000	530	160 (30.19)	290 (54.72)	70 (13.21)	10 (1.89)	0

**Figure 1.** Age related percent prevalence of vaginitis and vaginosis.

was observed among respondents, aged 21 to 25 years, while the least (40%) was observed among respondents, aged 31 to 35 years. Statistical analysis of the data revealed a significant difference ($P < 0.05$) in the prevalence of infectious vaginitis among the female students of the University of Calabar.

The most prevalence vaginal infection in this study was candidiasis (64.71%). Tables 2 and 3 show a pattern of infection according to age. The prevalence of different vaginal microorganisms such as *T. vaginalis*, *G. vaginalis* and *Candida* spp isolated from respondents in this study are shown in Tables 2 and 3. A total of 510 (51%) out of 70% infected respondents had single infections, of this number, 330 (64.71%) had candidiasis and 180 (35.29%) had *G. vaginalis*. On the other hand, 190 (19%) of the respondents had mixed infections, of this number, 110 (57.89%) had *C. albicans* and *G. vaginalis*, while 50 (26.32%) had *T. vaginalis* and *C. albicans* and only 30 (15.79%) had *G. vaginalis* and *T. vaginalis*. A total of 80 (48.11%) had *T. vaginalis* out of the number infected.

Table 4 summarizes symptoms related prevalence among the respondents. As shown, 78% were symptomatic while 22% were asymptomatic. Out of the symptomatic respondents, 490 (89.09%) were seen among

respondent of ages 21 to 25, 170 (68.00%) among ages 31 to 35. Table 4 also shows that the highest symptoms related prevalence, 400 (51.28%) was found among respondents with genital discharge, while 17 (21.79%) was observed amongst respondents with itching, burning and genital discharge.

Table 5 shows contraceptive related prevalence of vaginosis among the respondents. As shown, a total of 530 (53%) respondents used contraceptive. Of this number, 290 (54.72%) used condom, 160 (30.19%) used oral contraceptive, 70 (13.21%) used vaginal suppository, 10 (1.89%) used injectibles and none of the respondents used intrauterine devices. The table also shows that out of 530 respondents who used contraceptive, 300 (54.55%) of the contraceptive were used by respondents of ages 21 to 25, 160 (64.00%) were used by respondents of ages 26 to 30, 50 (33.33%) were used by respondents of ages 15 to 20, while the least 20 (40.00%) were used by respondents of ages 31 to 35 years.

DISCUSSION

The findings of this study have established the existence

of vaginosis and vaginitis among female students of the University of Calabar with a high prevalence of 81%. Vaginitis constitute a major public health problem of both developed and developing countries. Although they are the most commonly reported gynecologic disease (Kent, 1991), the number of cases increases daily. The impact of the high prevalence of vaginosis among University of Calabar female students has not been given adequate attention.

The 81% prevalence of vaginal infections (vaginitis) in this study was observed to occur mostly by BV and VC. This rate is less than that reported by Sobel (1997) and Sobel (1997a) who reported a 90% rate. The lower prevalence rate in the present study is probably due to asymptomatic cases and also the fact that the previous workers considered both vaginitis and vaginosis and also considered only single infection besides socio economic factors and other physical factors of the previous workers.

The prevalence of single infection observed in this present study corroborates the finding of Horowitz and Mardh (1997) who reported a prevalence of about 30% cases of candidiasis in Scandinavian countries. The finding of this study establishes the fact that candidiasis is the highest cause of vaginitis among the female students of the university. This can be attributed to the unhygienic facilities in the female hostels. However, it also supports the fact that vaginosis has more than one cause as observed in a mixed infection.

From this study, there is a correlation between symptoms and prevalence of vaginosis. Genital discharge was found to be the most common symptom followed by itching or burning sensation. The study showed a positive correlation between irritation and candidiasis which is in line with reports by Carr et al. (1998). The relationship between the use of contraceptive and the prevalence of vaginosis was also assessed. The findings of this research showed that condom (barrier contraceptive) was the most common contraceptive used by students. This is due to the high rate of awareness that condom can prevent sexually transmitted disease (STD). Using the information obtained from the questionnaire, physical examination, the findings of microscopic examination of the wet mount, KOH preparation and the result of the pH litmus test, it was noted that, the respondents who use condom and vaginal suppository had a relatively higher number of white blood cells (WBCs) and epithelial cells, which may have resulted in irritation, inflammation and ulceration.

The second most common contraceptive observed in this study was oral contraceptive (pill), it was noted that *C. albicans* and large amount of epithelial cells were frequent in specimen of respondents who use oral contraceptive, this is in accordance with the studies of Horowitz and Mardh (1997) who reported that progestin and estrogen content of oral contraceptive increases vaginal epithelial thickness leading to an increase in vaginal pH,

thus, changing the vaginal flora. They also demonstrated estrogen receptor on *C. albicans* organism. This suggests that certain oral contraceptives might increase the risk of developing candidiasis. Although the pathogenic mechanism is unclear, it was established by other researchers that oral contraceptives users have a 50 to 80% increase risk of recurrent vulvovaginal candidiasis. The findings of this study also show that BV, candidiasis and trichomoniasis are implicated as the most frequent causes of vaginitis

The 22% of the students who were infected but had no symptoms in this study is significant. Though, this is lower than about 85% of women affected with BV who have no symptoms reported by Stoppler (2010). This low prevalence could have been due to the social life styles social classes of the students examined. The implication of these findings has brought to the fore sanitary conditions of toilets in the hostels which may partly be responsible for the infection. Also, more attention will be drawn to high reported cases of pelvic inflammatory disease (PID) which is mostly caused by BV and candidal vaginitis. According to Sweet (2000), Ness et al. (2004) and Atashili et al. (2008), bacterial vaginosis has been shown to increase the risk of adverse gynecological and obstetrical outcomes such as pelvic inflammatory disease (PID) and upper genital tract infections, preterm delivery and late miscarriage.

Conclusion

The results obtained from this study have revealed a high prevalent rate of vaginitis among the students. The environmental conditions in the hostels and other factors identified in this study could have contributed to the high prevalent rate. This research has also revealed that contraceptive use can cause changes in the vaginal environment allowing pathogens to proliferate. The implication of the high prevalence rate of asymptomatic female students with vaginosis found in this study could have been due to the students not going for regular medical check up. This can lead to serious infertility problems in the students. Bacteria from the vagina can travel into the uterus causing serious damage to the fallopian tubes. Regular check ups are therefore necessary for every woman whether sexually active or not.

REFERENCES

- Atashili J, Poole C, Ndumbe PM, Adimora AA, Smith JS (2008). Bacterial vaginosis and HIV acquisition. *NIHPA* 22(12):1493-1501.
- Bump RC, Buesching WJ (1985). Bacterial vaginosis in virginal and sexually active adolescent female: evidence against exclusive sexual transmission. *Am. J. Obstet. Gynecol.* 158:935-939.
- Carr PL, Felsentein D, Friedman RH (1998). Evaluation and management of vaginitis. *J. Gen. Int. Med.* 13:335-346.
- Cheesbrough M (1992). Candidiasis. *Medical laboratory manual for tropical countries.* University Press, Cambridge. pp. 4-10.
- Curran T (2010). Bacterial vaginosis. *Medicine* 4:28-33.

- Egan ME, Lipsky MS (2000). Diagnosis of Vaginitis. *Am. Fam.* 20:1095-1104.
- Foxman B (1990). The epidemiology of vulvovaginal candidiasis risk factors. *Am. J. Public Health* 80:329-331.
- Hay PE (1998). Recurrent bacterial vaginosis. *Clin. Dermatol.* 16:769-773.
- Hill GB (1993). The microbiology of bacterial vaginosis. *Am. J. Obstet. Gynecol.* 169:450-454.
- Kent HL (1991). Epidemiology of vaginitis. *Am. J. Obstet. Gynecol.* 165:1168-1176.
- McCue JD (1989). Evaluation and management of vaginitis. An update for primary care practitioners. *Arch. Intern. Med.* 149:565-568.
- Monif GR (1985). Classification and pathogenesis of vulvovaginal candidiasis. *Am. J. Obstet. Gynecol.* 152:935-939.
- Ness RB, Hillier SL, Kip KE, Soper DE, Stamm CA, McGregor JA, Bass DC, Sweet RL, Rice P, Richter HE (2004). Bacterial vaginosis and risk of pelvic inflammatory disease. *Obstet. Gynecol.* 104(4): 761-769.
- Phillips BLO (1993). Bayesian statistics for social scientist. White Fair Press, London. pp. 198-215.
- Reilly BM (1991). Practical Strategies. In: *Out Patients Medicine*, 2nd ed. Saunders, Philadelphia. pp. 1016-1046.
- Schwebke J (2007). Understanding bacterial vaginosis: diagnosis, treatment and improved outcome. *Women's Health Med. Educ.* 64:18-24.
- Sobel JD (1997). Vaginitis. *New Engl. J. Med.* 337:1896-1903.
- Sobel JD (1993). Candidal vulvovaginitis. *Clin. Obstet. Gynecol.* 36:153-165.
- Sobel JD (1990). Pathogenesis and treatment of recurrent vulvovaginal candidiasis. *Clin. Infect. Dis.* 14(suppl):148-153.
- Stoppler MC (2010). Bacterial vaginosis, symptoms, causes and treatment. *Women's Health Newsletter.*
- Sweet RL (2000). Gynecologic conditions and bacterial vaginosis: implications for the non-pregnant patient. *Infect. Dis. Obstet Gynecol.* 8:184-190.

Full Length Research Paper

Nosocomial outbreak of Crimean-Congo hemorrhagic fever in Holy Family Hospital, Rawalpindi, Pakistan, 2010

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On 14 September, 2010, a suspected case of Crimean-Congo Hemorrhagic Fever (CCHF) was admitted in Holy Family Hospital (HFH). The case was confirmed on 20 September, 2010. The hospital had experienced loss of one intern due to CCHF in 2000s, a panic was created and the blood specimens of team taking care of index case (IC) was sent to reference laboratory for examination. On 28th September, all specimens announced positive for CCHF. A retrospective study was conducted to detect all cases and contacts of the IC. Line list of cases and contacts were built. We interviewed cases, contacts and relevant staff of the hospitals. Out of 19 suspected cases admitted in HFH on the 14th September to 4th November 2010, 11 were positive for CCHF. Nine of the 11 cases were hospital acquired infections (HAI). All the cases with HAI are exposed to IC. Four of the 11 cases had fever only and 2 of the 11 cases had fever with hemorrhagic signs and symptoms. Hemorrhagic cases were IC and another case who had fever, melena and hematuria. Five HAIs did not report any sign and symptom. Seven of the 9 HAI cases were treated with ribavirin. All cases were confirmed by polymerase chain reaction (PCR). None of their family contacts developed the disease. A nosocomial outbreak of CCHF involving 4 medical doctors, 3 nurses, 1 student of nursing school and 1 ward boy was investigated in HFH. IC and HAI cases survived. Poor infection prevention measures in the hospital were associated with the outbreak.

Key words: Nosocomial infection of Crimean-Congo hemorrhagic fever (CCHF), hospital based outbreak of CCHF, Crimean-Congo hemorrhagic fever, infection prevention hospitals, Pakistan.

INTRODUCTION

Crimean-Congo hemorrhagic fever (CCHF) is a severe vector borne viral hemorrhagic fever. Virus and its vector are widely distributed to the different parts of the world, which include Africa, Asia, Middle East and Eastern Europe (Chinikar et al., 2010). The virus which is causing the disease belongs to the genus *Nairovirus* in the

Bunyaviridae family. The virus is prevalent in animals and causes cases and outbreaks of CCHF in humans. CCHF infects a wide range of domestic and wild animals (Gonzalez JP, 1990; Morrill et al., 1990; Mir et al., 2011). The vehicle which transmits the disease from animal to human is Hyalomma ticks or the virus is transmitted by

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direct contact with the blood or tissues of infected humans or viraemic livestock (Wölfel et al., 2007).

Nosocomial transmission of the infection is frequently reported (Athar et al., 2005; Pierre et al., 2004). CCHF is mainly a rural disease; poverty and poor medical care services facilitate transmission of this disease (Boon NA, 2006). War, social unrest and lack of vector control programs are other factors that can trigger outbreaks of the disease.

CCHF has an incubation period of 2 to 9 days (Swanepoel et al., 1989). The disease has a wide range of hemorrhagic symptoms from rash to excessive bleedings from different body organs. Fever is constantly elevated from 5 to 12 days or may be biphasic. It is estimated that five infections occur for each hemorrhagic case, in Russia (Heymann, 2008). Case fatality rate is around 30% (range: 2 to 70%) (Kuljić-Kapulica, 2004; Ergönül, 2006). Most fatalities occur within 5 to 14 days after onset of the disease (Heymann, 2008). CCHF does not have a specific treatment except for providing supportive care (Papadakis, 2009). Early diagnosis of CCHF is important for case management and protection of medical staff. Convalescence is prolonged (Kuljić-Kapulica, 2004).

Nosocomial outbreaks of the disease have been reported in recent years in Pakistan, Iraq, Dubai, South Africa (Athar et al., 2005) and Mauritania (Pierre et al., 2004). Poor universal infection control measures are one of the main cause of nosocomial transmission of disease among health care workers (Mardani et al., 2009).

The first case of CCHF was reported in Rawalpindi, Pakistan in 1976 (Athar et al., 2003; Pirkani and Jogezi, 2007). Nosocomial infections of CCHF have been recorded in Pakistan in 1976 (Burney et al., 1980), 1987 (Pirkani et al., 2006), 1994 (Altaf et al., 1998), 2000 (Khabir A, 2000; IRIN, 2000), and 2002 (Athar et al., 2003; Khabir A, 2000).

The disease is more prevalent in Baluchistan (South east) province of Pakistan (Pirkani et al., 2006), but the disease is spreading toward the south and west of the country. CCHF in Pakistan has a bi-annual surge, the first peak is between March and May and the second peak is between August and October (Azeem et al., 2005).

On the 28th of September, 2010, Holy Family Hospital (HFH) were informed that health care providers who took care of a CCHF patient nearly two weeks earlier tested positive of CCHF. An outbreak investigation was launched to investigate the outbreak and recommend control measures.

METHODOLOGY

A retrospective investigation was conducted from 13th October to 4th November 2010. All patients who tested positive for CCHF infection at HFH from 14th September to 4th November, 2010 were included in the study.

Based on the hospital medical record and logbook of laboratories of National Medical Institute (NID), a comprehensive line list of cases

were developed. All suspected, probable and confirmed cases admitted to the HFH were included in the study. Interviews with patients and their families were conducted. All contacts were listed and interviewed.

Pakistan's Disease Early Warning System's case definitions were used for this outbreak investigation. Case definitions were (National Institute of Health, 2009; 2010):

1) Suspected case: A suspect case was defined as any patient with sudden onset of illness with high-grade fever over 38.5°C for more than 72 h and less than 10 days, especially in CCHF endemic areas and among those in contact with sheep or other livestock (shepherds, butchers, and animal handlers).

2) Probable case: A probable case was defined as a patient with acute history of febrile illness 10 days or less, and thrombocytopenia less than 50,000/mm³, and any two of the following: petechial or purpuric rash, epistaxis, hematemesis, hemoptysis, blood in stools, ecchymosis, gum bleeding, or other hemorrhagic symptoms and unknown predisposing host factors for hemorrhagic manifestations.

3) Confirmed case: Probable case with positive diagnosis of CCHF in blood sample, performed in specially equipped high bio-safety level laboratories, such as: confirmation of the presence of immunoglobulin G (IgG) or IgM antibodies in serum by enzyme-linked immunosorbent assay (ELISA); detection of viral nucleic acid in specimen by polymerase chain reaction (PCR); isolation of virus; HFH (working) outbreak case definition; a suspected, probable or confirmed case of CCHF that visited HFH from 1st September to 14th October, 2010; any health care provider who provided any direct care to any CCHF patients from 1st to 14th October, 2010 and wanted to be tested for CCHF.

National Institute of Health (NIH) laboratories tested all blood specimens by real time-polymerase chain reaction (RT-PCR). ELISA tests were not used on the specimens.

RESULTS

Nineteen persons met the outbreak case definition. Out of nineteen cases, one was the index case (IC) who was admitted in the hospital on the 14th of September and she was in the hospital till 16th of September, 2010.

The IC was a 35 years old woman from Toot area of Attock district, a rural district of Punjab province. Blood specimen of IC was collected upon admission and sent to NIH laboratories for confirmation. On 16th of September, a relative of the patient took her to another private tertiary hospital in Islamabad, where she was admitted in an isolation ward. On the 20th of September, the result of blood specimen was announced to be positive for CCHF. IC was treated in Shifa International Hospital and discharged on the 29th of September after recovery. IC did not report any tick bite or exposure to blood or body fluids of human or animals, but she was a resident of Attock, a rural area with frequent contacts with the animals. Family members of the IC reported that they keep small ruminants in the house. An infection control nurse reported that she found a tick from corridor of the IC room in the hospital.

During 14 to 16th September, at the time that IC was in HFH, nine health care workers took care of the IC. The composition of medical team members were as follows: four medical doctors, three nurses, one student nurse and

Table 1. Linelist of CCHF cases in HFH, 2010 Pakistan.

S/No.	Age (year)	sex	Profession	Sign and symptoms	Date of Admission	Specimen collection date	Lab result	Classification	Date of lab result announcement	Treatment with Ribavirin	Date of discharge
1	35	Female	Housewife	Fever, Melena, Hematuria	14-Sep-10	14-Sep	Positive	Confirmed case/ Index case	20-Sep	Yes	Shifted to Shifa Hospital 16/09/2010- Discharged alive
2	19	Male	Student	Fever, Hematemesis, Melena	17-Sep-12	17-Sep	Positive	Confirmed case	20-Sep	Yes	Died
3	24	Female	Nurse	NA	NA	21-Sep	Positive	Confirmed case	28-Sep	Yes	Discharged
4	26	Male	Nurse	Fever	29-Sep-10	21-Sep	Positive	Confirmed case	28-Sep	Yes	Discharged
5	26	Female	Doctor	Fever	NA	21-Sep	Positive	Confirmed case	28-Sep	Yes	Discharged
6	27	Female	Doctor	NA	NA	21-Sep	Positive	Confirmed case	28-Sep	Yes	Discharged
7	23	Female	Doctor	NA	NA	21-Sep	Positive	Confirmed case	28-Sep	No	Discharged
8	16	Female	Student Nurse	Fever	29-Sep-10	21-Sep	Positive	Confirmed case	28-Sep	Yes	Discharged
9	26	Female	Doctor	NA	NA	21-Sep	Positive	Confirmed case	28-Sep	Yes	Discharged
10	23	Male	Ward Boy	Fever	NA	21-Sep	Positive	Confirmed case	28-Sep	Yes	Discharged
11	25	Female	Nurse	NA	NA	22-Sep	Positive	Confirmed case	29-Sep	Yes	Discharged

one ward boy; on the 20th of September another suspected case was admitted in the HFH.

Nineteen suspected cases were tested for CCHF, eleven were positive for CCHF. Out of eleven positive cases, one was the IC, nine were the medical team who took care of the IC and one was a 19 year old boy who was admitted to the hospital three days after admission of IC.

Age range of eleven confirmed cases were 16 to 35 years with a mean of 24.5 years. Eight were female. Four out of eleven cases only reported fever and two out of eleven cases reported fever with hemorrhagic signs and symptoms. Five health care workers did not report any sign and symptom at all. All eleven cases were healthy individuals before their sickness and they did not report and recall CCHF for themselves and/or in their families (Table 1).

All specimens were tested from 14 to 28th of September, 2010. As per laboratory confirmation, primary attack rate of CCHF among health care workers were 100%. However, none of them

reported hemorrhagic signs and symptoms. Eight out of nine cases did not report any exposure with blood or body fluids of the patients, animals and tick bite. Only one nurse reported minimum contamination of her gloves with the blood of the IC.

Ten out of eleven HFH cases were treated with ribavirin. One hemolytic anemia due to ribavirin was reported. Ten out of eleven cases survived; the one death was a 19 year old boy who was admitted in the hospital three days after the IC and died of complications of the disease a day after admission. Another team took care of this patient and the first team was not responsible to take care of the 19 years old boy.

In interviews, seven out of eight members of the medical team in HFH admitted that infection control and prevention measures were not adequate at the time of admission of IC. The IC was admitted in a regular room. None of the team members had enough protective equipment, such as N95 mask, and only two medical doctors and one nurse had gloves on while examining the patient

or other medical procedures.

A contact investigation was conducted. Three types of contacts identified which include team mates, family and hospital staff. One hundred and eleven contacts were identified which include thirty three family contacts, seventy eight workplace and medical contacts. The investigation team interviewed ten family contacts and fifteen workplace and medical team contacts. One person per family (mainly head of households), all team mates and only those workplace contacts that consented were interviewed. No sign and symptom of disease was reported by workplace contacts, roommates, or family members of the confirmed cases. One nursing student, who was the roommate of a patient, reported fever in the last two weeks; this individual tested negative for CCHF. Contacts without signs and symptoms were not laboratory tested due to budgetary constraints and lack of resources. All the cases were confirmed by RT-PCR using the standard protocols (Schwarz et al., 1996) and ELISA test

was not used.

DISCUSSION

Nosocomial cases of CCHF are not uncommon. Hospital acquired infection and outbreaks of disease are reported in different countries including Iran (Naderi HR, 2011), Pakistan, Dubai (Suleiman et al., 1980), South Africa (van Eeden et al., 1985) and Mauritania (Pierre et al., 2004). Health care workers are a major risk group of the disease all over the world and almost all the time they contract the disease from the patients (Yunus et al., 2009). We reported a nosocomial outbreak of CCHF which involved nine health care workers recorded in the HFH in Rawalpindi, Pakistan. A team of the health care workers who took care of one suspect case of CCHF from 14 to 16th of September, 2010 contracted the disease. Health care workers manifested mild cases of CCHF and none of them reported hemorrhagic signs and symptoms of the disease. This is not the first time that cases of mild CCHF is reported, mild cases were also reported in South Africa (van Eeden et al., 1985) and Turkey (Ergönül 2004). Result of contact tracing confirmed that no tertiary cases developed.

A second case of CCHF also admitted in the hospital three days after the admission of the first case, due to implementation of strong infection control procedures, no secondary case was reported from the hospital.

Mild cases of CCHF secondary cases who contracted the disease from the IC, seems that transmission and passage of the virus from human to human reduce the virulence of the virus. More studies are required to confirm this finding.

Conclusion

CCHF has been recognized as being endemic in Pakistan since 1970s, and since 2000, the number of cases are rising (National Institute of Health, 2010). Health care workers are classified as being at high risk of this disease (Ergonol, 2007) and this is well documented in the literature. Nosocomial infections have been recorded in Pakistan in 1976 (Burney et al., 1980), 1987 (Pirkani et al. 2006), 2000 (Khabir, 2000), 2002 (Athar et al., 2003) and 2010. This is not the first time that nosocomial cases of CCHF occurred in HFH-Rawalpindi among health care workers. In February 2002 after admission of a CCHF case, two interns contracted the disease which resulted to death of a female intern (Athar et al., 2005; Athar et al., 2003).

Almost all victims of nosocomial infections were health care workers. Inadequate standards of the infection prevention and control measures in the hospital were associated with the outbreak.

Poor infection control measures in the hospitals increase the chances of health care workers to contract

the infection (Mardani et al., 2009). Therefore, heedful implementation of standard and universal infection control measures can prevent outbreak of diseases in health care setting.

Whilst usually the disease has a high mortality and severe morbidities, it is recommended to ensure availability of proper surveillance systems to detect suspected cases and diagnostic facilities were appropriate and possible. Early detection and diagnosis of the cases increase the chance of the survival of the patients and protect health care workers from infections.

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REFERENCES

- Ahmad K (2000). Outbreak of Crimean-Congo haemorrhagic fever in Pakistan. *Lancet* 356(9237):1254.
- Altaf A, Luby S, Ahmed AJ, Zaidi N, Khan AJ, Mirza S, McCormick J, Fisher-Hoch S (1998). Outbreak of Crimean-Congo haemorrhagic fever in Quetta, Pakistan: contact tracing and risk assessment. *Trop. Med. Int. Health* 3(11):878-82.
- Athar MN, Baqai HZ, Ahmad M, Khalid MA, Bashir N, Ahmad AM, Balouch AH, Bashir K (2003). Short report: Crimean-Congo hemorrhagic fever outbreak in Rawalpindi, Pakistan, February 2002. *Am. Soc. Trop. Med. Hyg.* 69(3):284-287. Retrieved from <http://intl.ajtmh.org/content/69/3/284.full.pdf>
- Athar MN, Khalid MA, Ahmad AM, Bashir N, Baqai HZ, Ahmad M, Balouch AH, Bashir K (2005). Crimean-Congo Hemorrhagic Fever outbreak in Rawalpindi, Pakistan Feb 2002: Contact tracing and Risk Assessment. *Am. Soc. Trop. Med.* 72(4):471-473.
- Sheikh AS, Sheikh AA, Sheikh NS, Rafi-U-Shan, Asif M, Afridi F, Malik MT (2005). Bi-annual surge of Crimean-Congo haemorrhagic fever (CCHF): a five-year experience. *Int. J. Infect. Dis.* 9(1):37-42.
- Burney MI, Ghafoor A, Saleen M, Webb PA, Casals J (1980). Nosocomial outbreak of viral hemorrhagic fever caused by Crimean hemorrhagic fever-Congo virus in Pakistan, January 1976. *Am. J. Trop. Med. Hyg.* 29(5):941-7.
- Chinikar S, Ghiasi SM, Hewson R, Moradi M, Haeri A (2010). Crimean-Congo hemorrhagic fever in Iran and neighboring countries. *J. Clin. Virol.* 47(2):110-114.
- Ergönül O (2006). Crimean Congo Hemorrhagic Fever. *Lancet Infect. Dis.* 6(4):203-14.
- Gonzalez JP, LeGuenna B, Guillaud M, Wilson ML (1990). A fatal case of Crimean-Congo haemorrhagic fever in Mauritania: virological and serological evidence suggesting epidemic transmission. *Trans. R. Soc. Trop. Med. Hyg.* 84(4):573-576.
- IRIN (2000). humanitarian news and analysis of a service of the UN Office for the Coordination of Humanitarian Affairs. (Humanitarian

- news and analysis of a Service of the UN Office for the Coordination of Humanitarian Affairs). Retrieved 23 December, 2012, from irin news: <http://67.199.16.123/Report/17473/PAKISTAN-Viral-fever-strikes-again-in-Baluchistan>
- Kuljić-Kapulica N (2004). Emerging diseases. Crimean-Congo hemorrhagic fever. *Medicinski Pregled* 57(9-10):453-6.
- Mardani M, Keshtkar-Jahromi M, Ataie B, Adibi P (2009). Crimean-Congo hemorrhagic fever virus as a nosocomial pathogen in Iran. *Am. J. Trop. Med. Hyg.* 81(4):675-8.
- Mir LM, Edris A, Emad M, Sam Y, Alia Z, Cynthia AR, Randal JS, Jawad M, Kathy F, Zarif A, Homayoon S, Toby L (2011). Crimean-Congo Hemorrhagic Fever, Afghanistan, 2009. *Emerg. Infect. Dis. J.* 17(10):1940-1941.
- Morrill JC, Soliman AK, Imam IZ, Botros BA, Moussa MI, Watts DM (1990). Serological evidence of Crimean-Congo haemorrhagic fever viral infection among camels imported into Egypt. *J. Trop. Med. Hyg.* 93(3):201-204.
- Naderi HR, Sarvghad MR, Bojdy A, Hadizadeh MR, Sadeghi R, Sheybani F (2011). Nosocomial outbreak of Crimean-Congo haemorrhagic fever. *Epidemiol. Infect.* 139(6), 862-6.
- National Institute of Health Paksitan (2009). Case Definitions and Standard Procedures for Collection and Transportation of Human Infectious Disease's Samples including Prevention & Control Measrues. Ministry of Health, the National Institute of Health, Pakistan and the World Health Organization.
- National Institute of Health Pakistan (2010). Guidelines. Retrieved from National Institute of Health(NIH): [http://www.nih.org.pk/files/Guidelines/Prevention%20of%20Crimean-Congo%20Haemorrhagic%20\(CCHF\)%20Fever%20\(Human%20and%20Animals\)%20in%20Pakistan.pdf](http://www.nih.org.pk/files/Guidelines/Prevention%20of%20Crimean-Congo%20Haemorrhagic%20(CCHF)%20Fever%20(Human%20and%20Animals)%20in%20Pakistan.pdf)
- Pirkani GS, Jomezai EK, Mansoor I (2006). Survey Report: Crimean Congo Haemorrhagic Fever (CCHF) in Balochistan. *Professional Med. J.* 13(3):464-467.
- Pirkani GS, Jomezai EK (2007). Crimean-Congo hemorrhagic fever; a survey of cases of CCHF in Balochistan. *Professional Med. J.* 14(1):17-20.
- Papadakis SJ (2009). *Current Medical Diagnosis and Treatment* (48th ed.). McGraw Hill, Lange.
- Nabeth P, Cheikh DO, Lo B, Faye O, Vall IOM, Niang M, Wague B, Diop D, Diallo M, Diallo B, Diop OM, Simon F (2004). Crimean-Congo Hemorrhagic Fever, Mauritania. *Emerg. Infect. Dis.* 10(12): 2143-2149.
- Schwarz TF, Nsanze H, Longson M, Nitschko H, Gilch S, Shurie H, Ameen A, Zahir AR, Acharya UG, Jager G (1996). Polymerase Chain Reaction for Diagnosis and Identification of Distinct Variants of Crimean-Congo Hemorrhagic Fever Virus in the United Arab Emirates. *Am. J. Trop. Med. Hyg.* 55:190-196.
- Suleiman MN, Muscat-Baron JM, Harries JR, Satti AG, Platt GS, Bowen ET, Simpson DI. (1980). Congo/Crimean haemorrhagic fever in Dubai. An outbreak at the Rashid Hospital. *Lancet* 2:939-41.
- Swanepoel R, Gill DE, Shepherd AJ, Leman PA, Mynhardt JH, Harvey S (1989). The Clinical Pathology of Crimean-Congo Hemorrhagic Fever. *Rev. Infect. Dis.* 11(4):794-800.
- van Eeden PJ, van Eeden SF, Joubert JR, King JB, van de Wal BW, Michell WL (1985). A nosocomial outbreak of Crimean-Congo haemorrhagic fever at Tygerberg Hospital, Part I- Clinical features. *S. Afr. Med. J.* 68(10):718-21.
- Wölfel R, Paweska JT, Petersen N, Grobbelaar AA, Leman PA, Hewson R, Georges-Courbot MC, Papa A, Günther S, Drosten C (2007). Virus Detection and Monitoring of Viral Load in Crimean-Congo Hemorrhagic Fever Virus Patients. *Emerging Infect. Dis.* 13(7):1097-1100.
- Yunus G, Irfan S, Bariş O, Ediz T (2009). A case of nosocomial transmission of Crimean-Congo hemorrhagic fever from patient to patient. *Int. J. Infect. Dis.* 13(3):e105-7.

Full Length Research Paper

Knowledge and attitudes about induced abortions among female youths attending Naguru Teenage Information and Health Centre, Kampala, Uganda

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This study aims to investigate unsafe abortion, which is more prevalent in low resource countries, contributes significantly to maternal morbidity and mortality. In Uganda, majority of patients treated for complications of induced abortion are adolescents and young, yet their knowledge and attitudes are understudied. In this paper we described the knowledge and attitudes of female youths about medical complications of induced abortions. Participants in this study were 319 youths aged 15 to 24 years who were attending Naguru's Information and Health Centre. At recruitment the youths' socio-demographic characteristics, knowledge and attitudes about induced abortions and its complications were obtained using an interviewer-administered questionnaire. Knowledge was assessed using a scoring system and attitude using a Likert scale. In addition, four focus group discussions were conducted using an interview guide. We did the Bivariate analysis to determine the association between the youth's attitudes towards induced abortion. Data from focus group discussions were analyzed manually. The results revealed most (93.1%) of the youths knew at least one medical complication of an induced abortion. Death (91.3%) was the most commonly cited complication. Few (16%) participants would encourage their colleagues to procure an abortion, while 83.7% would counsel others about perceived dangers of induced abortions. Participants who knew at least one complication were more likely to counsel their colleagues about the dangers of an induced abortion. Thus, knowledge of complications of induced abortions was high among female youths attending Naguru Teenage Information and Health Centre (NTIHC). The majority of the youths were willing to counsel others about the medical complications of induced abortions.

Key words: Knowledge, attitudes, induced abortions, female youth.

INTRODUCTION

Unwanted pregnancies in youths and complications of induced abortions are an important health problem in the world (WHO, 2011). Each year, approximately 20 million

abortions are performed worldwide, 95% of them in developing countries (WHO, 2011). In Uganda, about 297,000 women undergo induced abortions each year

and about one-third of these are treated for complications (Singh, 2005). However, this may be an underestimate considering the Ugandan law which does not allow termination of pregnancy on request.

Due to various reasons, youths are vulnerable to unplanned and unintended early sexual encounters which lead to unwanted pregnancies. They are therefore exposed to seek for induced abortion and candidates to suffer its complications. The youths who undergo an induced abortion expose themselves to serious health risks such as haemorrhage, genital injuries, sepsis (Mbonye, 2000; Mirembe et al., 2010) and death (Silberschmidt, 2001).

In general, in many African countries women younger than 20 years of age represent up to 70% of women treated for abortion complications (Mbonye, 2000; Ahman and Shah, 2011). Single, young, low-parity women, and most often secondary school and university students, account for the bulk of all induced abortions in Uganda (Mirembe et al., 2010). Uganda has one of the highest teenage pregnancy rates in the world of 25% (UDHS, 2006/07).

The complications of induced abortions have been documented in many studies around the world. However, knowledge and attitudes about induced abortions among young people have been addressed in very few previous studies and none in Kampala Uganda.

Youths between the ages of 10 to 24 who attend Naguru Teenage Information and Health Centre (NTIHC), which is a youth model Centre in Uganda, are either in school or out of school. They come from Kampala city and its neighbouring suburbs or districts and form a homogenous group.

This study assessed the knowledge and attitudes of female youths attending NTIHC about medical complications of induced abortions. The findings are hoped to provide evidences for policymakers regarding efforts to reduce risks associated with induced abortions in female youths.

METHODS

Participants in this study were 319 youths attending Naguru Information and Health Centre. Naguru Information and Health Centre is part of the Naguru Health Centre IV in Kampala City Council. It also serves as Youth Centre with Youth friendly Health Services. Many youths, especially those close to Kampala, are referred here for counseling and management of health related issues.

Female youths eligible for inclusion aged between 15 and 24 years, were seeking advice from the Health Centre and consented to the study. The youths were selected randomly using computer generated random numbers by the research assistants who were trained nurses until the sample size was attained. A sample size of 319 was taken to be sufficient based on calculations from the Kish and Leslie formula for cross-sectional studies.

At recruitment information was obtained about the youths' socio-demographic characteristics, knowledge and attitudes about induced

abortions and its complications using an interviewer administered questionnaire. The socio-demographic characteristics information obtained were the age, religion, tribe, marital status, residence, and the highest level of education. The knowledge obtained was about the medical complication of induced abortion such as haemorrhage, sepsis/infection, genital injuries and death and attitudes towards induced abortion. Each of these factors was given a score, which were summed up, and used to assess the youth's knowledge about induced abortions. These were categorized into whether the youth had adequate or inadequate knowledge about induced abortion.

Attitude about induced abortion was assessed using a Likert scale in which the participants made a decision on the level of agreement with each of the statements given to them. These were summarized to indicate whether the participant agreed or disagreed with the each of the statements.

Four focus group discussions (FGDs) were conducted. Two FGDs comprised members who were still in school and two had members who were out of school. Of these two FGDs, one had members aged 15 to 19 years and another one had members aged 20 to 24 years. This was based on the fact that knowledge and attitudes about induced abortions among female youths who were in school may be different from those of female youths who were out of school. In addition, knowledge and attitudes about induced abortions among adolescents aged 15 to 19 years might be different from that of young adults aged 20 to 24 years.

Members of Focus Group Discussion were eligible as above but did not participate in the quantitative part of the study. Each focus group comprised 12 female youths, and the duration for each discussion was one and half hours. The moderator of the discussion was one of the research assistants. The purpose of the discussion was explained to participants by the principal investigator. Participants were informed that there was no wrong or right answer during discussion.

Qualitative data collection was done after the quantitative data collection, in order to clarify and explain certain issues that arose from the quantitative aspect of the study. An interview guide of 10 questions which were generated from the quantitative data collection was used.

Each participant was encouraged to freely give her point of view. The discussions were recorded using a tape and were transcribed by the secretary. At the end of the discussion, participants were free to ask any question about the topic.

The data collected were cleaned, coded and entered in EPI Data version 2.1 b package (EpiData Association, Odense, Denmark) and exported to SPSS version 12.0 (SPSS Inc, Chicago, Ill) for analysis. Bivariate analyses were done to assess the association between the participants' attitudes towards induced abortions and the socio-demographic, social and medical factors. A p value of <0.05 was taken as significant. Qualitative data were manually analyzed.

Ethical approval was obtained from the Mulago Hospital Ethics Committee, the Makerere University College of Health Sciences Ethics Committee and the National Council for Science and Technology.

Written informed consent was obtained from the participants and assent was obtained from participants who were aged below 18 years.

RESULTS

A total of 319 female youths participated in the study. Most of the youths (63.6%) knew at least someone who had procured an abortion and 60.2% knew someone who became ill after undergoing an abortion. About 43.6% of

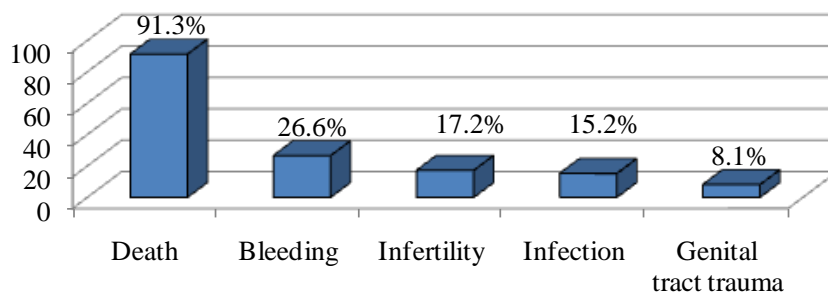


Figure 1. Medical complications of induced abortions mentioned by study participants.

Table 1. Attitudes towards induced abortion.

Attitude	Frequency	Percentage
Would advise or encourage a colleague to go for an abortion		
Yes	51	16.0
No	268	84.0
Would counsel a colleague about dangers of an induced abortion		
Yes	267	83.7
No	52	16.3
Ever considered undergoing an abortion		
Yes	79	24.8
No	240	75.2
Ever lost or terminated a pregnancy (N= 117)		
Yes	66	56.4
No	51	43.6
If yes, (N=66)		
Was done on purpose	49	74.2
Came out itself	17	25.8
If pregnant now, would consider going for an abortion		
Yes	47	14.7
No	272	85.3

the youths knew where to have an abortion procured. Most (93.1%) participants knew at least one complication of an induced abortion while 6.9% did not know any. The dangers of induced abortion as known by participants are presented in Figure 1. The most commonly cited complication was death. Other complications cited were: bleeding (26.6%), infertility (17.2%), infection (15.2%) and genital tract trauma including uterine perforation (8.1%). Participants' attitudes towards induced abortion are shown in Table 1.

Most (83.7%) participants would counsel a colleague with an unwanted pregnancy about the dangers of an induced abortion and 24.8% of participants had ever considered

undergoing an induced abortion. One hundred and seventeen (36%) youths had been pregnant before and 66 (56.4%) participants had lost or terminated a pregnancy in the past. Among participants who had lost or terminated a pregnancy in the past, 49(74.2%) had undergone an induced abortion.

At the time of the study, 14.7% participants would consider undergoing an abortion if they became pregnant at the time of the study. But it is shown that participants who would counsel a colleague about dangers of induced abortions were approximately eight times more likely to know at least one complication of an induced abortion than those who would not.

Table 2. Factors associated with knowledge of complications of induced abortion.

Factor	Knows complications of induced abortion		Odds ratio (OR)	95% CI
	Yes	No		
Age group (years)				
15 to 19	165	9	1.81	0.75 – 4.35
20 to 24	132	13		
Marital status				
Single	127	13	0.52	0.21 - 1.25
Married	170	9		
Family structure				
Monogamous	160	13	0.81	0.34 – 1.95
Polygamous	137	9		
Ever been pregnant before				
Yes	107	10	0.68	0.28 – 1.62
No	190	12		
Pregnant now				
Yes	115	12	0.53	0.22 – 1.26
No	182	10		
Do discuss sex matters with parents or guardians				
Yes	89	4	1.93	0.63 – 5.85
No	208	18		
Do discuss sex matters at school				
Yes	180	7	2.08	0.64 – 6.77
No	62	5		
Have ever considered abortion				
Yes	72	7	0.69	0.27 – 1.75
No	225	15		
Have ever lost/terminated a pregnancy before				
Yes	59	6	0.819	0.22 – 3.07
No	48	4		
Would counsel a colleague about dangers of induced abortions				
Yes	257	10	7.71	3.13 – 19.20*
No	40	12		

*p-value less than 0.05 is considered significant.

Bivariate analysis of factors associated with knowledge about complications of induced abortions and induced abortion

Bivariate analysis of factors associated with knowledge about complications of induced abortions is as shown in Table 2. Participants who had ever been pregnant before

were approximately three times more likely to advise or encourage a colleague with an unwanted pregnancy to go for an induced abortion than those who had never been pregnant (Table 3).

Study participants who had ever considered undergoing an abortion before were almost ten times more likely to advise or encourage a colleague with an unwanted

Table 3. Factors associated with induced abortions.

Factor	Would advise or encourage a colleague to go for abortion		Odds ratio (OR)	95% C.I.
	Yes	No		
Age group (years)				
15 – 19	28	146	1.02	0.56 – 1.86
20 – 24	23	122		
Marital status				
Single	24	116	1.17	0.64 – 2.12
Married	27	152		
Family structure				
Monogamous	25	148	0.78	0.43 – 1.42
Polygamous	26	120		
Ever been pregnant before				
Yes	30	87	2.98	1.61 – 5.49*
No	21	181		
Ever considered abortion				
Yes	34	45	9.91	5.10 – 19.27*
No	17	223		
Do discuss sex matters with parents				
Yes	10	83	0.54	0.26 – 1.14
No	41	185		
Do discuss sex matters at school				
Yes	27	160	0.78	0.37 – 1.63
No	12	55		
Would recommend legalization of abortion				
Yes	22	11	28.23	11.77 – 67.74*
No	17	240		
Ever lost or terminated a pregnancy				
Yes	24	41	4.49	1.67 – 12.06*
No	6	46		
If pregnant now, would considerer abortion				
Yes	32	15	28.41	13.15 – 61.38*
No	19	253		

*p-value less than 0.05 is considered significant.

unwanted pregnancy to go for an induced abortion.

Study participants who had ever lost or terminated a pregnancy were five times more likely to advise or encourage a colleague with an unwanted pregnancy to go for an induced abortion than those who did not have such an experience.

Study participants who would recommend its legalization by the government were more likely to advise or recommend a colleague with an unwanted pregnancy to go for an induced abortion .

Participants who would have considered undergoing an induced abortion at the time of the study if they were

pregnant, were twenty-eight times more likely to advise or encourage a colleague with an unwanted pregnancy to go for an induced abortion.

Qualitative aspect of the study

Source of knowledge about induced abortion and its dangers

The majority of the participants reported to have received information on induced abortion and its dangers from friends, either at school or at home. When asked about the contribution of parents and teachers in providing this information, they gave different answers.

Some of the participants who were informed by their parents were also warned about the dangers they may encounter in case they undergo an abortion. These dangers included death, becoming infertile, and getting sick.

Teachers at school also provided information to some of the participants. This information also included dangers of undergoing abortion.

“My parents usually warn me about abortion in case accidentally I become pregnant. They usually tell me that I may fail to produce again or I may get sick and die. Also at school teachers sometimes tell us about ladies who misbehaved, became pregnant, aborted and got problems.” (An adolescent female in school).

“Our parents usually tell us that if a lady becomes pregnant, it is better to deliver. If a lady removes a pregnancy, she may die.” (A young adult female in school).

Some participants in school never got any information from their teachers. They presumed that talking about abortion at school was not allowed.

“Since I started school, I have never heard my teachers telling us something about abortion and its dangers. I don’t know why. May be they are not allowed.” (An adolescent female in school)

Other parents did not contribute to the knowledge of their daughters about abortion and its dangers. Participants thought this was due to either lack of knowledge by parents or fear of encouraging their daughters to undergo abortion one day.

“...We are many ladies at home. My parents do not discuss with us about induced abortion and its dangers because maybe they fear we might abort one day.” (An adolescent female, not in school).

“Parents do not discuss with their daughters at home about induced abortion and its dangers maybe because

they do not know much about that. Or they know but they do not discuss with their daughters because they fear for them for them to go and put this into practice.” (A young adult female not in school).

Participants’ attitudes towards induced abortion

Participants had different attitudes towards induced abortion. Most of them were reluctant because they never appreciated the outcome of an induced abortion. They thought an induced abortion exposes the person undergoing it to many complications.

Moral consideration, religious conviction and potential values of the abortuses, were some of the reasons given by participants not willing to advise others to go for an abortion.

“I cannot advise or encourage a colleague of mine who has an unwanted pregnancy to abort because if she aborts she will lose respect. Also maybe the baby she will produce may become an important person in future and help the country.” (An adolescent female not in school).

“I cannot advise my colleague or my friend to go and have an abortion. She may abort, yet that may be the only chance God gave her to produce and have a kid. By aborting, she will lose that chance of having a kid. Also to abort is a sin.” (A young adult female not in school).

Only a small number of participants supported abortion and were willing to refer others to go and have it done. The main motivations of their willingness included fear of parents, remaining in school and irresponsibility of the boyfriend.

“Yes. I can advise a friend who becomes pregnant to go and have an abortion done because circumstances may not be favorable to continue that pregnancy. That will help her not to be chased away by her parents and will allow her to continue with school. Also the boyfriend who got her pregnant may not be responsible. So, I think abortion is good.” (A young adult female in school).

“Yes inducing abortion is good. If someone is in school, she will remove the pregnancy before parents and friends get to know and she will continue with her studies....If the parents get to know you are pregnant, they may chase you away.” (An adolescent female in school).

DISCUSSION

In this paper we present the youths’ knowledge about induced abortion and its medical complications. The study found that the major source of information for participants

about abortion was from friends and parents and teachers played a minor role in among those participants who were still in school. This result correlates with what Mitchell et al. (2006) observed in a Kenyan study on knowledge and perceptions of adolescents about abortion, where friends were the main sources of information cited by participants. However, this result contrasts another study which reported that adolescents consider their parents as useful sources of advice on sex matters (Adaji et al., 2010), although other investigators (Correia et al., 2011) have shown that sexual matters are not discussed freely with parents. Investigating teenage sexual activity among secondary school girls in Brazil, Correia found that the teenagers receive very little sex education from their parents (Correia et al., 2009). This could be due to the fact that talking about sex is still regarded as a taboo in many societies.

Since parents and teachers provide little information about abortion and its complications to youths, it is now friends who pass on the information to their peers yet themselves are not necessarily well informed. This was reflected by the different meanings of what abortion participants gave.

From both the quantitative and qualitative aspects of this study, it was shown that participants were aware of complications of induced abortion. An important proportion of participants (60.2%) knew someone who became sick after undergoing an abortion. Also, more than 90% knew at least one complication of an induced abortion. The most commonly mentioned complication was death followed by bleeding, infertility, infection and genital tract trauma. Similar findings were reported in a cross-sectional study in Ethiopia about the knowledge, attitude, behaviour and practice of women on abortion by Senbeto et al. (2005). This study also showed that awareness about complications of induced abortions was high among female youths with 75% of them knowing the complications of induced abortions. The most commonly cited complications in this Ethiopian study were death, bleeding and infections. Death is a tragic event and most people learn about it.

While 83.7% of the study participants would counsel their colleagues about the dangers of an induced abortion, about 16% of them were willing to refer others for an abortion. This is in contrast to what was found in South Africa by Buga (2002) where in a cross-sectional study on attitudes of medical students to induced abortion, 87.2% of respondents were willing to refer a woman for abortion under certain circumstances such as threat to the mother's life, rape, severely malformed fetus, threat to the mother's mental health, and parental incompetence. Only 12.8% of respondents would not refer colleagues for an abortion under any circumstances. This contrast in the results may be due to the fact that in South Africa abortion is legal and the study population in the two studies was not standardized. However, in the focus

group discussions, the few participants who supported abortion and were willing to refer others for abortion provided reasons. This means there is usually a reason why people choose to abort.

Contemplation of abortion was high before the time of data collection (24.8% versus 14.7%). Probably, all the participants were not straightforward when answering this question, abortion being a very sensitive topic. This figure was also reflected in the focus group discussions where few participants reported they would consider abortion if pregnant. Different reasons were given, like continuing with studies, irresponsibility of the boyfriend or fear of disappointing parents and being chased away.

In this study, participants who were willing to counsel a colleague about dangers of induced abortions were more likely to know at least one abortion-related complication. This could be because youths who knew complications of induced abortions were less likely to go or to refer others for an abortion. Willingness to advise or encourage a colleague to go for an induced abortion was significantly associated with participants' previous experience of having been pregnant, having considered undergoing an abortion and having ever terminated a pregnancy. This could also mean that those who became pregnant and induced abortion in the past did not have any complications. Therefore they think the procedure is safe and they are not concerned about referring others.

In this study, participants who did not have any knowledge about the abortion law in the country and those who would have considered abortion if pregnant at the time of the study were more likely willing to refer others for an abortion. This means lack of knowledge about the abortion law contributes to abortion consideration by female youths. This also means that personal attitude towards induced abortion influences a person's advice toward others regarding abortion. This tendency was reflected in the focus group discussions where participants who were willing to refer others for abortion were also themselves willing to undergo the procedure if pregnant.

LIMITATIONS

This study was conducted in an urban setting, and this may not reflect the knowledge and attitudes which the youth have in the rest of the country. Secondly, this topic is sensitive and some youths may not have given the correct responses to the questions which could have affected the results. However, we obtained valuable information which can be used by the policy makers in Uganda.

Conclusion

Knowledge of complications of induced abortions was high

among female youths attending Naguru Teenage Information and Health Centre (NTIHC). The majority of the youths were willing to counsel others about the medical complications of induced abortions. Parents and teachers need to teach the youth about abortions and its dangers. This may reduce the morbidity and mortality associated with unsafe abortion in this country.

REFERENCES

- Adaji SE, Warenus LU, Ong'any AA, Faxelid EA (2010). The attitudes of Kenyan in-School adolescents toward sexual autonomy. *Afr. J. Reprod. Health* 14(1):33-41.
- Ahman E, Shah IH (2011). New estimates and trends regarding unsafe abortion mortality. *Int. J. Gynecol. Obstet.* 115(2):121–126.
- Buga GA (2002). Attitudes of medical students to induced abortion. *East Afr. Med. J.* 79(5):259-62.
- Correia DS, Monteiro VG, Cavalcante JC, Maia EM (2011). Female teenager students: what they know about induced abortion complications. *Rev. Gaucha Emferm.* 32(3):465-71.
- Mbonye AK (2000). Abortion in Uganda: magnitude and implications. *Afr. J. Reprod. Health* 4(2):104-108.
- Mirembe F, Karanja J, Hassan EO, Faúndes A (2010). Goals and activities proposed by countries in seven regions of the world toward prevention of unsafe abortion. *Int. J. Gynaecol. Obstet.* 110:S25-9.
- Mitchell EMH, Halpern CT, Kamathi EM, Owino S (2006). Social scripts and stark realities: Kenyan adolescents' abortion discourse. *Cult. Health Sex.* 8(6):515–528.
- Senbeto E, Alene GD, Abesno N, Yeneneh H (2005). Prevalence and associated risk factors of induced abortion in northwest Ethiopia. *Ethiop. J. Health Dev.* 19(1):37-44.
- Silberschmidt M, Rasch V (2001). Adolescent girls, illegal abortion and “Angar-laddies” in Dar-es-Salam: Vulnerable victims and active social agents. *Soc. Sci. Med.* 52(12):1815-26.
- Singh S, Prada E, Mirembe F, Kiggundu C (2005). The incidence of induced abortion in Uganda. *Int. Fam. Perspect.* 31(4):183-91.
- Uganda Bureau of Statistics (UBOS) and Macro International Inc. (2007). Uganda Demographic and Health Survey 2006. Uganda Bureau of Statistics and Macro International Inc., Calverton, Maryland, USA.
- World Health Organization (2011). Unsafe abortion: global and regional estimates of the incidence of unsafe abortion and associated mortality in 2008, 6th Edition. Department of Reproductive Health and Research, World Health Organization.

Full Length Research Paper

Assessment of water quality and its effects on the health of residents of Jhunjhunu district, Rajasthan: A cross sectional study

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Achieving efficient, effective and cost effective water purification methods for the community is the key to human survival and development, as water management is a current global concern. Water is the basic resource necessary for sustaining all human activities, so its provision in desired quantity and quality is of utmost importance. Water pollution affects drinking water, rivers, lakes and oceans all over the world, which consequently harms human health and the natural environment. The present cross-sectional study is focussed on measuring the quality of drinking water in rural areas of Jhunjhunu district, Rajasthan and its effects on human health as told by the people living in these areas. Various analyses including physical, chemical and microbiological assessment were carried out on the water samples collected from the villages. The samples were found to have high pH, indicating alkalinity of the water samples, and high chromium content. Microbiological quality was also questionable in most of the cases. On the contrary to these findings, majority of people living in these areas were not suffering from various water borne diseases. So the study argues about the need and importance of water purification and water management systems in current times.

Key words: Water quality, chromium, cross sectional study, microbiological.

INTRODUCTION

Water covers over 71% of the earth's surface and is a very important natural resource for people (National Environment Research Council, 2007). Yet, only 2.5% of the earth's water is fresh and thus suitable for consumption. Not only that, but of that 2.5%, more than two-thirds is locked away in glaciers and not particularly able to help meet the growing demands of society (Ward, 2003). It is the fundamental right of every individual to get pollution free water. Water pollution affects drinking water, rivers, lakes and oceans all over the world, which consequently harms human health and the natural environment. Water pollution include sewage and waste water, industrial waste, oil pollution, marine dumping, atmospheric deposition, radioactive waste, underground

storage leakages, global warming, eutrophication etc. (Gambhir et al., 2012).

Water pollution may not cause immediate effect on the health of the individual but can prove fatal in the long run. Heavy metals from industrial processes can accumulate in nearby lakes and rivers, proving harmful to the marine animals, other animals consuming this toxic water and humans using animal products. Toxins in industrial waste can cause immune suppression, reproductive failure or acute poisoning. Microbial pollutants from sewage often result in infectious diseases like cholera and typhoid fever which are the primary cause of infant mortality (Water Pollution Guide, retrieved from <http://www.water-pollution.org.uk/economy.html>). Water pollution can be

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Table 1. Indian data and statistics.

Year	No. of diarrhoeal deaths in 0-6 years	No. of diarrhoeal deaths in 6+ years
2006	1,68,896	3,15,818
2011	1,81,986	3,40,296
2016	1,95,046	3,64,716

Source: National Commission on Macroeconomics and Health, Ministry of Health and Family Welfare, Government of India, 2005).

damaging to the economy as it can be expensive to treat and prevent contamination. Waste that does not break down quickly accumulates in the earth's waters and eventually makes its way to the oceans (Water Pollution Guide) Table 1.

Diarrhoeal diseases represent a major health problem in developing countries and also a high risk to travellers who visit these countries. Conservative estimates place the global death toll from diarrhoeal diseases at about two million deaths per year (1.7 to 2.5 million deaths), ranking third among all causes of infectious disease deaths worldwide (World Health Organization, 2012). Most of these deaths occur in children under five years of age. An average morbidity attack rate of 3.2 episodes of diarrhoea per year per child has been reported, but in some settings in developing countries, this number can be as high as 12 episodes per year per child (World Health Organization, 2012) Table 1.

Evidence has been accumulating for long-term consequences of such heavy disease burden in early childhood, on physical and mental development of children that may eventually translate into costly impairment of human fitness, and productivity at an adult age. Moreover, outbreaks of cholera, shigellosis and typhoid fever most often occur in resource-poor countries, adding to the burden of disease among the most vulnerable such as refugees, internally displaced populations and groups living in shanty towns (World Health Organization, 2012).

Water pollution can be prevented by stopping pollutants from contaminating nearby waters. There are a number of water treatments to prevent pollution such as biological filters, chemical additives and sand filters. These simple techniques cost money to maintain, but prevention is much cheaper than cleaning up water pollution that has already occurred (World Health Organization, 2012). Keeping the above facts in mind, this study was carried out to assess the water quality of villages of Jhunjhunu district, Rajasthan and its effect on the health of individuals pertaining to water borne diseases.

METHODOLOGY

Study area

A cross-sectional study was carried out in villages Bangothri khurd, Bangothri kalan, Chapra to assess the health status of the individual

pertaining to water borne diseases in the rural areas of Rajasthan.

Study tool

In total, 200 participants were interviewed with the help of a self designed pre-tested semi-structured questionnaire. Prior to the interview, informed consent was obtained from the participants. Questionnaire was designed to elicit descriptive accounts of the informants' everyday life, water usage, water storage habits, personal hygiene habits and experiences with diseases. Data collected was statistically analyzed using Statistical Package for Social Sciences (SPSS 10).

Study period

The study was carried out in a period of 4 months that is, August, 2009 to November, 2009. The study started with the collection of water samples from the villages, with the help of sterilised test tubes. For the microbiological sampling, water samples were brought to the laboratory in clean sterile test tubes and analysed within 24 h. These samples were taken from common water sources, that is, from where the whole village gets its water supply. So, testing water samples from these common sources like water tank, tube wells, wells, and common water taps, would serve the purpose and save resources.

To ascertain the physical, chemical and microbiological quality of drinking water of the selected villages, a total of 9 water samples were collected, one from the households (selected randomly), one from common taps (selected randomly) and one from the water tanks of each village. The household sites were chosen randomly using a random sampling technique. Physical parameters were measured directly at the water surface by conventional methods. Standard photometric analysis was employed for determination of chemical concentration of copper, chromium and Zinc. Microbiological assessment using Nutrient agar and MacConkey agar were used for presumptive and confirmed coliform counts, using the colony count and most probable number techniques.

RESULTS

The age distribution of people interviewed is given in Table 2. The education status of the population is given in Figure 1. According to the data collected, most of the subjects were illiterate (41%) or below metric pass (38%), so the level of literacy was very poor among the subjects under study.

Monthly income of the subjects

Majority of the subjects (65.0%) were from lower

Table 2. Age distribution of the subjects.

Age group	Percentage
16-20	10.5
21-25	28.5
26-30	17.0
31-35	14.5
36-40	10.0
41-45	5.5
46-50	5.0
51-55	2.5
56-60	6.5

socio-economic group, earning a monthly salary of 0 to 5,000 rupees only. Mean salary of the studied population was Rs. 5,175 only.

Sources for drinking water

Various sources for drinking water were tap (15.5%), well (13.0%), tube well (13.0%), and community water source supply (58%). Methods used for purification of drinking water included boiling (4.0%) and muslin cloth (7.5%), while 88.5% did not use any method for purification of drinking water.

Storage of drinking water

During storage of drinking water also, they did not use any precaution particularly. About 92.5% stored water in earthenware pots, 6.5% in stainless steel containers, 0.5% in plastic buckets as indicated in Figure 3. Most of them did not use any separate glass for taking out water from the containers in which water was stored. Inhabitants of the village, especially children, did not use basic hygiene measures like washing hands before taking out water from the storage container. Most of the villagers informed that they wash their water-storage utensil once a month while some of them washed it once every 2 to 3 months. Most of them were not aware of various precautions to be taken before and after storing water and to prevent water-borne diseases.

Medical illness of the subjects

About 20% suffered from medical illnesses like diarrhoea, vomiting, headache, stomach ache, dizziness, fever etc. while 80% did not have any such symptoms as shown in Figure 2.

Laboratory results

Physical, chemical and microbiological test results are shown in Table 3. Most probable numbers (MPN) is a

suitable and widely used method to determine the extent of microbiological quality of water. Most of the villages showed infinite number of microbial content, with the worst being Chapra village. This might be due to the favourable conditions like temperature, pH etc. High value of MPN indicates that water is not suitable for drinking purpose. Most bacteria grow between pH 4 to 10 and exhibit optimum growth in the range of pH 6.5 to 7.5.

DISCUSSION

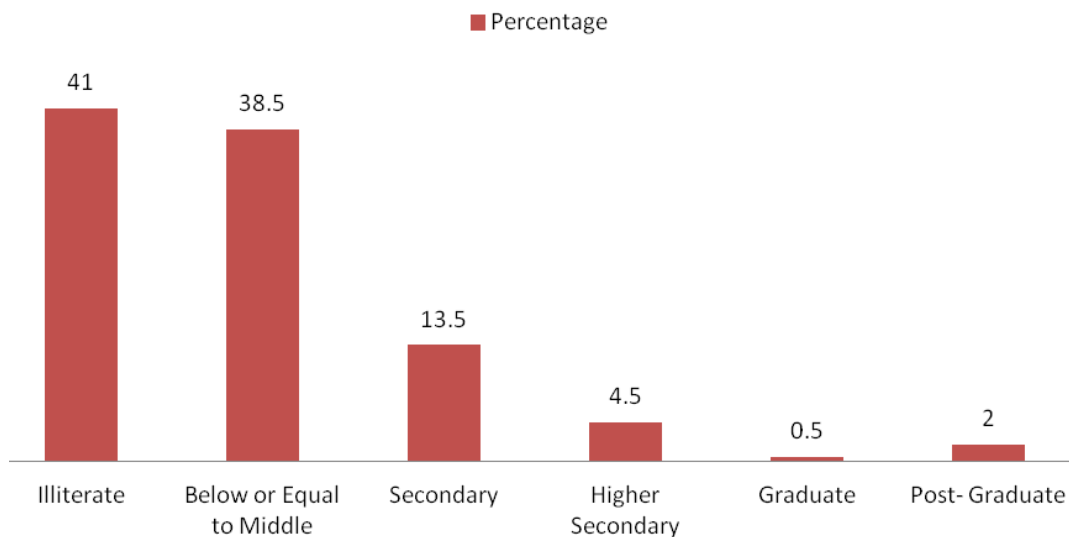
The villages Chapra, Bangothri Kalan and Bangothri Khurd have around 472, 476 and 550 households, respectively. The district has a population of 2,139,658 (2011 census), an area of 5,926 km², and a population density of 361 persons per km². Jhunjhunu district is supplied by mainly Sekhawati basin, and north western part falls under the basin, that is having inland drainage (Ministry of Water Resources, Government of India, 2008). Depth of ground water is between 20 m to 100 m, mostly observed in areas located to the west of Aravalli ranges covering Barmer, Jalore, Jhunjhunu, Sikar, Nagaur, Churu, Jaisalmer, Sirohi, Jodhpur, Bikaner, Jaipur, Hanumangarh and Dausa districts, served mainly by Kantli River (Ministry of Water Resources, Government of India, 2008). The region receives an annual rainfall of about 300 to 500 mm (Government of Rajasthan, 2009). As shown in the result of the above study also, the ground water is alkaline type, having pH value more than 7.

In India, majority of the rural population (approximately 72%) does not use any method of water disinfection and have no sanitary toilets (74%) (International Institute for Population Sciences (IIPS) and Macro International, 2007). Open air defecation is also a common practice among villagers, and may lead to contamination of the water supply system resulting in outbreaks of diarrheal diseases (Bora et al., 1997; Sarkar et al., 2007). According to the above study also, majority of villagers (88.5%) did not use any method for purification of drinking water and had poor knowledge about the need and availability of safe drinking water.

The commonest form of disinfection in rural India is single-point chlorination, using bleaching powder. However, this may not be effective because of the possibility of multiple sites of contamination (Propato and Uber, 2004). Alternative point-of-use disinfection methods such as solar water treatment (Kang et al., 2006; Rose et al., 2006) or point-of-use chlorination (Arnold and Colford, 2007) and storage of water in narrow-mouthed vessels (Mintz et al., 1995), need to be explored. Considering the contamination of all water samples at the household level, end-user disinfection with chlorine is likely to be more effective in such settings (Clasen et al., 2006) and it should be according to the WHO standards (World Health Organization, 1993). It has been estimated that diarrheal morbidity can be reduced by an average of 6 to 20% with

Table 3. Physical parameters.

Characteristic	Chapra villages	Bangothri khurd	Bangothri kalan
Taste	Agreeable	Agreeable	Agreeable
Odour	Unobjectionable	Unobjectionable	Unobjectionable
Temperature (°C)	26.5	27	27.5
Turbidity	No turbidity	No turbidity	No turbidity
Clarity	Clear	Clear	Clear
Chemical assessment			
pH	8.763	8.232	8.367
Heavy metal			
Copper (ppm)	Nil	Nil	Nil
Chromium (ppm)	0.117	0.110	0.078
Zinc (ppm)	0.258	0.277	0.233
Microbiological assessment			
Villages	Nutrient agar (Colonies/100 ml of water)	Mckonkey agar (Colonies/100 ml of water)	
+Control	Infinite	Infinite	
-Control	Nil	Nil	
Chapra village	Infinite	Infinite	
Bangothri Khurd	8	Nil	
Bangothri Kalan	Infinite	8	
Pond water	Infinite	Infinite	

**Figure 1.** Educational status of the subjects.

improvements in water supply and by 32% with improvements in sanitation (World Health Organization, 2004). Educating people and mass media campaigning can be used to popularize these methods. However,

sustainability of these methods over longer periods or cost-effectiveness in rural India is still questionable. In the present study, use of chlorine for water purification was not prevalent.

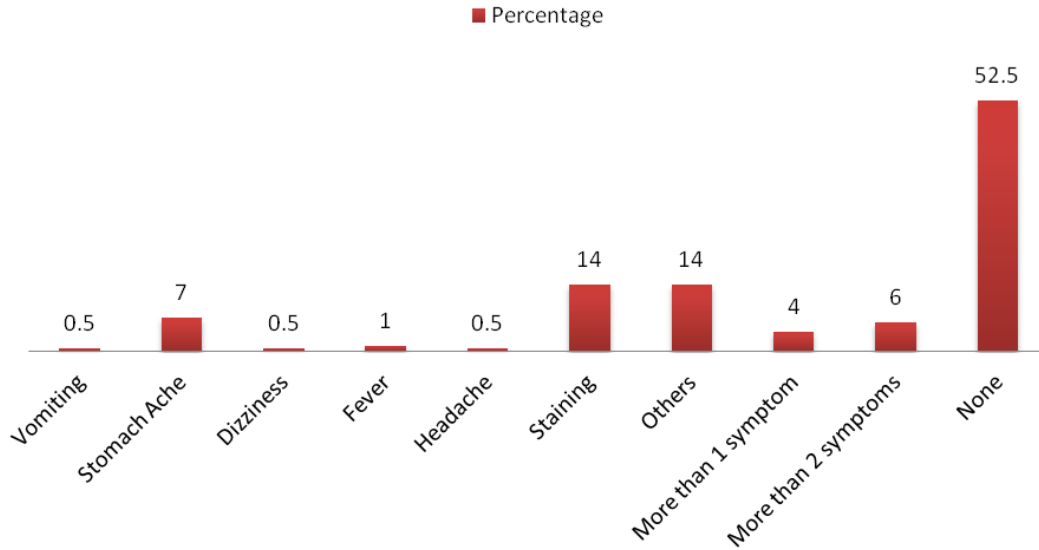


Figure 2. Past medical history of the subjects.

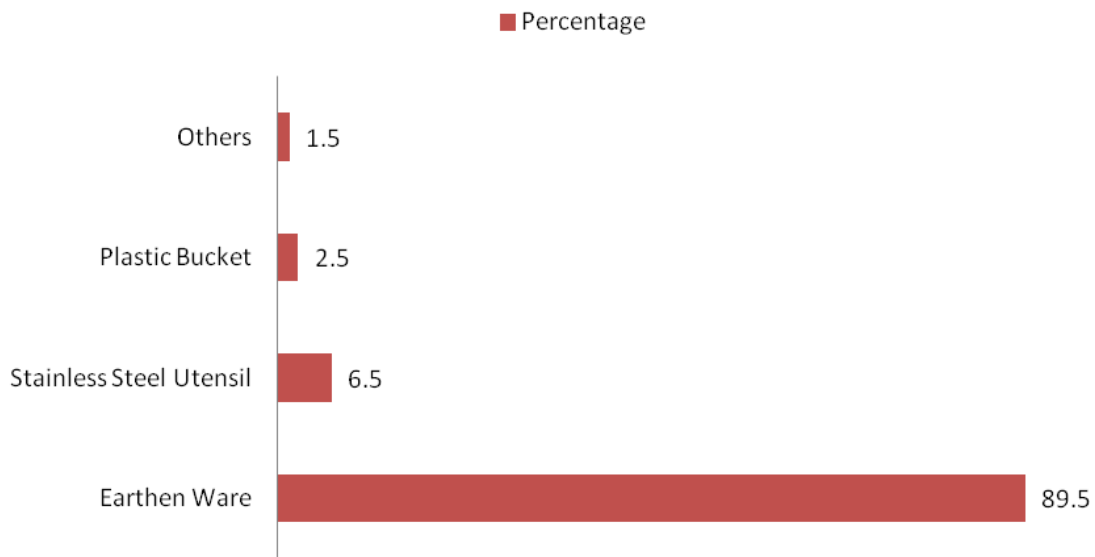


Figure 3. Storage of drinking water.

The study villages had no organized sewage system, open drains were common site and there was localized collections of waste water. Animal faecal matter was interspersed around houses (where animals were tethered), and on the streets. Children were seen defecating on the streets. Also at certain points, faeces were visible in the sewage drains and around the localized waste water collection spots. There was no system for collection and disposal of garbage. In certain places, garbage was inseparable from human and animal faeces, so the chances of diarrheal diseases were even more, but on the contrary 80% of people living in these villages

did not report any symptom of diarrheal diseases. The reasons for this may be that they have developed immunity towards various water-borne bacterial and viral infections. The other reason could be that people are unaware about these symptoms, their relevance and why reporting these symptoms is important. So their ignorance about these symptoms and diseases could have been responsible for under reporting of the same.

The study also indicated that the accumulation of heavy metals over large areas and long periods of time resulting in gradual damage to living organisms necessitates careful monitoring of the input, movements and effects of

such pollutants (Ida, 2012). Other studies also came out with similar results like a study of drinking water quality of desert affected area of Jhunjhunu district in Rajasthan which was carried out to find out water pollutants and to test the suitability of water for drinking and irrigation purpose in study area. In this study, it was found that nitrate fluoride and total dissolved solids (TDS) were higher, and water of study area was found to be hard (Literature Review).

In the study on heavy metal contamination in ground water at outer skirts of Kota city, Rajasthan India, researchers analyzed 72 ground water samples for determination of contamination level of Fe, Pb, Ca, Zn, Mn, Cr, and it was found that lead and chromium concentrations were high (Patil and Ahmed, 2011).

Zinc

Zinc is a very essential micronutrient in human being but if at very high concentrations, it may cause some toxic effect. Zinc compounds are astringent corrosive to skin, eye and mucous membranes. They cause special types of dermatitis known as "Zinc pox". Zinc is also irritating to digestive tract, causing nausea and vomiting. The maximum permissible concentration of zinc in drinking water is 15 ppm according to World Health Organization (WHO). The values of zinc content in all water samples of the study were below the maximum permissible limit according to WHO (1996) norms (Patil and Ahmed, 2011).

Chromium

Chromium is also essential to organisms as a micronutrient, in traces from fat and carbohydrate metabolism. Chromium is also more harmful in its lower oxidation state (III). Chromium and chromates are potential carcinogens. The limit of chromium in drinking water is 0.01 ppm according to WHO. The values of chromium content in all water samples were higher than maximum permissible level according to WHO (1996) norms. This is a serious health risk and should be looked upon by the concerned authorities (Patil and Ahmed, 2011).

The limitations of study are the low sample size of the study; fluoride, chlorine and other heavy metals levels were not tested due to resource constraints. Long term effects of these results were not studied in the sample population.

REFERENCES

Arnold BF, Colford JM (2007). Treating water with chlorine at point-of-use to improve water quality and reduce child diarrhea in developing countries: a systematic review and meta-analysis. *Am. J. Trop. Med. Hyg.* 76:354-64.

- Clasen T, Roberts I, Rabie T, Schmidt W, Cairncross S (2006). Interventions to improve water quality for preventing diarrhoea. *Cochrane Database Syst. Rev.* 3:CD004794.
- Bora D, Dhariwal AC, Jain DC, Sachdeva V, Vohra JG, Prakash RM, Datta KK, Sharma RS (1997). *Vibrio cholerae* O1 outbreak in remote villages of Shimla district, Himachal Pradesh, 1994. *J. Commun. Dis.* 29:121-5.
- Gambhir R, Kapoor V, Nirola A, Sohi R, Bansal V (2012). Water Pollution: Impact of Pollutants and New Promising Techniques in Purification Process. *J. Hum. Ecol.* 37(2):103-109.
- Government of Rajasthan (2009). Environmental Management Guidelines and Action Plan of SWRPD for Water Sector in Rajasthan. Rajasthan, India.
- Ida J (2012). Heavy Metals in Suchindramkulam (a Lentic Water Body) of Kanyakumari District, Tamil Nadu, India. *J. Theoretical Experimental Biol.* 141-145.
- International Institute for Population Sciences (IIPS) and Macro International (2007). National Family Health Survey (NFHS-3), 2005-06, India.
- Kang G, Roy S, Balraj V (2006). Appropriate technology for rural India - solar decontamination of water for emergency settings and small communities. *Trans. R. Soc. Trop. Med. Hyg.* 100:863-6.
- Literature Review. Retrieved from: http://shodh.inflibnet.ac.in/bitstream/123456789/318/3/03_literature%20review.pdf.
- Mintz ED, Reiff FM, Tauxe RV (1995). Safe water treatment and storage in the home. A practical new strategy to prevent waterborne disease. *JAMA* 273:948-53.
- Ministry of Water Resources, Government of India (2008). Ground Water Brochure. Jhunjhunu District, Rajasthan. India.
- National Commission on Macroeconomics and Health, Ministry of Health and Family Welfare, Government of India (2005). Burden of disease in India. New Delhi, India.
- National Environment Research Council (2007). The Oceans: Scientific certainties and uncertainties. Swindon, England.
- Patil G, Ahmed I (2011). Heavy metals contamination assessment of Kahargaoon dam water near Chhindwara City. *Acta Chim. Pharm. Indica* 7-9.
- Propato M, Uber JG (2004). Vulnerability of water distribution systems to pathogen intrusion: how effective is a disinfectant residual? *Environ. Sci. Technol.* 38:3713-22.
- Sarkar R, Prabhakar AT, Manickam S, Selvapandian D, Raghava MV, Kang G, Balraj V (2007). Epidemiological investigation of an outbreak of acute diarrhoeal disease using geographic information systems. *Trans. R. Soc. Trop. Med. Hyg.* 101:587-93.
- Rose A, Roy S, Abraham V, Holmgren G, George K, Balraj V, Abraham S, Muliylil J, Joseph A, Kang G (2006). Solar disinfection of water for diarrhoeal prevention in southern India. *Arch. Dis. Child.* 91:139-41.
- Ward A (2003). Weighing Earth's water from Space. In NASA Earth Observatory.
- Water Pollution Guide. Retrieved from <http://www.water-pollution.org.uk/economy.html>
- World Health Organization (1993). Guidelines for cholera control. World Health Organization, Geneva.
- World Health Organization (2004). Water Sanitation and Hygiene Links to Health Facts and Figures. WHO, Geneva. Retrieved from: http://www.who.int/water_sanitation_health/factsfigures2005.pdf.
- World Health Organization (2012). Diarrhoeal Diseases. WHO, Geneva. Retrieved from: http://www.who.int/vaccine_research/documents/DiarrhoealDiseases20091122.pdf

Full Length Research Paper

Impact of community health educators on the nutrition of children in Gaza province, Mozambique

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Twenty six percent of children with protein-energy malnutrition live in Africa. This study determines whether Care Groups (CG) in collaboration with Community-based Health Educators (CHE) help reduce malnutrition in children between 0 and 23 months of age. A total of 299 caregivers at baseline (2004) and 380 at follow-up (2007) were interviewed using a structured questionnaire. Caregivers were between 12 and 49 years (mean 26.9 years standard error (SE)=0.33, 95% confidence interval (CI):26.3 to 27.6). Data was analysed with STATA version 10. A two-sample t-test was used to compare the findings while logistic regression analysis was used to test the association between outcome variables and predictor variables. Underweight children decreased from 16.3% at baseline to 7.6% at follow-up, fluid intake during diarrhoea episodes increased from 4.6 to 16.1%, exclusive breastfeeding increased from 91.9 to 95.2%, children attended by skilled health personnel at birth increased from 45.2 to 72.8%. Dehydrated children were 1.61 times more likely to be taken to hospital. Children weighed in the previous three months were 1.3 times more likely to have received food with marula nuts added to it. The world relief project appears to have improved caregivers' knowledge and behaviour regarding child nutrition in Gaza province of Mozambique.

Key words: Community health workers, care group (CG), baseline, follow-up, malnutrition, underweight, dehydration, Mozambique.

INTRODUCTION

Malnutrition is associated with 60% of all deaths among children under five years old in low-income developing countries (UNICEF, 2007). More than one-quarter of malnourished children live in Africa. Malnutrition impedes development of an adequate immune system and thus predisposes children to illness from opportunistic diseases like malaria, diarrhea, and pneumonia (WHO, 2005). Moreover, general malnutrition and specific micro-nutrient deficiencies hinder children's development, learning capacity, child morbidity and complications during

and after birth among women. When diet is exclusively driven from a single source like corn or rice all the time, we dispose ourselves to malnutrition. This may either be caused by a lack of education about proper nutrition, or from only having access to a single food source (Dennill et al., 1999). Malnutrition can be derived from health issues such as gastroenteritis or chronic illness like the HIV/AIDS pandemic. Diarrhea is another infection that can cause malnutrition in instances like decreased intake of food, decreased nutrient absorption, increased metabolic

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requirements, and direct nutrient loss. Furthermore, parasite infections can also lead to malnutrition (Baro and Deubel, 2006).

Child malnutrition has many roots, including inadequate food supply, limited family purchasing power, poor environmental health conditions, and inadequate parental knowledge about nutrition and health. Inadequate breastfeeding leads to malnutrition in infants and children and is associated with the deaths of an estimated one million children annually (Afreen et al., 2000). Illegal advertising of breast milk substitutes continues three decades after its 1981 prohibition under the WHO International Code of Marketing Breast Milk Substitutes and this continuously contributes to malnutrition (WHO, 1981).

Low birth weight is 10 to 13% (< 2.5 kg) in the six Southern African countries including Mozambique and usually children grow well for the first few months. At the age of three, the prevalence of underweight is around 30% (at < -2 standard deviation (SD), weight-for-age); stunting (< -2 SD height-for-age) is around 50% and wasting (< -2 SD weight-for-height) is 5 to 10%. Mozambique showed worsening of wasting from 2000 to 2002, while underweight showed no consistent pattern during this time period (UNICEF, 2003). In Mozambique, high levels of wasting were at 14% in December, 2002. A major deterioration in wasting was seen in Gaza province (3.5% to 14%) before this study was conducted.

Child malnutrition continues to be a vexing public health problem in developing countries, and fighting malnutrition through education and behavior change is a cornerstone of anti-poverty efforts in these areas worldwide (ACC/SCN, 1988).

Mozambique ranks among the highest countries in the world with infant, early childhood, and maternal mortality (DHS, 2003), with only 30% of the population having access to health services. Nationally, 44% of deaths among children <5 years old are nutrition related. Despite increasing levels of economic growth, malnutrition worsened substantially in Mozambique between 1997 and 2006, and the proportion of children <5 years old suffering from malnutrition increased from 36 to 46% over the decade. Gaza province, in Southern Mozambique, has a population of 1.2 million, high rates of poverty, and especially, high malnutrition and child and maternal mortality. Poor nutrition and hygiene practices have been linked with continuous malnutrition among children between 0 and 23 months of age. In 2003, 30% of children <2 years old in Gaza province were malnourished, almost 16% were underweight, and almost 10% were assessed to be wasted.

Maternal nutritional practices in Gaza province were poor due to lack of knowledge among caregivers (World Relief Mozambique, 2005). Exclusive breastfeeding was a neglected practice due to taboos that involved weaning a child when a mother becomes pregnant. The expected

increase in feeding frequency and giving foods with micronutrients to children were overlooked by caregivers because children did not receive three nutrient balanced meals per day. In addition, most women living in Gaza province were unaware of the importance of immunization for their children and themselves when they were pregnant.

To address the persistent problem of malnutrition among young children in Gaza province, the World Relief's Vhuronga Expanded Impact Child Survival Program (VEICSP) intervened in December, 2004 and focused on both child and maternal nutrition. The programme's goal was to scale up the Care Group Model (CG) for child survival with the following objectives: (1) strengthen the capacity of the health system to improve quality and coverage of Integrated Management of Child Illnesses (IMCI) through training and supervision and by establishing effective health information systems; (2) develop sustainable community based mechanisms to improve prevention and care seeking practices for IMCI; and (3) improve child feeding practices to reduce malnutrition.

The overall objective of this study was to determine whether the community health system that is supported by Community-based Health Educators (CHEs) can reduce malnutrition in Mozambique. This study looked for ways to foster a sustainable community based nutrition mechanism that is supported by a CG Model.

METHODOLOGY

The current study is a secondary analysis of data collected as part of the World Relief's Vhuronga Expanded Impact Child Survival Program (VEICSP). This study examined only data on the effects of the CG Model and CHEs using "before and after" intervention data collected in the cross-sectional survey conducted in 2004 and 2007.

Participant selection

The target population was caregivers of children of 0 to 23 months of age residing in Gaza province during September, 2004 and September, 2007. Researchers selected the two cross-sectional samples separately using Lot's Quality Assurance (LQAS) methodology (Valadez and Devkota, 2002). Given the target population of 247,146 in Gaza province and the presence of 20 supervision areas (intervention areas), calculations specified a total sample of 299 at baseline and 380 at follow-up to be representative of Gaza province. This translated into 19 households to be selected from each supervision area (SA). Researchers selected households by visiting the centre of each supervision area, gathering mothers in a circle, spinning a bottle, and selecting the caregiver to whom the bottle pointed if she had a child of 0 to 23 months old. This procedure was conducted until a total of 19 caregivers were interviewed in that SA. Researchers then moved to the next supervision area and repeated the steps mentioned earlier. Only one caregiver and one youngest child per household were selected. For caregivers who had twins, only one child was chosen by randomly picking one piece of paper with numbers 1 or 2 written on either of them.

CG intervention

The CG intervention strengthens the health infrastructure through training CHEs to improve nutrition of children and manage child illnesses. VEICSP implemented the project in Gaza province by first collecting baseline data in 2004. The project aimed to reduce child morbidity and mortality in the province where malaria, pneumonia, malnutrition and diarrhoea were dominant. The intervention addressed appropriate dietary management and counselling for the sick child according to the Integrated Management of Childhood Illness (IMCI) guidelines which include: continuing to breastfeed during illness; feeding the child with more food during illness and for two weeks following illness; feeding the child with fluids during illness; and prompt referral if the child exhibits danger symptom of vomiting and inability to drink or eat. The project encouraged regular attendance of the caretakers and children for weighing, educating and counselling pregnant women to consume more food during pregnancy and take iron supplements Underwood,1983; Mandomando et al.,2007).

The CG training program included community interventions with a focus on: diarrhoea prevention, nutrition, immunization, hygiene and sanitation and pneumonia prevention (Laughlin, 2008; Partners in Health, 2007). Training sessions for each intervention area lasted 2 weeks. For diarrhea prevention (Sebedo et al.,1977), the curriculum covered causes of diarrhea and its possible prevention measures. Good nutrition practices and prevention of malnutrition were covered in nutrition lessons. Growth monitoring (GM) including the importance of immunization for children between 0 and 23 months of age were a teach and practise activity among caregivers. Hygiene in homes, use of clean water and prevention of pneumonia in children were among the most important topics included in the curriculum. The training procedure involved a group of 10 to 15 caregivers with children between 0 and 23 months of age. In return, the trained caregivers would each train ten more mothers in the same topics thereby increasing coverage. All lessons were taught by community health workers using flip-charts with bold pictures and inscriptions that described each picture. Pictures were widely used because they helped in transferring messages to the rural, illiterate populace and the method proved to be useful and friendly. The 10 to 15 caregivers regularly meet together with project staff for training, supervision and support.

Measures and data collection protocol

Survey

A survey was conducted in December, 2004 to obtain baseline demographic information and information on community taboos and beliefs about child nutrition and caregiver care-seeking practices for their sick children. The survey was readministered in 2007 to obtain information on the progress of the intervention. The survey questionnaire consisted of 49 questions and caregivers of children under two years of age were interviewed in the local language (Changaana). Response categories were binary (that is, yes or no) and ordinal (e.g., amount of food taken during pregnancy=less than usual, usual, more than usual).

Clinical measures

Child malnutrition status was assessed by CHEs in households in the intervention area. Malnutrition was determined using a measure of child underweight status. The cut-off point of underweight was based on the WHO maxim equation of weight for age measurement index which shows mild [$-2SD > WAZ \geq 1 SD$] to moderate [$-3SD > WAZ \geq 2 SD$] level of malnutrition (WHO: Child

Health at a glance; March 2002).

Data analysis

Two-pronged analyses were conducted using STATA version 10 statistical package. Two-sample t-test was conducted on baseline and follow-up data basing on answers given to questions in the questionnaire to determine changes in mothers' knowledge and practice in nutrition, illness management, and GM, and in care-seeking behaviours over the intervention period. This was followed by a multivariate logistic regression to determine predictors of practice and behaviour change caused by the CG Model through the use of CHEs involving caregivers who have children between 0 and 23 months of age with an aim to reduce malnutrition.

For the two-sample tests of proportions, the following dependent variables were studied: dehydration danger sign, underweight, weight in the last three months, dehydration and mother's education that intended to change mothers' behaviour after training them. Independent variables in the study included: highest level of education attained by the mother; breastfeeding at post-partum; liquid or food given to the child in the last 24 h; introduction of complementary foods; knowledge about signs of illness; liquids or foods given during a diarrhoea episode; diarrhoea treatment at home using porridge prepared from fermented maize flour; complete child immunisation; tetanus injection to pregnant women; and birth assisted by a skilled health personnel.

An analysis was performed in order to obtain the crude un-adjusted odds ratios and their 95% confidence intervals. The odds ratios were used to assess the association between the dependent variables and independent variable. Backwards stepwise regression was performed starting with a full model, including interaction terms. Variables that were the least significant were removed one after the other. Each variable removal was followed by a likelihood ratio test (lrtest). The lrtest evaluated whether removal of a variable improved the model or not, the aim being to end up with the simplest possible model which best predicts the outcome. The same modelling process was followed in building all the logistic regression models in this study. Post-regression analysis was used to evaluate the models.

Tests of goodness of fit (GOF) were performed using the Pearson's GOF, the Hosmer and Lemeshow's GOF and the analysis of area under the receiver operating characteristic (ROC) curve.

RESULTS

Characteristics of caregivers and households of children of 0 to 23 months of age

The demographic characteristics of caregivers at baseline and follow-up are shown in Table 1. The caregivers were all female and mostly between 12 and 49 years of age with mean age of 26.9 years (SE=0.33, 95% CI:26.3 to 27.6) both at baseline and follow-up. Caregivers of age 12 to 17 years comprised 5% of the sample at baseline and 3.4% at follow-up. Caregivers 18 to 35 years old comprised 84% of the sample at baseline and 86% at follow-up. Fewer women at follow-up (38%) compared with baseline (68%) reported that they had completed primary education and could read and write. The percentage of caregivers who reported they had

Table 1. Socio-demographic characteristics of caregivers and households of children of age 0 to 23 months for baseline and follow-up surveys.

Characteristic	Baseline (n=299)	Percent	Follow-up (n=380)	Percent
Age of mother (years)				
12-17	15	5	13	3.4
18-35	252	84	326	86
36-49	32	11	40	11
50+	0	0	1	0.3
Children under 5 living in the household				
HH = 1 child	125	42	119	31.3
HH = 2 children	106	35	174	46
HH = 3 children	36	12	47	12.4
HH ≥ 4children	32	11	40	11
Mother's biological children				
Mother = 1	183	61	217	57
Mother = 2	113	38	158	42
Mother = 3	3	1	4	1.1
Mother ≥ 4	0	0	1	0.3
Mother's level of education				
Primary, but cannot read	38	23	50	13.2
Primary, can read	114	68	145	38.2
Secondary and higher	15	9	34	8.9

completed secondary education was the same (about 9%) at baseline and follow-up.

Baseline and follow-up indicators for children between 0 and 23 months of age

Table 2 shows results of the comparison between baseline and follow-up data. The percentage of underweight children decreased from 16.3 to 7.6% at follow-up while fluid intake during diarrhoea episodes increased from 4.6 to 16.1% at follow-up. Exclusively breastfed children were 91.9% at baseline and 95.2% at follow-up. Children who were attended to by skilled health personnel increased from 45.2 to 72.8% at follow-up. DPT3 coverage was 48.8% at baseline and 62.8% at follow-up while proper administration of oral rehydration salts (ORS) during a diarrhoea episode increased from 29% at baseline to 67.11% at follow-up. Nutrition counselling increased from 2.3 to 80.6% at follow-up.

Factors associated with underweight and immunisation among children of 0 to 23 months of age

The model revealed that newly born underweight children

delivered in a health facility were 4.4 times more likely to receive Bacille Calmette Guerin (BCG) vaccine than those who were not delivered in a health facility. Children who were underweight in the follow-up study were 77% less likely to receive Polio 0 than those who were not underweight. The Diphtheria Tetanus and Pertussis (DPT)1 odds ratio showed that children in the study who were underweight were 97% less likely to receive the vaccine than those who were not underweight. The DPT2 vaccine odds ratio reveals that those children who were underweight in the study were 22.4 times more likely to receive DPT2 vaccine than those who were not underweight after controlling for other variables in the model. The DPT3 odds ratio showed that children in the study who were underweight were three times more likely to receive DPT3 vaccine than those who were not underweight after controlling for other variables in the model. The measles odds ratio showed that children who were underweight in the study were 60% less likely to receive measles vaccine than those who were not underweight. Furthermore, children who were underweight were 1.84 times more likely to receive Vitamin A capsules, 1.80 times more likely to have had complete immunisation, and 1.42 times more likely to receive Polio 3 vaccine than those who were not underweight, after controlling for other variables in the model. The tetanus

Table 2. Baseline and follow-up indicators for children of age between 0 and 23 months .

Indicator	Baseline (%)	Follow-up (%)	Difference (%)	CI- 95% of difference	p-value
Immunisation					
DPT1 Coverage (%)	78.2	81.5	3.3	(-2.0, 10.0)	0.12
DPT3 Coverage (%)	48.8	62.8	14	(8.0, 24.0)	0.00
Percent of children aged 12-23 months who received a measles vaccine	27.42	41.32	13.90	(7.0, 22.0)	0.00
Nutrition					
Percent of currently breastfed children	91.9	95.2	3.3	(-0.00, 6.00)	0.06
Percent of children who received complementary feeding	16.2	15.3	-0.9	(-10.0, 4.0)	0.44
Percent of children weighed regularly in growth monitoring (GM)	76.9	87.4	10.5	(5.0, 17.0)	0.00
Percent of children of age 0-23 months who are underweight (-2SD from the median weight-for-age)	16.1	7.6	-8.7	(-14.0, -3.0)	0.00
Percent of caregivers of malnourished children who received nutrition counselling	2.34	80.6	78.26	(56.0, 93.0)	0.00
Diarrhoea					
Percent of sick children of age 0-23 months who received increased fluids during illness	4.6	16.1	11.5	(9.0, 18.0)	0.00
Percent of children with diarrhoea treated with ORS	29	67.11	38.1	(30.0, 45.0)	0.00
Maternal care					
Percent of children of age 0-23 months whose births were attended by skilled health personnel	45.2	72.8	27.6	(25.0, 36.0)	0.00

injection odds ratio showed that caregivers with underweight children in the study were 23% less likely to receive the injection than those who did not have underweight children.

Factors associated with GM by caregivers among children between 0 and 23 months of age

A logistic regression analysis for factors associated with GM among children between 0 and 23 months of age was performed. The study revealed that at baseline, 16.11% of the children were $-2SD$ from the median weight-for-age, indicating underweight while follow-up results showed that 7.65%

of children were underweight. The outcome variable “weighed in the last three months” (Table 3) was analyzed to see if children were weighed regularly to guard against underweight. The outcome variable was analysed against two explanatory variables which were GM counselling and the use by caregivers of marula nuts in children’s food. “The GM counselling” variable looked at nutrition counselling by CHEs to caregivers. “GM using marula nuts” looked at how the caregivers were involved in using marula nuts in the daily improved feeding practices using locally available food stuffs. The logistic regression model showed the effect of GM counselling and the use of marula nuts in feeding children. The odds ratio for

GM counselling is 2 and it indicates that children who were weighed in the previous three months were twice as likely to have caregivers who received GM counselling than those who had not been weighed in the previous three months. The marula nuts odds ratio shows that children who had been weighed in the previous three months were 1.3 times more likely to have received food with marula nuts added to it than those who had not been weighed in the previous three months.

Factors associated with underweight of children and maternal care for caregivers

In this study, pregnant caregivers were asked about

Table 3. Logistic regression analysis for growth monitoring, underweight of children and maternal care for caregivers, exclusive breastfeeding and caregiver's education and hand-washing among children of age 0 to 23 months.

Weight in last 3 months	OR	P-value	95% CI	
			Lower limit	Upper limit
Growth monitoring (n=31)				
Growth monitoring counselling	2	0.64	0.10	39.07
Growth monitoring marula	1.3	0.85	0.07	23.43
Maternal Care (n=374)				
Delivery by skilled personnel	0.79	0.60	0.33	1.88
Delivery by TBA	0.67	0.65	0.11	3.89
Eat food less than usual amount	1.25	0.71	0.37	4.20
Exclusive breastfeeding (n=379)				
Current breastfeeding	3.76	0.29	0.32	44.25
Breastfeeding only	0.23	0.16	0.03	1.82
Complementary feeding	2.09	0.07	0.92	4.76
Solid food	2.19	0.12	0.79	6.05
Complementary food-age	1.02	0.90	0.70	1.47
Hand-wash before food (n=380)				
Preparation	0.91	0.69	0.57	1.44
Hand-wash before feed child	1.06	0.80	0.64	1.75
Hand-wash after child defecates	0.97	0.89	0.61	1.53
Hand-wash after caregiver defecates	1.67	0.05	0.99	2.82

about the amount of food they eat. The outcome variable "underweight" (Table 3) and three explanatory variables were included in the final model. Explanatory variables included the delivery of caregivers' babies with the help of skilled health personnel, delivery with the help of traditional birth attendants (TBAs), and eating food that is less than usual by pregnant caregivers. The initial model was compared with the final model and the $\text{Prob} > \text{Chi}^2$ was equal to 0.7551. The p-value is greater than the significance level (>0.05). At baseline, 58.19% of caregivers mentioned that they ate less food than usual and at follow-up 21.32% reported that they ate less food than usual when they were pregnant. Nutrition counselling was 2.34% at baseline and 80.65% at follow-up, with p-value of 0.00. Caregivers delivered by the help of a doctor were 1.34% at baseline and 1.32% at follow-up. The odds ratio for delivery by skilled personnel indicates that children who were underweight were 21% less likely to have been delivered by skilled health personnel than those children who were not underweight, after controlling for other variables in this model. The odds ratio for deliveries attended by TBAs show that, children who were underweight were 33% less likely to have been delivered by TBAs at birth than those who were not underweight, after controlling for other variables in the model. Children who

were born underweight were 1.25 times more likely to have been born of caregivers who ate less food during pregnancy than the usual amount than those children who were not underweight, after controlling for other variables in the model.

Factors associated with underweight and exclusive breastfeeding among children between 0 to 23 months of age

Exclusive breastfeeding was based on the question that sought to find out if caregivers gave breast milk only to their children in the 24 h preceding the survey. Caregivers who gave water and breast milk to their children 24 h preceding the baseline study were 73.58% and follow-up study showed 24.21%. Baseline results show that 88.63% of caregivers exclusively breastfed their children and at follow-up, 95.00% of caregivers exclusively breastfed their children. A percentage of 28.43% of caregivers breastfed their babies within the first hour after giving birth at baseline and at follow-up, 45.82% of caregivers reported that they gave breast milk to their babies within the first hour after giving birth. Table 3 shows that children who were underweight were 77% less likely to

receive breast milk only than those who were not underweight, 2.09 times more likely to receive complementary foods than those who were not underweight, 2.19 times more likely to receive solid foods than those who were not underweight and 1.02 times more likely to receive complementary foods at the recommended age than those not underweight after controlling for other variables in the model, respectively.

Factors associated with caregiver's education and hand-washing

Caregivers who washed their hands before food preparation were 29.10% at baseline and 67.63% at follow-up. Those who washed their hands before feeding the child were 9.03% at baseline and 23.42% at follow-up with p-value of 0.00, which is statistically significant. Caregivers who washed their hands after the child defecated were 6.35% at baseline and 33.68% at follow-up. At baseline, caregivers who washed hands after they had defecated and before handling their children were 41.81 and 78.42% at follow-up. Hand washing with soap was 13.38% at baseline and 100% at follow-up with p-value of 0.00, and this is associated with adoption of the practice. A logistic regression analysis for the factors associated with caregiver's education and hand-washing was run (Table 3). The outcome variable in this model was "the mother's education". An analysis was performed between the outcome variable and four explanatory variables. When the logistic regression test (Irttest) was performed, the result was: $\text{Prob} > \text{Chi}^2 = 0.9115$, after removing the variable "hand-washing never" from the model. We failed to reject the null hypothesis that the two models are the same. Therefore, the removal of the variable from the model or keeping it in the model does not make much difference. However, the variable was removed from the model. The odds ratios give the following understanding of the study that: caregivers who were educated were 9% less likely to wash hands before preparing food; 1.06 times more likely to wash hands before feeding the child; 3% less likely to wash hands after the child defecates; and 1.67 times more likely to wash hands after they themselves defecate than those who were not educated.

Demographic characteristics of target age group (0 to 23 months old)

The age range of the target group was 0 to 23 months for both males and females and the mean age was 9.9 months (SE=0.34, 95% CI:9.3 to 10.6 with n=299 at baseline and n=380 at follow-up). The mean age was alike in both male and female children. The highest percentages for children at baseline were 36.79% for the

12 to 23 months and 36.45% for the 0 to 5 months age groups. The 6 to 11 months age group was 26.76% at baseline and was the lowest percentage.

At follow-up, 36.58% of the children made up the 12 to 23 months age group while 32.63% made up the 6 to 11 months age group. The 0 to 5 months age group at follow-up was 30.79%, which was the lowest category.

DISCUSSION

Prior studies found that erroneous sources of diet may be caused by a lack of education about proper nutrition, or from only having access to a single food source (Baro and Deubel, 2006). This study further proved that knowledge, practice and behaviour change due to CHEs' efforts using care groups of mothers with children between 0 and 23 months of age is associated with a tremendous reduction of malnutrition. The literature supports the fact that proper nutrition during pregnancy has also proved essential for the healthy growth and development of the fetus (Nancy et al., 2002). Health sciences also confirm how nutrition during lactation improves the quality and quantity of breast milk, which is the best food for the child in the first six months of that child's life (Sternin et al., 1998). This study found out that as children grow, their nutritional need exceeds that of the nutritional content of the mother's breast milk. This additional need can be addressed by providing appropriate supplementary food. In contrast, inadequate food during pregnancy and lactation by the mother and poor child feeding practices lead to poor physical growth, poor mental development and susceptibility to infection, which ultimately results in high morbidity and mortality, as observed among children in the developing world (Mulholland, 2005; Fenn et al., 2005). It is estimated that more than 60% of deaths among under 5 (U5) children in developing countries are associated with malnutrition (WHO, 2002; Berg, 1987; PAJPH, 2005)).

Breastfeeding, nutrition and factors associated with underweight

Inadequate breastfeeding leads to malnutrition in infants and children and is associated with the deaths of an estimated one million children annually (WHO, 1981). This study proved the fact that breastfeeding is acceptable by most caregivers and in some cases is fully practised for a period of six months after giving birth. Exclusively breastfed children feed on only the mother's breast milk and if and when given water in addition to breast milk, then those children are no longer exclusively breastfed. Exclusive breastfeeding (EBF) is recommended for the first four to six months of life of a born child. This helps to prevent diarrhoea by minimising

the infant's exposure to diarrhoeal pathogens, which are common in other foods and in water (Kenneth and Brow, 2005). In this study, the percentage of children (0 to 6 months of age) exclusively breastfed in 24 h diet recall increased by 6% between baseline and follow-up. The percentage of increase was associated with increased efforts by CHEs who operated in the project area, although the baseline figure is relatively high.

Adoption of EBF through information from friends in neighbouring project areas may have inflated the baseline figure. The rest of the children were given plain water (73.58% at baseline and 24.21% at follow-up). This is associated with the reduction of mothers who gave water instead of EBF, causing a rise in EBF in the project area. The study reveals a further increase in complementary feeding in children of 6 to 24 months of age when solid food is introduced in addition to breast milk. The percentage of children (6 to 24 months) who received complementary feeding in a 24 h diet recall was 69.90% at baseline and 66.84% at follow-up. The 2.06% reduction in percentage must have been caused by those mothers who adjusted from earlier introduction (3 to 4 months) of complementary foods to the exact recommended age (after 6 months). This may have given a shift in increase in caregivers who abided to the recommended period of introducing complementary foods. However, the observed universal breastfeeding practice should be encouraged, despite the fact that the high rate of poverty in Gaza province could affect the mother's own nutrition. The absence of other safe options to meet the nutritional needs of children makes breastfeeding mandatory to the survival of the child. More effort is needed to promote EBF during the first six months of the child's life.

Immunisation

Factors associated with immunization of children of 0 to 23 months of age

In Mozambique, children in poor households are half as likely to be fully vaccinated as children in best-off households (Instituto Nacional De Estadísticas, 2008).

Preventive health care practices are essential to the growth of children. The target population for infant immunization from both poor households and best-off households in this study was those children between 12 and 23 months of age. This study revealed overwhelming improvements in the follow-up coverage of DPT3 vaccination (14% increase from baseline), Polio 3 vaccination (12% increase from baseline), measles vaccination (14% increase from baseline), tetanus vaccination (19% increase from baseline) and reception of tetanus injection more than twice by caregivers (30% increase from baseline). Among the 368 children, 367

(99.7%) had immunization cards and 33.95% had complete immunization by one year of age. The p-values for all variables are statistically significant except for DPT1 (p-value 0.12>0.05). The statistical significance of the p-values of all, but one variable leads one to tentatively conclude that caregivers had changed their behavior in favor of child immunization.

Furthermore, 62.9% of the children who had reached their fifth month had immunization for DPT3 compared to 48.8% who received the injection at baseline. Immunization was accessible, with children receiving Polio 3 (51.8%) at baseline and 63.4% at follow-up, DPT 1 (78.3% at baseline and 81.6%) at follow-up. There was a continuous rise in coverage in immunization practices except for DPT1 (3% increase from baseline) where the increase in percentage was very low compared to other immunizations given. CHEs seemed to neglect DPT1 in their messages to the caregivers and attention is needed so that caregivers are encouraged to take children for DPT1 vaccination. Generally, the study shows that there was an increase in immunization coverage and that caregivers adopted the practice. It seems that caregivers know the benefits of getting their children immunized. The increased immunization trend also gives the impression that there was a good motivation amongst the caregivers and, on the other hand, stock-outs in hospitals and clinics seemed to be rare or non-existing. However, continuous motivation of caregivers to get their children completely immunized is needed. In general, there is a large proportion of participating children in preventive health care services, as demonstrated by the high immunization coverage.

Factors associated with GM in children of 0 to 23 months of age

GM without teaching and involving caregivers does not improve nutrition. Many programmes spend time weighing and using health charts because this is often easier than careful explanation to caregivers about how they can better feed their children (Lankester, 2000). This study agrees with Lankester (2000) since the results after involving CHEs and caregivers were progressive. The objectives of regular GM and community-based nutrition programmes, among others in this study were to monitor closely the nutritional status of children using GM cards, and to train mothers of malnourished children in proven child feeding, child caring and preventive health care practices through practical demonstration.

The percentage of underweight children identified through GM in this study was 16% at baseline and this was reduced by 8.46%. There was an increase by 3.68% of caregivers who used marula nuts in improved feeding practices. The percentage increase in the use of marula nuts is insignificant, especially if we consider that

access to the nuts has no cost attached to it.

The use of locally available food stuffs in the preparation of improved porridge increased by a small proportion (3.6%). It is difficult to identify from the results children who underwent GM using age for weight measurement index if they had a mild [$-2SD > WAZ < -1 SD$] or a moderate [$-3SD > WAZ < -2 SD$] level of malnutrition. However, the results were clear enough to show that underweight reduced from 16.11% at baseline to 7.65% at follow-up.

Maternal care

Factors associated with underweight of children and maternal care

A malnourished pregnant woman is at high risk of giving birth to a low birth weight (LBW) baby who will be prone to growth failure during infancy and early childhood, and can be at increased risk of morbidity and early death.

This study found out that women who eat less food than usual are more likely to give birth to a child who is underweight than those who eat the same food as usual or more food than usual. This finding indicates that more food and well balanced diet will result in healthy babies at birth. Scientists are aware that malnutrition is a pathological condition brought about by the inadequacy of one or more of the essential nutrients that the body cannot make but that are necessary for survival, for growth and reproduction, for the capacity to work, learn and function in society (Berg, 1987). This study agrees with the view expressed by Berg (1987) since even eating more food than usual but lacking essential nutrients for the child's growth will not yield the expected result of a healthy child. It is encouraging to notice that nutritional counselling increased from 2.34% at baseline to 80.65% during the follow-up survey. The increase of use and adaptation of feeding practices at follow-up shows that, caregivers improved in their nutrition management when they were pregnant.

LIMITATIONS OF THE STUDY

This study used secondary data. Errors and biases which may have occurred during primary data collection will, in some way, appear in this study. There are no sections in the secondary datasets where grandparents who look after children without parents are mentioned and in reality such situations exist in the communities. However, since the questionnaire clearly investigated caregivers with biological children, this bias may have little potential to cause negative effect on the results. Furthermore, the study does not reflect the inclusion of qualitative data that may have brought about rich information about the

caregivers with children in the target age group although the findings are credible.

Conclusion

The CG and CHEs appear to have improved caregivers' knowledge and behaviour regarding child nutrition. Involvement of CHEs has left community mothers with knowledge and sustainable practice in the nutrition of infants in Gaza province of Mozambique. Although there are some areas that need to be improved by the CG Model working with CHEs, complex problems that contribute to the incessant malnutrition of children in Gaza province, Mozambique, are being minimized. According to this study, good feeding practices in children, hygiene and sanitation practices, home management of child illnesses (especially diarrhoea), and the use of scales to track underweight in children at home level have proved useful to reduce malnutrition in children between 0 and 23 months of age in Gaza province of Mozambique.

The percentage increases in the follow-up survey figures in comparison to the baseline survey figures relative to all the world relief project indicators manifest the progress. World relief's CG Model could be regarded as a leader model for use in comprehensive primary health care implementation by using CHEs working with children under the age of two years. Women of reproductive age and children under the age of 24 months could benefit the fruits of replication and expansion of community health education in the entire Mozambique.

REFERENCES

- ACC/SCN (1988). Supplement on Methods and Statistics to the First Report on the World Nutrition Situation.
- Afreen S, Black RE, Antelman G, Baqui A, Caulfield L, Becker S (2000). Exclusive breastfeeding reduces acute respiratory infection and diarrhoea deaths among infants. *J. Am. Acad. Paediatr.* 108(4):67.
- Baro M, Deubel T (2006). Persistent Hunger: Perspectives on Vulnerability, Famine, and Food Security in Sub-Saharan Africa. *Ann. Rev. Anthropol.* 35: 521.
- Berg A (1987). *Malnutrition What can be done?* Baltimore and London: The Johns Hopkins University Press.
- Dennill K, King L, Swanepoel T (1999). *Aspects of primary health care. Community health care in Southern Africa.* 2nd ed.
- Fenn B, Morris SS, Robert E (2005). Co-morbidity in Childhood in Northern Ghana: Magnitude associated factors and impact on mortality. *Int. J. Epidemiol.* 34:368-375.
- Instituto Nacional De Estatisticas (2008). *Final Report of the Multiple Indicator Cluster Survey.* Available at: http://www.childinfo.org/files/MICS3_Mozambique_FinalReport_2008.pdf.
- Kenneth H, Brow KH (2005). *Symposium: Nutrition and Infection, Prologue and Progress since 1968 Diarrhoea and Malnutrition.*
- Lanckester T (2000). *Community Health Programs,* 2nd ed. Middlesex: Macmillan Publishers Limited.
- Laughlin M (2008). *The Care Group Difference-A Guide to Mobilizing Community-based Volunteer Health Educators.* Available at: http://www.coregroup.org/storage/documents/Workingpapers/Case_S_tudy_community_approaches_CH-malawi.pdf

- Mandomando IM, Macete EV, Ruiz J (2007). Aetiology of diarrhoea in children younger than 5 years of age admitted in a rural hospital in Southern Mozambique 76(3):552-527.
- Mulholland K (2005). Co-morbidity as a factor in Child Health and Child Survival in Developing Countries. *Int. J. Epidemiol.*34:375-377.
- Nancy FB, Lopez-Alarcon C, NF-Garza Butte MG, Lopez-Alarcon MG, Cutberto G (2002). Nutrient adequacy of exclusive breastfeeding for the term infant during the first six months of life. *World Health Organization Health & Fitness* p 54.
- Pan American Journal of Public Health (PAJPH) (2005). Assessing the cause of less than five mortality in the Albert Schweitzer Hospital service area of rural HAITI 18 (3):178-186.
- Partners in health model (2007). A library of PIH tools, resources and guidelines for global health delivery.
- Sebodo T, Soenarto Y, Rohde JE (1977). Aetiology of diarrhoea in children aged less than two years in central Java. *Lancet* 26;1(8009):490-1.
- Sternin M, Sternin J, Marsh D (1998). Designing a community-based nutrition program using Hearth model and the Positive Deviance approach.
- Underwood BA (1983). *Nutrition Intervention Strategies in National Development*. New York; Academic Press.
- UNICEF (2003). *Drought, HIV/AIDS and Child Malnutrition in Southern Africa*.
- Valadez JJ, Devkota BR (2002). Decentralized Supervision of Community Health Programs-Using LQAS in Two Districts of Southern Nepal Inc. *Community-Based Health Care Lessons from Bangladesh to Boston*.
- World Health Organization (WHO) (2005). *Nutrition for Health and Development Protection of the Human Environment: Quantifying the health impact at national and local levels* Geneva <http://www.who.int/nutrition>
- World Health Organization (WHO) (1981). *International Code of Marketing of Breast-Milk Substitutes*
- World Relief Mozambique (2005). *Expanded Impact Child Survival Program, Mozambique* .

Full Length Research Paper

Knowledge and preventive practices related to Avian influenza among livestock farmers and poultry traders in Ikorodu, Lagos state, Nigeria

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The emergence of H5N1 led to increased global attention as the virus could potentially represent the source of the next human influenza pandemic. The disease has led to the loss of millions of birds which constitute a major source of animal protein. This study was therefore aimed at determining the knowledge and preventive practices related to Avian influenza among livestock keepers and poultry traders in Ikorodu, Lagos state, Nigeria. A descriptive cross sectional survey was conducted using standardized structured questionnaire administered at interview. The mean age of respondent was 34.5 ±10.5 years; only 38.1% of respondent correctly defined Avian influenza as a disease of bird caused by H5N1 virus. Majority (77.5%) of respondents were aware that the virus could be transmitted from bird to bird while 41.8% knew that transmission could be from birds to human. Only 28.7% stated correctly that wild birds are the common vectors of the virus. Preventive practices adopted include hand washing (70.5%) and wearing of overall (61.5%). However only about half (54.1%) modified their work habit by hand washing after touching birds for fear of getting avian influenza. Main source of information on Avian influenza was the mass media (57.9%). Predictors of knowledge of Avian influenza included education ($P < 0.001$), being a poultry trader ($P < 0.001$) and older respondents ($P < 0.031$). Predictors of preventive practice included education ($P < 0.001$) and being a livestock farmer ($P < 0.001$). This study suggests that education predicted knowledge and practice of preventive measures among the poultry workers.

Key words: Avian influenza, livestock farmers, poultry traders, knowledge, preventive practice.

INTRODUCTION

Avian influenza (AI) is an infectious disease in birds caused by Influenza, virus (WHO, 2006). Pandemic viruses result from antigenic shift, abrupt and major changes caused by new combinations of the hemagglutinin (HA) and/or neuraminidase (NA) proteins on the surface of the virus (CDC, 2005). There are two types of Avian influenza virus antigen: 16 hemagglutinin (H) and 9 neuraminidase (N) (Anaeto and Chioma, 2007;

FAO Animal Production and Health Paper, 2008). High pathogenicity has so far been found in H5 and H7 viruses. Over the centuries some adaptation to other species such as man, horse and pigs have taken place. These species serve as amplifying hosts which increase the risk of human to human spread and hence risk of human pandemic of very high mortality (Public Health Agency of Canada, 2008). The disease has led to the

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loss of millions of birds which constitute a major source of animal protein. However, the human factors which have potential for facilitating the spread of the disease have not been fully explored systematically. Therefore this study aimed at assessing the knowledge and prevention control practices regarding Avian influenza among poultry and livestock traders with a view to provide more data to guide policy and practice of prevention in a local government area (LGA) in Nigeria.

MATERIALS AND METHODS

The research was carried out in Ikorodu LGA, Lagos State, located in the South western part of Nigeria. Ikorodu Local Government Area has one of the largest concentrations of livestock farms and market in Lagos with over 70 farms distributed across the six community development areas. These include: Ikorodu North, Ikorodu Central, Ikorodu West, Imota, Ijede and Igbogbo- Bayeku. There are a total of two farm settlements in Ikorodu Local Government Area. The largest farm settlement is located in Ikorodu North community development area while the second and smaller farm settlement is located at Imota community development area of Ikorodu local government. The only live bird market is Ejina market with over 50 poultry traders. It is located in Ikorodu Central and was also chosen for the study. Three out of the six community development areas were chosen purposively for the study based on the location of the farm settlements and live bird market. Sample size is calculated from the formula for cross sectional survey as given by (Kish 1965).

$$n = Z^2_{1-\alpha/2} p q / d^2$$

Where; n- Sample size, Z- Standard deviation at 95% confidence interval that is, 1.96, p – Proportion of respondents that provided correct definition of disease and knew routes of transmission is 22.6% (Abbate et al., 2006),

q = 1- p d = 5% desired level of precision at 95% confidence interval.

Data from questionnaire were entered to SPSS software version 16.0. Data collected presented using descriptive statistics such as frequencies, graphs and percentages. A descriptive cross sectional survey was conducted from June to September 2009 among poultry traders and livestock farmers. A closed-ended questionnaire which included questions on knowledge and preventive measures on Avian influenza was used for data collection. Knowledge was scored on a 25 item scale in which correct knowledge was scored one and incorrect response was scored zero. Good knowledge was then categorized as mean scores above 9.9 while poor knowledge were those with mean score less than 9.9. Preventive practice was score on a 7 item scale in which correct knowledge was scored 1 and incorrect knowledge was scored zero. Practice scores were then categorized as good based on scores above 5.3. Descriptive statistics and multiple linear regression analysis were done to explore associations between demographic characteristics, knowledge and preventive practice scores. All levels of significance were set at $p < 0.05$.

RESULTS

Demographic characteristics

A total of 244 respondents were recruited into the study

by a random cluster sampling technique in three community development areas in Ikorodu Local Government Areas, giving a response rate of 91%. 205 were livestock farmers and 39 were poultry traders. The average age of respondent was 34.5 ± 10.5 years; there were more male (57.8%), more livestock farmers (84.0%), Majority (34.4%) of the respondents was at the age group of 20 to 29 years and majority (78.7%) had spent greater than 36 months in their profession.

Knowledge of Avian influenza and prevention

Majority (77.5%) of respondents were aware that the virus could be transmitted from bird to bird while 41.8% knew that transmission could be from birds to human. About 54.5% of the respondents know that avian influenza is transmitted from eating uncooked poultry meat. Only about one third (32.8%) of respondents are aware that avian influenza virus can be transmitted from touching uncooked poultry. The larger percentage of 42.6% do not agree while 24.6% do not know that the virus could be transmitted from touching raw poultry. Only 28.7% stated correctly that wild birds are the common vectors of the virus. Only 38.1% of respondent correctly defined Avian influenza as a disease of bird caused by influenza virus. More than half of the respondents (54.5%) know that swollen eyes are one of the symptoms of Avian influenza in poultry. Also, 45.1% of the respondents know that excessive mucus is a symptom of Avian influenza compared to 18.9% that do not agree or do not know (36.1%). Majority considered Avian influenza as a serious (60.2%) and preventable (74.6%) disease. preventive practice adopted always include mainly hand washing (70.5%), use of outer garment (61.5%) and use of gloves (24.2%). In the study, 54.1% have modified their work habits by adopting necessary preventive measures. Majority of respondents (39.8%) dispose their poultry waste through selling or use as manure on farms. Less than one tenth (7.4%) use burning as a method of waste disposal. Predictors of knowledge of Avian influenza included education ($P < 0.001$), being a poultry trader ($P < 0.001$) and older respondents ($P < 0.031$). Predictors of preventive practice included education ($P < 0.001$) and being a livestock farmer ($P < 0.001$) (Table 1,2).

Sources of information

While the main source of information on Avian influenza was the mass media (57.9%), majority (94.1%) agreed to the need for more information on avian influenza.

DISCUSSION

Socio-demographic data of the respondents indicated that the total respondents had more male and young

Table 1. Predictors of knowledge of Avian influenza among poultry traders and livestock farmers in Lagos state.

Model	Unstandardized coefficients (Beta)	T	Sig.	95% CI of Beta	
				Lower	Upper
(Constant)	3.508	18.007	.000	3.124	3.892
Highest Level of education of respondent	-.202	-8.378	.000	-.249	-.154
Occupation of respondents	-.534	-7.066	.000	-.683	-.385
Community Development Area	-.137	-3.941	.000	-.206	-.069
Sex of respondent	-.122	-2.293	0.023	-.226	-.017
Age of respondent	-.038	-2.176	0.031	-.073	-.004

Table 2. Predictors of preventive practice towards Avian influenza among poultry traders and livestock farmers in Lagos state.

Variable	Unstandardized coefficients (B)	T	Sig.	95% CI of B	
				Lower	Upper
(Constant)	2.054	8.420	.001	1.574	2.535
Sex of Respondent	.150	2.251	.025	.019	.282
Community Development Area	-.215	-5.363	.001	-.295	-.136
other occupation of respondent	-.416	-4.379	.001	-.604	-.229
Highest level of education of respondent	.098	3.268	.001	.039	.157

adults. This finding agreed with that of Fatiregun and Sanni in Ibadan (Fatiregun and Saani, 2008) and Fawole in Lagelu (Fawole, 2006) in Nigeria. This study also corroborates the findings of Abbate (Abbate et al., 2006) and Fatiregun (Fatiregun and Saani, 2008) and Fawole (Fawole, 2006) on the age distribution that majority of workers were young adults and male. This is expected to improve the knowledge of Avian influenza among workers as age and sex were found to be predictors of knowledge of Avian influenza in the study.

The higher knowledge could also be due to the current campaign on Avian influenza by the control programme in Nigeria (AICP, 2009). Also less than one third of the respondents knew the importance of wild bird in the transmission of the disease. This is low, considering the fact that wild birds may be a source of introduction of virus to domestic birds (Bridges et al., 2003). Spread may occur via wild birds which have been responsible for long distance spread and initial introduction of infection in some countries (FAO Animal Production and Health Paper, 2008). Also, among the respondents, awareness of the means of transmission of Avian influenza was low such as from eating uncooked eggs, especially as it concerns the existence of the fact that Avian influenza could be transmitted from uncooked birds or bird products to humans (Bridges et al., 2002). Highly pathogenic Avian influenza virus can be found inside and on the surface of eggs laid by infected birds; however there is no epidemiological evidence that suggests that people have been infected with Avian influenza by consumption of egg or egg product (INFOSAN, 2005). Studies have identified

direct exposure to infected poultry as the primary risk factor in transmission of Avian influenza virus to human. Furthermore faeces from infected birds is the second most dangerous source of infection of Avian influenza virus (FAO Animal Production and Health Paper, 2008) and using as manure keeps the virus in areas where humans and other birds can come in contact with these faeces. In this study, majority of respondent used other means of waste disposal such as use as manure, thus further increasing the possibility of spread of the infection through this work practice.

Despite the fact that all of the respondents had received information about Avian influenza from various sources such as mass media, employer, health professional, friends, there is still low knowledge of symptoms of AI in human and animals. However Di Giuseppe had shown through a knowledge, attitude and practice survey that knowledge of Avian influenza symptoms can be improved through information education and communication strategies (Giuseppe et al 2008). This finding although indicating that there is success in the dissemination of information in Nigeria, also reveals that there is persistence of gap in the understanding of the transmission mechanism of the virus among the people, including those at risk. This is so regardless of the fact that the nation has established desk offices (state centers for coordinating surveillance) which are actively engaged in information dissemination of the disease (AICP, 2009).

Results from the survey indicate low compliance with the use of glove as a preventive measure; this is in agreement with the findings of Abbate et al. (2006). This

is low adherence of the WHO/FAO recommendations to avoid spread of Avian influenza through handling of poultry and poultry products. In the study reported by Fatiregun and Sanni, the most common preventive practice reported was also washing of hand with soap and water (Fatiregun and Saani, 2008). It would assist the campaign for the prevention of Avian influenza if the workers are encouraged to use detergent (which is affordable in low income countries) as disinfectant since the virus is susceptible to detergent.

This study particularly highlights the need to direct efforts towards live bird market traders. These groups of poultry workers are shown in this study as less probable to adopt preventive measures, be knowledgeable about Avian influenza, have poorer attitude and adopt preventive measures inadequately. However, in Nigeria, these persons represent a group at high risk since their activities though unregulated are ubiquitous in many homes and local settings all over Nigeria. If the control of Avian influenza is to be successful, these group handling domesticated local fowls must be included in the campaign.

Therefore Avian influenza preventive efforts should adopt a strong education strategy to achieve desired results. A sustained information education and communication efforts needs to be continued until pockets of ignorance about the disease and its mode of transmission and risks is completely routed. Particular efforts should be directed at the knowledge of symptoms of the disease and adoption of preventive practice and use of personal protective equipments.

This study was limited in scope by its inability to obtain a comprehensive census of farms in Lagos state thus affecting the representativeness of the sample in comparison to other studies by FAO and in a previous study in Oyo state.

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REFERENCES

- World Health Organisation, WHO (2006a) (Geneva)- Avian Influenza, February 2006. Available at http://www.who.int/mediacenter/factsheet/avian_influenza/en/index.htm/Retrieved 16 Feb. 2009
- Centres for Disease Control, CDC (2005). Influenza Viruses. <http://www.cdc.gov/flu/avian/gen-info/flu-viruses.htm>
- Anaeto M, Chioma G (2007): Avian Influenza in Nigeria- Suggestion for eradication. *Int. J. Poult. Sci.* 6(5): 67-371.
- Public Health Agency of Canada (2008) - available at <http://www.phac-aspc.gc.ca/fluwatch/index.html>. Retrieved 13 June 2008.
- Kish L (1965). Survey Sampling. John Wiley and Sons Inc., New York.
- Abbate R, Di Giuseppe G, Marinelli P, Angelillo IF (2006). Knowledge, attitudes and practices of avian influenza, poultry workers, Italy. *Emerging Infect. Dis.* 12: 1762-5. Available from <http://www.cdc.gov/ncidod/EID/vol2no11/06-0671.html>.
- Fatiregun AA, Saani MM (2008). Knowledge, attitudes and Compliance of poultry workers with preventive measures for avian influenza in Lagelu, Oyo State, Nigeria. *J. Infect. Dev. Cntries.* 2(2):130-134.
- Fawole OP (2006). Poultry Farmers' Utilization of Information in Lagelu Local Government Area, Oyo State of Nigeria. *Int. J. Poult. Sci.* 5(5):499-501.
- Nigeria Avian influenza Control Programme (AICP) (2009). Bird flu watch. Publication of Nigeria's AI control and pandemic preparedness and response project (AICP), 2009 February Vol.1 (1):7.
- Bridges CB, Kuehnert MJ, Hall CB (2003): Transmission of Avian Influenza: Implication for control in healthcare settings. *Clin. Infect. Dis.* 37:1094-101.
- FAO Animal Production and Health Paper (2008) – Biosecurity for Highly Pathogenic Avian Influenza: Issues and Options. Rome. Italy. p 15.
- Bridges CB, Lim W, Hu-Primmer J, Sims L, Fukuda K, Mak KH, Rowe T, Thompson WW, Conn L, Lu X, Cox NJ, Katz JM (2002). Risk of influenza A (H5N1) infections among poultry workers, Hong Kong 1997-1998. *J. Infect. Dis.* 185:1005-10.
- International Food Safety Authorities Network (INFOSAN) (2005). Safety Implication- 5 Nov 2005.
- Di Giuseppe G, Abbate R, Albano L, Marinelli P, Angelillo I (2008). A Survey of Knowledge, Attitude and Practice towards avian influenza in an adult population of Italy. *Bio. Med. Central infect. Dis.* 8:36.

APPENDIX

QUESTIONNAIRE

Do you wish to answer a few questions Yes () No ()

A. Demographic and Personal Information

Assigned ID -----

A1. Age as at last birth day: -----

A2. Gender: Male () Female ()

A3. Marital Status: (a) Married () (b) Single () (c) Divorced () (e) Widow ()

A4. Occupation: Poultry Trader () Livestock Farmer ()

A5. Level of Education:

(a) No formal education ()

(b) Primary education ()

(c) Secondary education ()

(d) Tertiary ()

A6. Community Development Area: -----

A7. How long have you been in your profession:-----? (a) 6 months () (b) one year ()

(c) Two years () (d) Three years () (e) Over Three years ()

B. Knowledge of Disease and Prevention

This section of the interview is designed to explore your knowledge related to AI

B1. How do you define AI -----

I will read you some statement regarding AI, for each statement please

Give me a Yes, No or do not know answer

B2. Avian influenza is transmitted by

-Animal to Human	Yes ()	No ()	Don't Know()
-Animal to Animal	Yes ()	No ()	Don't Know()
-Human to Human	Yes ()	No ()	Don't Know()
-Eating uncooked poultry	Yes ()	No ()	Don't Know()
-Eating uncooked eggs	Yes ()	No ()	Don't Know()
-Touching uncooked poultry	Yes ()	No ()	Don't Know()
-Touching cooked eggs	Yes ()	No ()	Don't Know()
-Saliva, Feaces & formites of infected birds	Yes ()	No ()	Don't Know()
-Touching Wild birds	Yes ()	No ()	Don't Know()

B3. Symptoms of AI in poultry

-Swollen eyes	Yes ()	No ()	Don't Know()
-Excessive mucus	Yes ()	No ()	Don't Know()
-Massive death	Yes ()	No ()	Don't Know()
-Diarrhoea	Yes ()	No ()	Don't Know()

B4. Individuals at risk of contacting AI are

-Poultry workers	Yes ()	No ()	Don't Know()
-Butchers	Yes ()	No ()	Don't Know()
-Hunters	Yes ()	No ()	Don't Know()
-Veterinarian	Yes ()	No ()	Don't Know()
-Live bird traders	Yes ()	No ()	Don't Know()

B5. Symptoms of AI in human:

-Serious fever	Yes ()	No ()	Don't Know()
-Cough	Yes ()	No ()	Don't Know()
-Sore throat	Yes ()	No ()	Don't Know()
-Joint or Muscle ache	Yes ()	No ()	Don't Know()
-Fatigue	Yes ()	No ()	Don't Know()
-Red and itching eyes	Yes ()	No ()	Don't Know()

C. Practice of preventive measures

I am going to read a list of preventive measure concerning AI and for each of them I would like you to tell me how often you practice the following:

- C1. Outer garment: Always () Often () Sometimes () Rarely () Never ()
- C2. Gloves: Always () Often () Sometimes () Rarely () Never ()
- C3. Face mask: Always () Often () Sometimes () Rarely () Never ()
- C4. Boots: Always () Often () Sometimes () Rarely () Never ()
- C5. Wash and disinfect utensil and surfaces: Always () Often () Sometimes () Rarely () Never ()
- C6. Keep new chicken away from old stock: Always () Often () Sometimes () Rarely () Never ()
- C7. Wash hands with water alone: Always () Often () Sometimes () Rarely () Never ()
- C8. Wash hands with soap and water: Always () Often () Sometimes () Rarely () Never ()
- C9. In the past one year have you modified your working habits for the fear of getting AI
 Yes () No ()

Specify if yes -----

C10. How do you dispose of your waste from poultry?

- Burning/ incineration ()
- Dug pit ()
- Burial ()
- Refuse dump ()
- Others () specify -----

D. Sources of information

D1. How did you first learn of Avian influenza?

- None ()
- Mass media ()
- Family/Friend ()
- Employer ()
- Health professional ()
- Government Agency ()
- Pamphlet ()
- Others (specify) -----

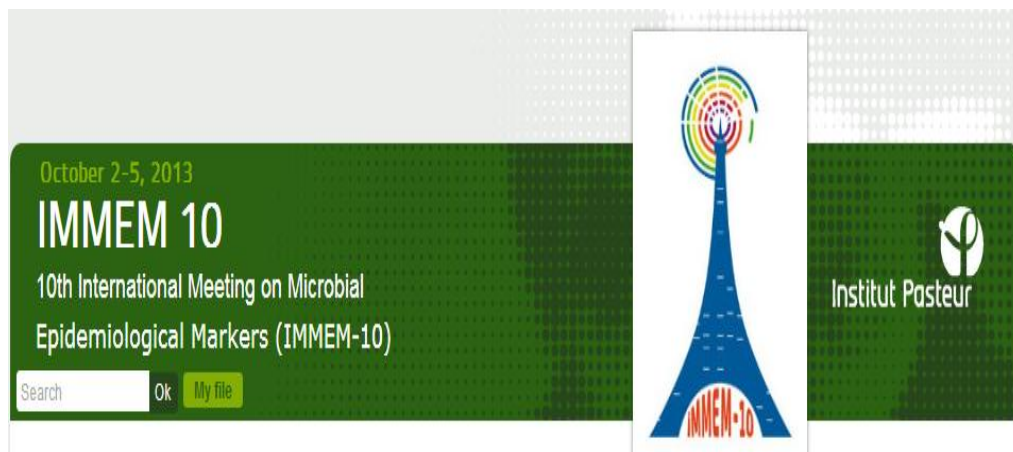
D2. Do you feel you need more information about AI: Yes () No ()

UPCOMING CONFERENCES

**Environment and Health -
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