

A detailed 3D rendering of a biological scene. In the foreground, several large, irregularly shaped cells are visible, some with a textured, brownish surface and others with a smoother, yellowish surface. Numerous smaller, spherical green particles, likely representing viruses or bacteria, are scattered throughout the scene, some appearing to be attached to the larger cells. The background is a dark, blueish-purple gradient, suggesting a microscopic environment.

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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*

# A review of infant feeding policy in Botswana within the context of best practices for the prevention of mother-to-child transmission (PMTCT) of human immunodeficiency virus (HIV): 1998 to 2012

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In this review, the extent to which the Government of Botswana (GoB) applied international health recommendations and guidelines on infant feeding “best practices” within the context of the prevention of mother-to-child transmission (PMTCT) of human immunodeficiency virus (HIV), into its national infant feeding policies between 1998 and 2012 was assessed. The infant feeding guidelines of focus here are those endorsed by the World Health Organization (WHO) between 1998 and 2006, namely, involving the promotion of exclusive breastfeeding for infants in the first six months of life, irrespective of the HIV status of their mothers, under circumstances in which uninterrupted access to safe formula feeding cannot be ensured. This review identifies a significant delay in policy transfer from international guidelines to Botswana’s national infant feeding policies, particularly between the years 1998 and 2006. The need for more effective policy coordination and more efficient research management are recommended to the Botswana government as a means of avoiding such occurrences in the near future. These recommendations are also relevant to other low and middle-income countries and particularly to many countries within sub-Saharan Africa, where HIV-endemicity and high rates of vertical transmission persist in many countries, and where improvements in health policy implementation mechanisms can afford many benefits.

**Key words:** Mother-to-child transmission (MTCT) of human immunodeficiency virus (HIV), prevention of mother-to-child transmission (PMTCT) of HIV, infant feeding policies, Government of Botswana (GoB), Ministry of Health of Botswana (GoB MoH), acceptable, feasible, affordable, sustainable and safe (AFASS).

## INTRODUCTION

Integral to the 2011 political declaration on HIV and AIDS was the commitment made by member states of the United Nations (UN) General Assembly, to endeavor to eliminate all new cases of mother-to-child transmission (PMTCT) of HIV by 2015 (UNAIDS, 2011). This was largely a result of the exceedingly high numbers of individuals that have continued to be newly infected with HIV annually, and the fact that many infants continue to be born having already contracted the HIV virus. Notably, in 2009, an estimated 370,000 children globally contract-

ed HIV during the prenatal and breastfeeding period (UNAIDS, 2010). In Botswana alone, with a population of only 1,952,000 persons (United Nations Population Division, 2012), it was estimated that 20,000 children, defined as persons under the age of 15, were thought to be living with HIV in 2009 (UNAIDS, 2010). An additional 886 new child infections also occurred within the country in the same year (GoB AIDS Response Report, 2012). Also, the risk of vertical transmission in the country still remains considerable as the HIV prevalence among adults

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aged 15 to 49 years in Botswana is 25% (GoB AIDS Response Report, 2012), while the estimated prevalence among pregnant women is 30.4% (MoH ANC Surveillance Report, 2011). In light of this national epidemic, concerns in Botswana have arisen regarding optimal infant feeding practices within the context of the prevention of mother-to-child transmission (PMTCT) of HIV [GoB AIDS Response Report, 2012; Botswana MDG Status Report, 2010]. This has especially been the case as the country has continued to experience higher than expected infant and under-five mortality rates due to non-HIV/AIDS-related causes, such as diarrheal diseases (GoB AIDS Response Report, 2012), which often resulting from the ingestion of foods and liquids derived from unsafe water sources that are given to infants as alternatives to breast milk.

Additionally, although the rate of new child infections experienced in Botswana in 2009, represent a drop of 78% from their 2001 estimates (Government of Botswana AIDS Response Report, 2012), these figures still remain considerably high when compared with many of the nation's developed country counterparts wherein new cases of HIV among children have virtually been eliminated (WHO, 2010a). These trends both elucidate and reaffirm the critical role that both the breastfeeding period and appropriate breastfeeding practices, continue to have on the trajectory of national HIV epidemics. This is particularly so with respect to the epidemiology of HIV transmission among pediatric populations in low and middle-income countries (LMICs), and namely in sub-Saharan Africa where more than 90% of the global newly acquired child HIV infections occurred in 2011 (UNAIDS, 2012).

Within the same context, the identification of the presence of the HIV virus within the breast milk of HIV-infected mothers has been well documented, and breastfeeding has thus been established as a significant route of mother-to-child transmission (MTCT) of HIV (Ziegler et al., 1985; Vonesch et al., 1992; Nduati et al., 1994; BHITS, 2004). Noteworthy however, is that the nutritious and protective benefits that breastfeeding affords infants against the risk of deaths due to infectious diseases, such as diarrhoea and pneumonia, as well as malnutrition, has also been well documented over the years (WHO, 2007; UNICEF, 2009; WHO, 2010b). These latter advantages have also resulted in breast milk being tagged as the 'ideal' food for infants and young children (Latham, 1997; WHO, 2010b).

Similar observations have also influenced endorsements such as those made by members of the international health community, such as WHO, who have endorsed breastfeeding when acceptable, feasible, affordable, sustainable and safe (AFASS), among mothers living with HIV/AIDS (WHO, 2010b).

Accordingly, the critical importance of evidence-based infant feeding policy and infant feeding policy transfer (and implementation), from international health guidelines and recommendations into the national policies of coun-

tries with high burdens of HIV/AIDS, cannot be understated. The need for greater progress among countries, and particularly those within sub-Saharan Africa, with the development of policy frameworks for preventing new child infections, as well as for more efficiently adapting existing systems and approaches for preventing new child infections as new evidence becomes available, has also been observed (UNAIDS, 2012).

Therefore, in this review, we use the experiences of Botswana to demonstrate some of the implications that such policy transfer and implementation can have not only on PMTCT, but also on the overall status of infant health. The national situation in Botswana is also noteworthy, as the country's PMTCT program has seen a significant reduction in mother-to-child transmission of HIV from 20 to 40% in 2001 to around 4% in 2009, with an associated increase in PMTCT uptake from 27% in 2002, to 94% in 2011 (GoB AIDS Response Report, 2012). The former feat has also resulted in the country being heralded as a success story, due to its achieved declines in prevalence levels of vertical transmission of HIV (GoB AIDS Response Report, 2012).

Against this backdrop, this study reviews infant feeding policy in Botswana between the years 1998 and 2012. Despite the first case of HIV/AIDS documented in Botswana, having done so in 1985, which was also the year that the first case of HIV transmission through breastfeeding (globally) had been documented (NACA et al., 2008); the authors have nevertheless selected the year 1998 as our starting point for this review because it was the first year in which the Government of Botswana (GoB) took observably substantive measures to try and curtail the levels of MTCT in the country. The end point of 2012 for this review was selected as it represents the last year up to which the authors reviewed Botswana's infant feeding policy.

In this process, this review examines the factors that precipitated both policy transfer, as well as a delay in policy transfer from international infant feeding guidelines and recommendations into the national infant feeding policies of the Government of Botswana. Additionally, the review assesses the impact of overall levels of infant feeding policy transfer on both the rates of mother-to-child transmission (MTCT) of HIV, as well as on the levels of overall HIV-free infant survival in Botswana. Lastly, this review aims to derive insights from the experiences of Botswana that can be applied to other HIV endemic countries that are similarly experiencing high rates of mother-to-child transmission of HIV, and particularly to the country's counterparts in sub-Saharan Africa.

## METHODOLOGY

A systematic search was carried out by each of the authors, using the terms 'breastfeeding', 'infant health', 'breastmilk', 'infant formula', 'breastfeeding and HIV', 'Botswana and infant', and various combinations of these terms. A focused literature review of the topic 'breastfeeding and HIV' was also conducted. The medical and

scientific databases used were: PUBMED and EMBASE. The WHO's, Nutrition for Health and Development tool was also consulted. These sources were cumulatively used to retrieve relevant articles, reports, and commentaries that addressed: the benefits of breastfeeding for the growth, health and development of infants and young children; the health effects of other forms of infant feeding (including mixed feeding); and the risk of transmission of HIV from breastfeeding. Publications that did not address these factors were excluded, and no limits were placed on the publication date used for our search.

The identified databases and international health publications were reviewed to identify and map available international infant feeding guidelines. A list of the publications and guidelines that were referred to included: WHO's infant and young child feeding list of publications; UNICEF's HIV and infant feeding guidelines; University of California, San Francisco's Center for HIV Information PMTCT: Related Resources; Women, Children, and HIV: resources for prevention and treatment (Center for HIV Information); and the Emergency Nutrition Network: Infant and Young Child Feeding in Emergency Core Group.

Additionally, the infant feeding guidelines of the Botswana government, as well as data on the infant feeding practices performed at the local level within the country were derived from documents, reports and publications produced by the Government of Botswana's Ministry of Health; the Botswana's Department of HIV/AIDS Prevention and Care; Botswana's National AIDS Coordinating Agency; WHO/UNICEF/UNAIDS: Botswana country information; and the University of California, San Francisco Center for HIV Information Botswana.

## RESULTS

### Infant feeding guidelines espoused by international health organizations

International health organizations have a mandate to be objective and to formulate policies that are in line with the best available evidence base (WHO, 2010b). Available evidence reveals that the infant feeding policies of the WHO over the years, have been reflective and coherent with the available scientific evidence base on breastfeeding, infant health, and HIV (Ziegler et al., 1985; BHITS, 2004; Theiry et al., 1985; WHO, 1987; Bertolli et al., 1996; Ekpini et al., 1997; Humphrey, 2010; WHO, 2001; Iliff et al., 2005; WHO, 2007). Thus, within the context of infant feeding guidelines pertinent to PMTCT, WHO's guidelines acknowledged both the costs and benefits of formula and breast milk feeding among HIV+ mothers (that is, the potential risk of infant deaths if not breastfed, and the risks of HIV transmission if breastfed). Accordingly, dating back to 2001, WHO recommended that HIV+ women should avoid breastfeeding if they met the AFASS criteria for replacement feeding and if not, then they should exclusively breastfeed during the first 6 months of an infant's life (WHO, 2001).

Furthermore, an assessment of WHO's international infant feeding guidelines in 1998, 2001 and 2006 reveal that their guidelines were clearly consistent and coherent with one another. This was such that the 1998 guidelines stated that 'when children born to women living with HIV can be ensured uninterrupted access to nutritionally safe

and adequate breast milk substitutes, then they are at less risk of illness and death' (Humphrey, 2010). The 2001 and 2006 guidelines recommended that "When replacement feeding is AFASS, then avoidance of breastfeeding is recommended; otherwise, exclusive breastfeeding is recommended during the first six months of life (WHO, 2001, 2007).

### Efforts made by the government of Botswana in the area of PMTCT

From 1998 onwards, the GoB took several measures to address the issue of PMTCT within the country. These initial efforts were partly reflected by the country's formulation of its infant and young child feeding policy around the same time that UNICEF started to support PMTCT programs in many low-income countries (LICs), in 1998 (UNICEF, 2003). In 1998, the GoB also formed a technical advisory committee (TAC) comprised of staff from Botswana's ministries, including the food and nutrition units, as well as staff from WHO and UNICEF. This committee, tasked with documenting the implementation of a PMTCT pilot program in the country, would in the process also define a package for the PMTCT program, develop protocols, guidelines, an implementation plan, and submit a budget to the ministry of health for assessment (UNICEF, 2003).

In conjunction with these efforts, in 1999, the GoB would take arguably the most concrete measure until that point in its aim of tackling MTCT of HIV. This would involve the initiation of its widespread establishment of PMTCT facilities across the country (NACA et al., 2008). After establishing the first PMTCT site in 1999 in two districts, Gaborone and Francis Town, the GoB went on to make such sites available nationwide by the end of 2002 (NACA et al., 2008).

Over the years, the GoB had also demonstrated a strong commitment to reducing MTCT of HIV through breastfeeding. In June 2001, at the United Nations General Assembly Special Session on HIV/AIDS (UNGASS), the GoB would be one of the nations that would jointly declare its commitment to reducing the proportion of infants being infected with HIV by 20% by 2005, and by 50% by 2010 (United Nations, 2001). It asserted that it would achieve this feat through ensuring that HIV+ women had access to effective treatment, particularly ART, in order to reduce MTCT of HIV; and that where appropriate, the provision of breast milk substitutes and a continuum of care would also be provided (United Nations, 2001). Similarly, and in more recent years, estimates in changes in the GoB's spending on HIV/AIDS also reveal that spending has increased.

This has been such that the government has disbursed a greater amount of its domestic national funds, 165.1 million USD in 2005, 130.9 million USD in 2006, 203.8 million USD in 2007, 228.7 million USD in 2008, to cover its HIV/AIDS-related costs (UNAIDS, 2008, 2010). As

shown, domestic spending by the GoB represented over 65% of the total funds spent on HIV/AIDS for each of the respective years between 2005 and 2008 (UNAIDS, 2008, 2010).

### **Infant feeding policies and nationally observed infant feeding practices between 1998 and 2006**

Although commendable in many respects, the efforts made by the GoB between 1998 and 2006 to reduce national levels of MTCT, unfortunately did not go far enough, and were not consolidated by tangible policy changes that could have been taken to meet this end. This was partly reflected by the way in which the GoB failed to substantiate and clarify in accordance with one of the earlier cited recommendations; the grounds on which breast milk substitutes could be provided to HIV+ mothers, and only indicated that it would offer these substitutes to relevant mothers where appropriate, in addition to offering them access to effective treatment, namely ART (United Nations, 2001). Indeed, the lack of vigour with which this recommendation was enforced, and evidence that this important contingency within the guidelines was not rigorously clarified and executed on the ground, was reflected by a number of memorandum and initiatives that were released by the GoB around the same time. An example includes the 1998 document, the "Prevention of Mother to infant transmission of HIV and the establishment of a national HIV/AIDS fund", in which policy recommendations were made for the introduction of essential drugs such as Zidovudine (AZT) in PMTCT health facilities (Latham and Kisanga, 2000). Noteworthy here, was that while these recommendations did not explicitly state that infants born to HIV positive mothers who were given AZT should be formula fed, the document contained an annual national budget for the provision of free infant formula or "bottle feeding" to all HIV+ mothers, which corresponded with an annual estimated stated cost of "5,301,100 Pula" (691,400 USD) (Latham and Kisanga, 2000).

In another government document titled "Mother to Child Transmission of HIV Infant Feeding Guidelines for the Health Worker", one of the intervention strategies endorsed, which the GoB felt had proven to contribute significantly to the reduction of MTCT, included the "avoidance of breastfeeding" (Latham and Kisanga, 2000). These findings support the assertion that by the time PMTCT pilot programs were established in Botswana in 1999 (NACA et al., 2008), the country's national infant feeding policy supported the 'avoidance of breastfeeding', as well as the provision of free infant formula to HIV positive mothers. This was corroborated by Tlou et al. (2000) who argued that Botswana's pilot PMTCT strategy involved 'purchasing and distributing AZT and breast milk substitutes'. UNICEF (2004) further substantiated these findings through its observation that

during the period at which the first PMTCT sites were established in Botswana, that the GoB used government funding sources to procure and distribute infant formula to HIV positive mothers.

Furthermore, in a 2001 study that evaluated infant feeding practices in Botswana among HIV infected and uninfected women at PMTCT sites, and women of unknown HIV status at non PMTCT sites (Table 1).

Notably, approximately 90% of all HIV positive mothers interviewed reported feeding their babies with infant formula, whereas only 3% reported exclusive breastfeeding. These infant feeding practices could be seen as consistent with recommendations made in Botswana's "mother-to-child transmission of HIV feeding guidelines" report, which espoused the "avoidance of breastfeeding" as a way to curb the spread of the epidemic (MoH, 2001). This study also found that while most HIV+ women chose to formula feed, in contrast to uninfected mothers and mothers of unknown HIV status who preferred to breast-feed, that the rate of exclusive breastfeeding among the latter was very low, which was mainly because of the early introduction of infant formula. For example, 77 and 60% of HIV-uninfected mothers and mothers of unknown status, respectively, mixed fed their babies before they were 6 months of age (MoH, 2001).

In 2001, Botswana's Ministry of Health also documented that the government's practice of promoting formula feeding for HIV+ mothers had a considerable "spill-over effect", as it had influenced the infant feeding practices of uninfected women and those of unknown HIV status (UNICEF, 2004). They asserted that this likely influenced the significant number of these women (77 and 60%, respectively) who reported mixed feeding. These factors may have likely enticed many of these women to adopt mixed feeding as normal breastfeeding practice (MoH, 2001). However, this practice of mixed feeding was and remains inconsistent with WHO's guidelines, which had, and have continued to recommend exclusive breastfeeding for the first six months of life to uninfected mothers and those of unknown HIV status (WHO, 2001, 2010b).

Similar findings, which reflect the endorsement of formula feeding by the GoB, and which also demonstrate that international infant feeding guidelines were likely not adopted on a wide-scale at the local and community levels, arise from studies which documented the widespread practice of infant formula feeding and the technical incapacities of health workers to undertake appropriate infant feeding counseling sessions (MoH, 2001; Creek et al., 2010; Chopra et al., 2008). In the Botswana Ministry of Health's 2001 study assessing the infant feeding patterns of HIV infected and uninfected women at Botswana PMTCT clinics, they found that of the 158 HIV+ mothers assessed, 87% reported practicing exclusive replacement feeding, 10% reported mixed feeding, and only 3% reported exclusive breastfeeding within the first 6 months of an infant's life (MoH, 2001).

**Table 1.** Reported infant feeding practices in Botswana from 2001 to 2002 following the introduction of PMTCT programs (among infants 0 to 6 months old, based on 24 h recall).

| Infant feeding practice   | HIV Status |       |         |
|---|------------|-------|---------|
|   | HIV +      | HIV - | Unknown |
| <b>Botswana (infants 0 to 6 months old, based on 24 h recall)</b> |            |       |         |
| Exclusive breastfeeding (%)                                       | 3          | 17    | 32      |
| Exclusive replacement feeding (%)                                 | 87         | 6     | 8       |
| Mixed feeding (%)   | 10         | 77    | 60      |
| Number of women   | 158        | 157   | 186     |

Botswana MoH (2001) [32]

Furthermore, and as delineated by the study described earlier, it is highly questionable whether the 87% of HIV+ mothers who reported exclusive replacement feeding, had actually all met the 'AFASS' criteria recommended by WHO. Indeed, and as observed by Shapiro et al. (2003), the acceptability and safety of this infant feeding practice in a context where breastfeeding was perceived as normal, and where the availability of clean water was lacking, brings about doubts as to whether the 'AFASS' criteria could realistically be met for any but a small proportion of HIV+ mothers. Additionally, Shapiro et al. (2003), also documented very low adherence to infant feeding strategies among rural Botswana HIV+ mothers who were either assigned to, or who personally chose exclusively formula feed.

### 2006 Flooding and subsequent diarrhea outbreak

Between November 2005 and February 2006, heavy rains and flooding occurred in Botswana, causing approximately 24,000 cases of diarrhea, and approximately 486 deaths in children under 5 years of age (Creek et al., 2010; Timberg, 2007). Mach et al. (2009) reported that the mortality rate among children affected by the outbreak was above the international threshold for emergency action, with an estimated 547 excess deaths. This was in comparison to the only 9,166 diarrhea-cases and 21 diarrhea-related deaths that occurred across the entire country in the first quarter of 2005 (Creek et al., 2010).

The Botswana Ministry of Health (MoH) in collaboration with the United States Center for Disease Control and Prevention (CDC) investigated the outbreak and found that the public water supply was contaminated in 26 villages tested, within which 63% of infants born to HIV+ women were formula fed from birth, and 20% of infants born to HIV- mothers were weaned from breast milk before the age of six months (Creek et al., 2010). Overall, they estimated that 35% of infants under 6 months of age were not breastfeeding. Additionally, upon conducting a closer examination of 154 children hospitalized for diarrhea, the CDC found that the majority (93%) were not breastfeeding. In one village visited, 30% of formula fed babies (and no other babies) died during the outbreak.

Thus, the CDC concluded that the severest morbidity and mortality that resulted from the outbreak occurred in children who were HIV negative, and who were not breastfed. On the strength of these findings, the CDC also recommended that the GoB review its infant and young child feeding policies (Creek et al., 2010). The premise for this recommendation also echoed the widespread international criticisms of the country's infant and young child feeding policies that the event had triggered. This was such that the GoB's national infant feeding policies had been identified as being incoherent with the scientific research evidence-base, as well as with international guidelines on infant feeding best practice (Creek et al., 2010; Timberg, 2007).

Subsequently, and as a result of this outbreak, the government then changed its national infant feeding guidelines in July 2006 to make them consistent with those of the WHO's. These revised national guidelines recommended exclusive formula feeding to HIV+ mothers for whom formula feeding is 'AFASS', and exclusive breastfeeding to HIV+ mothers for whom formula feeding is not 'AFASS'. Also, in July 2006, the Department of HIV/AIDS Prevention and Care in Botswana created a PMTCT training package for health workers with infant feeding guidelines that were more in line with WHO's 2001/2006 recommendations ([WHO, 2001, 2007]). These guidelines were again reiterated in the 'Botswana National HIV/AIDS Treatment Guidelines: 2008 version', as elaborated in Table 2.

## DISCUSSION

### Challenges with implementing infant feeding policy shifts

Although available evidence on stated infant feeding policy shifts have been made by the government of Botswana since 2006, less than optimal changes with respect to policy implementation on the ground, and at the level of the community, have been observed during the same time period. For instance, in 2007, the GoB in collaboration with UNICEF published a progress report entitled "A World Fit For Children; Mid Decade Review",

**Table 2.** Botswana's 2006 to 2010 infant feeding guidelines.

| Patient situation   | Feeding recommended from 0 to 6 months                                       | Feeding recommended from 6 to 24 months   |
|---|--|---|
| HIV-negative women  | Exclusive breastfeeding (no added foods or liquids, including plain water)   | Breastfeeding until at least 2 years, plus complementary foods  |
| HIV-positive women for whom formula feeding is AFASS*                     | Exclusive formula feeding (no added foods or liquids, including plain water) | Formula until 1 year, plus complementary foods  |
| HIV-positive women for whom formula feeding is not AFASS*                 | Exclusive breastfeeding (no added foods or liquids, including plain water)   | Early cessation of breastfeeding at six months with transition to formula feeding, plus complementary foods |
| Women of unknown HIV status (should be strongly encouraged to be tested.) | Exclusive breastfeeding (no added foods or liquids, including plain water)   | Breastfeeding until at least 2 years, plus complementary foods  |

Botswana Department of HIV/AIDS Prevention and Care (2008).

in which it reported that by the end of 2006, 1,653 infants had been given ART from the PMTCT program, and of this number, 1,595 infants had been given infant formula (UNICEF, 2007). This implied that in the year 2006, 96% of infants born to HIV infected mothers who visited PMTCT sites, and who were receiving ART, were also being formula fed. Whether the mothers of these infants all met the 'AFASS' criteria is again unknown, but questionable.

Additionally, in the 2010 Botswana Assessment Report, in which the GoB's Ministry of Health (Nutrition and Food Control Division) carried out a national assessment of the status of the country's implementation of the Global Strategy for Infant and Young Child Feeding (*IYCF*)<sup>1</sup>, some of the noteworthy findings of the report identified that spill-over of infant formula feeding from PMTCT mothers to non-PMTCT mothers remained a challenge within the country (MoH GoB, 2010). The assessment also noted that health workers' skills in infant feeding counseling and support in HIV were sub-optimal, and that the support provided to mothers to better implement their infant feeding choices were inadequate (MoH GoB, 2010). Also, in assessing the extent to which national policies and programs were in place to ensure that HIV+ mothers were being informed about the risks and benefits of different infant feeding options, as well as on the extent to which they were being supported in carrying out their infant feeding decisions, the assessors provided very low ratings on the related criteria corresponding with these indicators (MoH GoB, 2010). For instance, some of the low scoring indicators included those on assessments pertinent to national efforts that had been made until that

point to counter misinformation made on HIV and infant feeding, as well as on efforts made for the promotion, protection and support of 6 months of exclusive breastfeeding and continued breastfeeding in the general population (MoH GoB, 2010).

In light of these observations, a plausible explanation for the limited levels of infant feeding policy implementation undertaken in Botswana since 2006, could be due to the turn over time often experienced by countries that are in the process of translating policy from the level of government to the ground or community level. Also, other related and specific factors which may have impacted the limited levels of policy implementation in Botswana include: the lengthy and bureaucratic processes often involved with promulgating new information across health ministries and sectors; and the time required for retraining and upgrading the information supplied to health workers, designed to enable them carry out changes in health care practices. Also, with respect to the latter, and in the context of PMTCT in Botswana, such changes would also entail health workers having to modify their attitudes, behaviours and perceptions about the benefits of breastfeeding when consulting women living with HIV/AIDS on optimal practices for PMTCT and overall infant survival.

In addition to these findings, other data suggest that the country's infant feeding policy shift may have begun to be associated with a reduction in MTCT levels after 2006. For instance, in Botswana's 2008 and 2010 country progress reports, the government estimated that only 4.8 and 3.8% of infants born to HIV infected mothers were infected in 2007 and 2009, respectively. This represents a significant reduction from the 20.7% of infants infected in 2003, and the 11.5% of infants infected in 2005 (NACA, 2008). Namely, these findings can largely be explained by the improved increases in PMTCT coverage levels that the government had made for women living with HIV/AIDS

<sup>1</sup>The Global Strategy for Infant and Young Child Feeding (*IYCF*), adopted at the World Health Assembly in 2002 was done so using the WBTi World Breastfeeding Trends Initiative tool in order to document the existing gaps in feeding practices, policy and programs (GoB MoH, 2010).

over this time period, which rose from 19% in 2003 to greater than 95% in 2009 (UNAIDS, 2006, 2010). Similarly, significant increases in ART coverage levels among children in Botswana have also been made over the past decade, such that in 2009, among the 25 countries with the greatest number of people living with HIV, Botswana was the only country that reported antiretroviral coverage of greater than 80% among children (UNAIDS, 2010). Also in the same year, only Botswana and South Africa achieved higher levels of antiretroviral therapy coverage among children than adults (UNAIDS, 2010). These findings are particularly notable when comparing Botswana's progress to that of the vast majority of its sub-Saharan African counterparts wherein ART coverage among children remained much lower (UNAIDS, 2010).

This evidence demonstrates that despite the limited levels of implementation of HIV infant feeding policy that has occurred in Botswana, there have nevertheless been observable declines in vertical transmission of HIV in the country. Also noteworthy is that in the period between 2005 and 2010, infant mortality dropped from 43 to 36 child deaths per 1000 live births; and that under-5 mortality dropped from 61 to 48 child deaths in the same respect (WHO, 2011). Furthermore, when compared with other countries in the sub-Saharan African region, Botswana's under-five mortality rate of 48 child deaths per 1000 live births is considerably lower than the regional average of 119 child deaths per 1000 live births (WHO, 2012). Thus providing evidence to support the fact that if Botswana were to better implement its infant feeding policy, it would be able to achieve even more marked declines in its overall infant and child mortality rates. This is also especially the case as HIV/AIDS continues to be the third leading cause of death among children under the age of five in the country (WHO, 2012).

These findings are also significant as some of the challenges that were being experienced by the GoB with implementing its infant feeding policies will likely also mirror challenges that other countries in the region experience when trying to achieve the same measures. Thus, taking Botswana as an example raises the issue of the need for better and more fortified policy implementation mechanisms and frameworks in the region that can better ensure that there is a continuum between health policy formulation and implementation.

### Reasons for delay in policy transfer

One of the explanations for the delay in infant feeding policy transfer undertaken by the GoB could be seen as due to the government's strong focus on trying to reduce the overall burden of HIV in the country. This was such that the GoB had tended to place a disproportionate focus on reducing HIV transmission and prevalence levels within the country, thereby limiting cumulative efforts that could have been directed towards improving

the overall health and survival of the country's infants.

This was demonstrated through the GoB's initial position, which supported infant formula feeding as the primary feeding method for women living with HIV/AIDS, as it was felt that this was an intervention, which could directly result in averting new child infections. In comparison, whereas the WHO's endorsed approach to infant feeding among mothers living with HIV/AIDS also aimed to reduce MTCT, the WHO however also gave consideration to the overall health of children when formulating their guidelines. This was conveyed through WHO's strong adherence to the AFASS criteria, which inherently emphasized the role that poor water and sanitation systems could have on undermining the overall health and development of infants, under circumstances in which infant formula was employed as a primary feeding method for mothers, vis-a-vis the option of breastfeeding. This was advocated even to HIV+ mothers who might be pursuing the infant formula feeding option, in order to avoid exposing their children to the risk of vertical transmission of HIV. Furthermore, despite the fact that this remained the position of the WHO, the GoB did not clearly incorporate these considerations into their national guidelines until at least 2006. Conversely also, and in principle, the GoB's policies were stipulated in such a way that it was obliged to provide free infant formula to HIV+ mothers at PMTCT clinics (Shapiro et al, 2003). This would occur regardless of whether any of the prerequisites for encouraging the use of infant formula, notably ensuring its acceptability, feasibility and sustainability, could be assured.

Corporate commercial interests within the baby food industry may have also enticed the GoB to endorse infant formula feeding. This is demonstrated by the fact that between 1999 and 2002, the GoB had procured infant formula from the local market (UNICEF, 2004), which could have possibly been at subsidized rates. The GoB had also opted to purchase this formula through the local market as opposed to receiving it at no cost from UNICEF (UNICEF, 2004). Similarly, the Botswana MoH (2001) and Chopra and Rollins (2008) reported that health workers in Botswana received free samples of infant formula outside of the health system's institutions, and that HIV+ mothers received branded formula, instead of generic ones, demonstrating clear violations of articles 5, 6 and 7 of the ICMBMS<sup>2</sup> (International Code of Marketing of Breastmilk Substitutes) (WHO, 1981). This also suggests that the baby food industry could have also had some influence over the provision of these free samples of formula. This conjecture is further substan-

<sup>2</sup>The International Code of Marketing of Breastmilk Substitutes was endorsed as a set of recommendations, collectively agreed upon by United Nation's Member States, at the World Health Assembly in 1981. The stated aim of this code was to 'contribute to the provision of safe and adequate nutrition for infants, by the protection and promotion of breast-feeding, and by ensuring the proper use of breast milk substitutes, when these are necessary, on the basis of adequate information and through appropriate marketing and distribution' (WHO, 1981).



tiated by the fact that immediately after the 2006 diarrhea outbreak, Botswana's Minister of Health launched the regulations on the marketing of foods for infants and children (UNICEF, 2006), and later during the same year, the ICMBMS was enacted as legislation within the country (IBFAN, 2006).

Similarly, and as observed more recently within the Botswana Assessment Report 2010 (on the *IYCF*), the GoB noted that some of the challenges they had been experiencing with the implementation and application of the International Code of Marketing of Breastmilk Substitutes, were the resistance by some baby food manufacturers for complying with all of the provisions of the GoB's regulations (MoH GoB, 2010). They also noted repeated violations of the government's regulations by baby food manufacturers (MoH GoB, 2010).

## Conclusion

The findings of this review are noteworthy for other low and middle-income countries, and particularly for other countries in sub-Saharan Africa, where more than 90% of the new globally acquired child infections occurred in 2011. And yet despite demonstrated reductions in child infections having been observed between 2009 and 2011 in sub-Saharan Africa, which have largely been a result of scale-ups in the provision of infant feeding based prevention services (UNAIDS, 2012), much remains to be done in the domain of averting new child infections. Furthermore, in addition to breastfeeding, additional future improvements in child health survival will be contingent upon additional increases in ART coverage among pregnant women in sub-Saharan Africa. For instance, unlike in Botswana, who by 2009 had already achieved 92% coverage of ARV's among pregnant women living with HIV/AIDS, the overall average coverage levels for sub-Saharan African women receiving antiretroviral therapy or prophylaxis, remained a less satisfactory 59% (53 to 66%) in 2011 (UNAIDS, 2012).

Lastly, this review supports the need for assertive steps to be taken in low and middle-income countries and particularly those in sub-Saharan Africa, to encourage increased policy transfer and implementation when involving effective and evidence-based recommendations, such as those outlined by the WHO. Improving the uptake of such policies could be achieved through the development of commissions within countries, which identify best mechanisms for achieving national health objectives and goals. The establishment of coordinating systems and bodies, or policy reviewing units at different levels within health ministries, who encourage the application and implementation of evidence-based and best practice policies formulated at the international level, can also bolster such efforts. Corporate bodies, donors, and other external funding actors, may also play a role in enhancing policy transfer by demonstrating their social responsibility through encouraging the implementation of

evidence-based policies within countries such as Botswana. Taken together, such cumulative and multi-faceted efforts will certainly also enhance the likelihood of countries in the region achieving the UN Political Declaration on HIV and AIDS' global goal of eliminating new child infections by 2015.

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*Full Length Research Paper*

## Changes in blood profile of human immunodeficiency virus (HIV)-infected patients on highly active antiretroviral therapy (HAART) in North Eastern Nigeria

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We evaluated the changes in blood profile of patients in a prospective 30 month observational follow up study involving 145 antiretroviral naive acquired immune deficiency syndrome (AIDS) participants. Participants were divided into two groups at one year of highly active antiretroviral therapy (HAART), antiviral success (viral load < 2.60 log<sub>10</sub> copies/ml); and antiviral failure (viral load > 2.60 log<sub>10</sub> copies/ml). The mean ± standard deviation (SD) viral load in the antiviral success group (119 patients) was 5.25 ± 0.53 and 5.09 ± 0.71 log<sub>10</sub> copies/ml in antiviral failure group at baseline. Antiviral success cohort had significant reduction of viral load at 6 months, achieved viral suppression at one year and maintained undetectable viral load in the subsequent follow-up period. Antiviral failure participants on the other hand failed to achieve significant viral load suppression at six month and had fluctuation and persistence of viral load. In the antiviral success group, the mean ± SD CD4+ T-cell count increased significantly at 6 month of treatment ( $P \leq 0.038$  versus baseline), and in the subsequent follow-up period ( $P < 0.05$ ). Detectable human immune deficiency virus-ribonucleic acid (HIV-RNA) viral load at six months was associated with unremarkable increase in CD4 count, and its persistence at 12 month with virological failure. This observation may imply that early poor immunological improvement may suggest virological failure. Initial unremarkable change in CD4 count parameters in response to HAART may predict early virological failure and efficacy of therapy in the absence of viral load in our environment.

**Key words:** Human immune deficiency virus (HIV), acquired immune deficiency syndrome (AIDS), highly active antiretroviral therapy (HAART), haemoglobin, white blood count, CD4<sup>+</sup> count

### INTRODUCTION

Haematological abnormalities seen in human immune deficiency virus (HIV) infected individuals involve all line-

ages of blood cells and the abnormalities seem to be dependent on the level of virus replication, as these

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abnormalities are severe in late-stage acquired immune deficiency syndrome (AIDS) patients with high viraemia (Lee et al., 2001). Although the mechanism underlying these abnormalities is still obscure, HIV-1 infection of marrow stromal cells may result in cytopenia and derangement of blood profile (DHHS/Henry, 2000; Moses et al., 1996; Bahner et al., 1997). The incidence of anaemia, the most common haematological abnormality in HIV seropositive patients increases with the progression of the disease. Neutropenia is most commonly seen in the advanced stages of AIDS and often caused or exacerbated by concomitant myelosuppressive drugs. Adverse drug reactions from anti retroviral drugs or those used in management of opportunistic infections may result in neutropenia in patients with HIV/AIDS. Thrombocytopenia also occur in the setting of HIV/AIDS especially among those with low CD4 cell count and older age (Scadden et al., 1990; Spivak et al., 1989; Frickhofen et al., 1990).

Bone marrow abnormalities are found in all stages of HIV disease, and increase in frequency as the disease progresses. Several morphologic abnormalities of the bone marrow have been reported in AIDS patients (Creag-Kirk et al., 1988). Bone marrow examination may be useful for the definitive assessment of iron stores which can assist in the differentiation of iron-deficiency anaemia from anaemia of chronic disease.

Use of highly active antiretroviral therapy (HAART) has been associated with improvements in immune function, increase in haematopoietic progenitor cell growth and significant declines in HIV-1 RNA levels (Moses et al., 1996; Bahner et al., 1997). A decrease in serum erythropoietin levels (Spivak et al., 1989), auto-antibodies to erythropoietin or marrow suppression by opportunistic infections, tumours or various medications may also contribute to the haematological abnormalities commonly observed in HIV- infected persons (Frickhofen et al., 1990; Creag-Kirk et al., 1988; Seneviratne et al., 2001; Sipsas et al., 1999). HAART may ameliorate many of these effects in an indirect manner simply by rebuilding the immune system and decreasing the HIV viral burden (Semba et al., 2001; Mellors et al., 1995; Walker et al., 1998).

In view of the paucity of data on the effect of HAART on blood profile of HIV-infected individuals in African literature, the present study prospectively analysed the effects of HAART on changes in viral load, CD4<sup>+</sup> count, haemoglobin, white blood count and platelets.

## MATERIALS AND METHODS

### Study area

The study was conducted in the Department of Medicine, University of Maiduguri Teaching Hospital, Borno State. This is a 500 bedded

hospital designated as a Centre of Excellence for infectious diseases and provides primary, secondary and tertiary services for the North Eastern part of Nigeria. It also caters for the neighbouring countries such as Cameroon, Niger and Chad Republics.

A total of 145 AIDS patients who were HAART eligible based on Centre for Disease Control and prevention classification system for HIV-1 infection (Segal et al., 2011) were recruited into the study between May and December, 2007. The participants were extracted from a cohort of 960 patients studied for West African College of Physician (FWACP) fellowship dissertation (Flow chart 1). The following cases were defined as having AIDS: HIV-1-positive adults with a CD4<sup>+</sup> count < 200cells/ $\mu$ l or the clinical condition listed in the AIDS surveillance case definition (Centers for Disease Control and prevention, 1993). Using a structured, pre-evaluated questionnaire, information was obtained on demographic characteristics, clinical manifestation, medication used, blood transfusion, sexual and drug use behaviours. Patients with haematological diseases or other chronic condition affecting metabolism were excluded. HAART experienced prior to the study were excluded. All participants included had adherence of  $\geq$  80%. Adherence was defined through a self-reported evaluation by the patient and registered as percentage by the physician. An evaluation higher than 80% was classified as "adherent", whereas lower than 80% was considered as "non-adherent" and were excluded.

Patients were divided into two groups: antiviral success (where viral load was < 2.60 log<sub>10</sub> copies/ml after treatment); and antiviral failure (where viral load was > 2.60 log<sub>10</sub> copies/ml after treatment). Permission was obtained from the University of Maiduguri Teaching Hospital (UMTH) Ethical Committee. Written informed consent (signed or thumb printed) was obtained from patients.

### Blood samples analysis

Samples for CD4+ T-cell count was collected between 9:00 and 10:00 am and assayed within 6 h of collection of whole blood, using standardized flow cytometric Cyflow machine (manufactured by Cytec, Partec, Germany, 2005). Haemoglobin and WBC was analysed using Haematology analyzer (manufactured by Sysmex®, Corporation Kobe, Japan) while plasma HIV RNA levels was measured using freshly frozen specimen separated within 6 h of phlebotomy, utilizing the Amplicor HIV-1 Monitor Test, version 1.5, manufactured by Roche® Germany, with a minimum cut off value of 200 copies per ml. Using the outlined standard testing techniques, data on the determined parameters was collected on initial visit, 6, 12, 18, 24 and 30 months after HAART.

### Statistical analyses

Data were analysed using the Statistical package for social sciences (SPSS®) statistical package, version 15.0 (SPSS Inc., Chicago, IL, USA) for Windows®. Normal distributions were analysed using the Kolmogorov-Smirnov test, and the results of analysis of variance and rank sum tests of multiple sets of data were analysed by the Pearson's  $\chi^2$ -test and P value < 0.05 was considered to be statistically significant.

## RESULTS

A total of 145 HAART naive adult AIDS participants were consecutively recruited into the study. The study popula-

**Flow chart 1.** Chart showing the number of participants recruited into the study.

| Number of participants enrolled into the study = 960                   |   |
|--|---|
| Number of participants with < 80% adherence (chart documented) = 715   | Number of participants with ≥ 80% adherence (chart documented) = 145  |
| Participants that achieved that virological success at 12 months = 119 | Participants that achieved that virological success at 12 months = 26 |

**Table 1.** Sociodemographic characteristics of participants, stratified by antiviral outcome.

| Characteristics              | Overall<br>(n = 145) | Antiviral success group<br>(n = 119) | Antiviral failure group<br>(n = 26) | p-value |
|------------------------------|----------------------|--------------------------------------|-------------------------------------|---------|
| Age, years                   | 35.68±8.40           | 36.42±9.25                           | 34.86±7.37                          | 0.189   |
| Female, sex (%)              | 98 (67.6)            | 81 (68.1)                            | 17 (66.4)                           | 0.960   |
| <b>Risk factor</b>           |                      |                                      |                                     |         |
| Heterosexual                 | 123                  | 103 (85.7)                           | 20 (76.9)                           | 0.414   |
| Homosexual                   | 0                    | 0                                    | 0                                   |         |
| IV drug use                  | 0                    | 0                                    | 0                                   |         |
| Blood transfusion            | 3                    | 3 (2.5)                              | 0                                   |         |
| Unknown                      | 19                   | 13 (10.9)                            | 06 (23.1)                           | 0.177   |
| <b>Educational status</b>    |                      |                                      |                                     |         |
| No formal education          | 38                   | 22 (18.5)                            | 16 (61.5)                           | 0.000*  |
| Primary education            | 50                   | 39 (32.8)                            | 02 (7.7)                            | 0.020*  |
| Secondary education          | 34                   | 21 (17.7)                            | 05 (19.2)                           | 0.999   |
| Tertiary education           | 23                   | 18 (15.1)                            | 03 (11.5)                           | 0.869   |
| <b>Marital status</b>        |                      |                                      |                                     |         |
| Married                      | 77                   | 76 (63.8)                            | 21 (80.7)                           | 0.153   |
| Single                       | 39                   | 22 (18.5)                            | 05 (19.3)                           | 0.999   |
| Divorced                     | 22                   | 16 (13.5)                            | 00                                  |         |
| Separated                    | 07                   | 05 (4.2)                             | 00                                  |         |
| CD4 count                    | 165.17±132.54        | 171.04±108.80                        | 152.19±112.85                       | 0.376   |
| Viral load log <sub>10</sub> | 5.46±0.87            | 5.25±0.53                            | 5.09±0.71                           | 0.762   |

tion were divided into two treatment groups at the end of the study; the antiviral HAART success and failure. Participants that had no formal education were more likely to fail HAART therapy. Conversely, those that had at least primary education showed antiviral success preponderance. Marital status had no effect on the antiviral outcome, the socio-demographic characteristics of participants, stratified by antiviral outcome, is as depicted in Table 1. All the participants had received up to 30 months of uninterrupted HAART. Seven patients were lost to follow up, with three mortalities (2 males and a female) within 3 months of recruitment, the other 4 requested for transfer to Health facility closer to their homes.

The CD4+ Tcells/μl and haemoglobin concentration increased significantly from the 6th month (in comparison to baseline P < 0.05), their levels remained significantly high throughout the study. Conversely, there was no significant change in the levels of platelets and WBC at any point throughout the study (Table 2).

The mean ± standard deviation (SD) viral load in the antiviral success group (119 patients) was 5.25 ± 0.53 log<sub>10</sub> copies/ml at baseline. This decreased to an undetectable level after 12 months of treatment and remained relatively stable in the subsequent follow-up period. The mean ± SD of viral loads in the 26 antiviral failure cases was 5.09 ± 0.71, it fluctuated and was detectable at 30 months of treatment at a mean ± SD

**Table 2.** Changes in blood profile 145 AIDS after 30 months of HAART.

| Treatment duration (months) | CD4 <sup>+</sup> T-cell (cells/ $\mu$ l) | Haemoglobin (g/dl) | WBC (cells/ $\mu$ l) | Plateletes (platelets/ $\mu$ l) |
|-----------------------------|--|--------------------|----------------------|---------------------------------|
| 0 (Baseline)                | 167.67 $\pm$ 109.38                      | 10.27 $\pm$ 2.08   | 5.32 $\pm$ 2.36      | 300.57 $\pm$ 106.12             |
| 6                           | 260.46 $\pm$ 142.46*                     | 11.23 $\pm$ 1.80*  | 4.89 $\pm$ 1.74      | 302.78 $\pm$ 113.56             |
| 12                          | 341.19 $\pm$ 173.85*                     | 11.78 $\pm$ 1.58*  | 4.98 $\pm$ 1.60      | 297.23 $\pm$ 99.91              |
| 18                          | 371.86 $\pm$ 205.02*                     | 12.02 $\pm$ 1.68*  | 4.76 $\pm$ 1.34      | 309.88 $\pm$ 98.47              |
| 24                          | 410.97 $\pm$ 244.72*                     | 11.95 $\pm$ 1.73*  | 5.00 $\pm$ 1.54      | 295.38 $\pm$ 91.49              |
| 30                          | 481.48 $\pm$ 481.01*                     | 11.95 $\pm$ 1.61*  | 4.80 $\pm$ 1.23      | 279.25 $\pm$ 73.80              |

Data presented as mean  $\pm$  SD. WBC: white blood cell count.\*P < 0.05 compared with baseline; least-squares difference of one way analysis of variance.

**Table 3.** Viral load (VL) in patients with Acquired Immuno Deficiency Syndrome during 30 months of highly active anti-retroviral therapy (HAART).

| Treatment duration (month) | Antiviral success Group (n = 119) VL log <sub>10</sub> (copies/ml) | Statistical significance <sup>a</sup> | Antiviral failure Group (n = 26) VL log <sub>10</sub> (copies/ml) | Statistical significance <sup>a</sup> | Statistical significance <sup>b</sup> |
|----------------------------|--|---------------------------------------|---|---------------------------------------|---------------------------------------|
| 0 (Baseline)               | 5.25 $\pm$ 0.53  |                                       | 5.09 $\pm$ 0.71   |                                       | 0.040*                                |
| 6                          | 3.96 $\pm$ 0.98  | 0.000*                                | 3.41 $\pm$ 0.95   | 0.152                                 | 0.897                                 |
| 12                         | 2.30   | -                                     | 4.78 $\pm$ 0.77   | 0.688                                 | -                                     |
| 18                         | 2.30   | -                                     | 4.51 $\pm$ 0.82   | 0.477                                 | -                                     |
| 24                         | 2.30   | -                                     | 4.43 $\pm$ 0.64   | 0.608                                 | -                                     |
| 30                         | 2.30   | -                                     | 4.40 $\pm$ 0.48   | 0.056                                 | -                                     |

Data presented as log<sub>10</sub> mean  $\pm$  SD. <sup>a</sup>Statistical significance versus baseline; least-squares difference of one way analysis of variance. <sup>b</sup>Statistical significance of antiviral failure group versus antiviral success group; least-squares difference of one way analysis of variance.\*Statistically significant.

**Table 4.** CD4<sup>+</sup> T-cell count in patients with acquired immuno deficiency syndrome during 30 months of highly active antiretroviral therapy (HAART).

| Treatment duration (month) | Antiviral success Group (n = 119) (cells/ $\mu$ l) | Statistical significance <sup>a</sup> | Antiviral failure Group (n = 26) (cells/ $\mu$ l) | Statistical significance <sup>a</sup> | Statistical significance <sup>b</sup> |
|----------------------------|--|---------------------------------------|---|---------------------------------------|---------------------------------------|
| 0 (Baseline)               | 171.04 $\pm$ 108.80                                | -                                     | 152.19 $\pm$ 112.85                               | -                                     | 0.376                                 |
| 6                          | 273.89 $\pm$ 141.15                                | 0.038*                                | 201.27 $\pm$ 135.45                               | 0.900                                 | 0.000*                                |
| 12                         | 359.13 $\pm$ 175.58                                | 0.000*                                | 259.12 $\pm$ 141.57                               | 0.205                                 | 0.000*                                |
| 18                         | 394.39 $\pm$ 201.43                                | 0.000*                                | 268.77 $\pm$ 192.73                               | 0.132                                 | 0.000*                                |
| 24                         | 435.26 $\pm$ 246.23                                | 0.000*                                | 299.77 $\pm$ 207.59                               | 0.230                                 | 0.000*                                |
| 30                         | 519.61 $\pm$ 515.72                                | 0.000*                                | 306.96 $\pm$ 196.92                               | 0.140                                 | 0.000*                                |

Data presented as mean  $\pm$  SD. <sup>a</sup>Statistical significance versus baseline; least-squares difference of one way analysis of variance. <sup>b</sup>Statistical significance of antiviral failure group versus antiviral success group; least-squares difference of one way analysis of variance. \*Statistically significant.

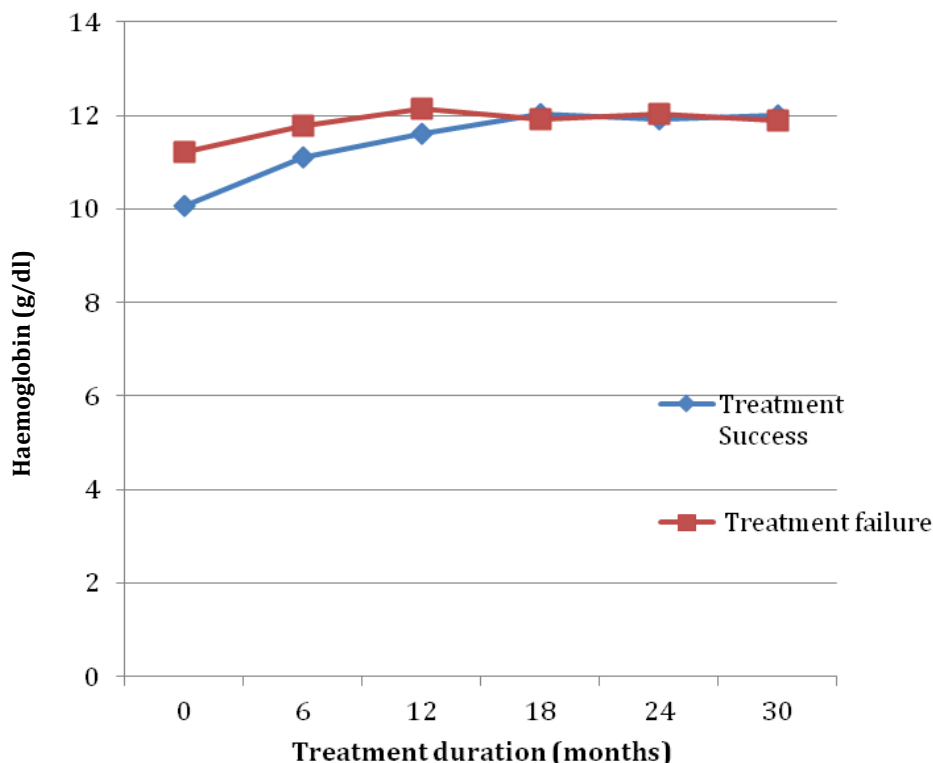
level of 4.40  $\pm$  0.48 log<sub>10</sub> copies/ml as shown in Table 3. In the antiviral success group, the mean  $\pm$  SD CD4<sup>+</sup> T-cell count increased significantly at 6 months of treatment (P  $\leq$  0.038 versus baseline), and then increased steadily

and significantly in the subsequent follow-up period (P < 0.05). The increase in CD4<sup>+</sup> T-count was not significant at any point in the antiviral failure group (Table 4). The change in mean  $\pm$  SD WBC count was insignificant in

**Table 5.** White blood count (WBC) in patients with acquired Immuno deficiency syndrome during 30 months of highly active antiretroviral therapy (HAART).

| Treatment duration (Months) | Antiviral success Group (n = 119) (cells/ $\mu$ l) | Statistical significance <sup>a</sup> | Antiviral failure Group (n = 29) (cells/ $\mu$ l) | Statistical Significance <sup>a</sup> | Statistical significance <sup>b</sup> |
|-----------------------------|--|---------------------------------------|---|---------------------------------------|---------------------------------------|
| 0 (Baseline)                | 5.49 $\pm$ 2.45                                    |                                       | 4.56 $\pm$ 1.73                                   |                                       |                                       |
| 6                           | 4.92 $\pm$ 1.76                                    | 0.167                                 | 4.76 $\pm$ 1.67                                   | 0.997                                 | NS                                    |
| 12                          | 5.04 $\pm$ 1.65                                    | 0.426                                 | 4.68 $\pm$ 1.38                                   | 1.000                                 | NS                                    |
| 18                          | 4.87 $\pm$ 1.35                                    | 0.303                                 | 4.31 $\pm$ 1.25                                   | 0.996                                 | NS                                    |
| 24                          | 4.97 $\pm$ 1.24                                    | 0.833                                 | 4.45 $\pm$ 1.61                                   | 1.000                                 | NS                                    |
| 30                          | 5.10 $\pm$ 1.82                                    | 0.490                                 | 4.15 $\pm$ 0.98                                   | 0.969                                 | NS                                    |

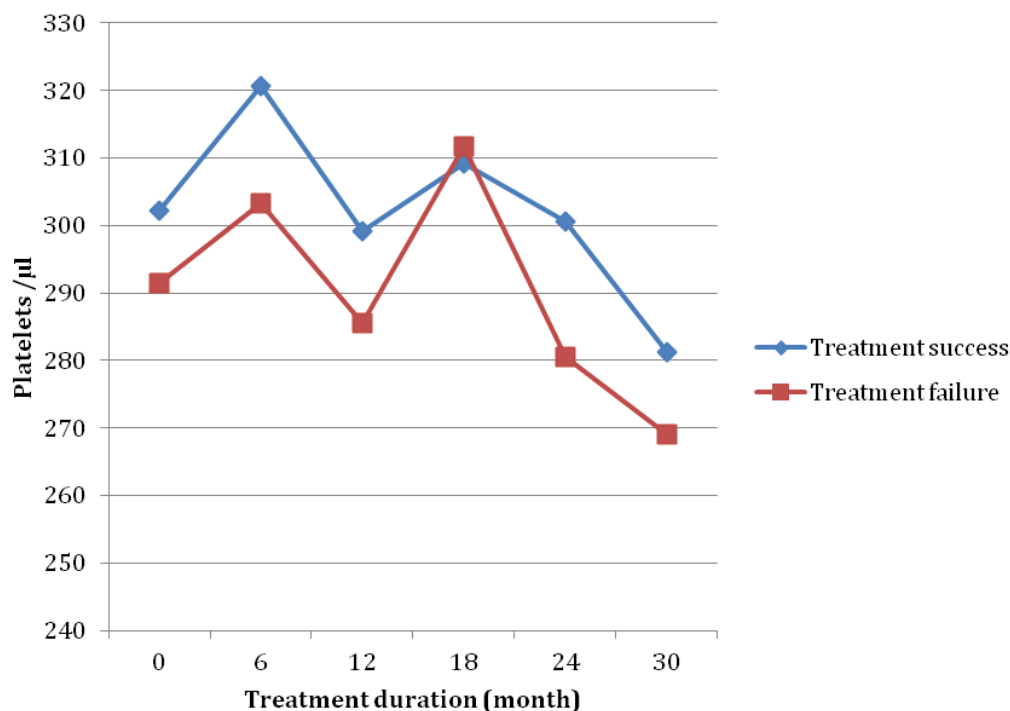
Data presented as mean  $\pm$  SD. <sup>a</sup>Statistical significance versus baseline; least-squares difference of one way analysis of variance. <sup>b</sup>Statistical significance of antiviral failure group versus antiviral success group; least-squares difference of one way analysis of variance. NS: not statistically significant between group differences ( $P > 0.05$ ).



**Figure 1.** Haemoglobin concentration over time in AIDS patients during 30 months of highly active antiretroviral treatment, haemoglobin levels in the treatment success group were similar to treatment failure group ( $P > 0.05$ ) (data presented as mean  $\pm$  SD).

over the 30 months study in both antiviral HAART success and failure group, neither was any significant difference between these two groups observed (Table 5). Before the initiation of HAART, mean  $\pm$  SD haemoglobin concentrations (g/dl) of 10.06  $\pm$  2.09 in HAART success group was similar to 11.23  $\pm$  11.23 in HAART failure. The

mean  $\pm$  SD haemoglobin increased to 12.01  $\pm$  1.62, with a change of 1.95  $\pm$  0.47 in the success group, the corresponding increase in HAART failure group was 11.88  $\pm$  1.58, with a change of 0.65  $\pm$  0.26 after 30 months of HAART (Figure 1). There were no significant differences in platelet count in either group from baseline to study



**Figure 2.** Platelet numbers in AIDS patients during 30 months of highly active antiretroviral treatment; no statistically significant differences in platelet count versus baseline in either group (data presented as mean  $\pm$  SD).

end point (Figure 2).

## DISCUSSION

The decision to start HAART in patients with HIV involves making a judgment about when the benefits of therapy outweigh the harms; HAART should be commenced early enough to avoid any clinical consequences of immune suppression and maximise immune reconstitution, but late enough to minimise harms such as drug adverse effects, drug pressure risking development of resistance, and burdens such as the cost of medication (Cohen, 2000; Zachariah et al., 2006). Haematological abnormalities (anaemia, leucopenia and thrombocytopenia) are common manifestations of advanced HIV-1 infection that could potentially limit the use of some components of antiretroviral therapy (ART) regimens (Zachariah et al., 2006; Levine et al., 2006).

The CD4+ cell count is central to the decision to initiate HAART in standard clinical practice along with clinical indices and HIV RNA viral load measurement (Anonymous, 2003). CD4 count and viral load tests are rarely available in resource poor settings for reasons of, high cost, inadequate infrastructure, and insufficient

numbers of trained personnel to administer tests, among others (Colebunders et al., 2006). Even where the duo is available, CD4 count may fail to increase despite sustained virological suppression (discordant Immunovirologic response), thus limiting the use of CD4+ cell count in monitoring response to HAART (Bisson et al., 2006; Taiwo and Murphy, 2008). Conversely, rapid changes in CD4+ T-cell count and function appear to have a temporal correlation with clinical immune reconstitution inflammatory syndrome (IRIS) events in conditions such as mycobacterial and cryptococcal infections; and some observational data using blood have suggested that IRIS occurs more frequently in individuals with faster and more marked elevations in blood CD4+ cell count after commencing HAART.

Clear evidence to support this hypothesis, especially at local sites of inflammation, however, is lacking. In Cytomegalovirus (CMV) uveitis, cryptococcal meningitis and tuberculosis, studies suggests that IRIS is more common when there is extensive disease presence (Breen et al., 2004; Shelburne et al., 2005; Karavellas et al., 2001; Jenny-Avital and Abadi, 2002). The underlying pathological mechanisms driving these events are unclear, although the available data highlight the importance of CD8 T-cell responses, perhaps with a Th2 bias,



as shown by increased plasma level of soluble CD30 (Stone et al., 2002; Hsieh et al., 2001). A plausible explanation of this would be that abundant microbial antigen, whether alive or dead, promotes a greater immune response when it encounters suddenly increased numbers of functionally active antigen specific cells. This may suggest that IRIS might be expected to be less frequent if HAART is delayed until such time as significant antigen clearance has occurred, following specific antimicrobial therapies (Shelburne et al., 2005; Stone et al., 2002; Hsieh et al., 2001). On the other hand, whereas several AIDS-defining infections associated with severe immunodeficiency, including pneumocystis jiroveci pneumonia (PCP), mycobacterium avium complex, and CMV retinitis, decreased significantly in the HAART era as did AIDS-defining malignancies such as kaposi sarcoma (KS) and primary central nervous system lymphoma (PCNSL).

Unfortunately, AIDS-related lymphoma (ARL) of intermediate and high-grade peripheral B-cell phenotype has not changed as significantly, with some studies reporting no change or even an increase in incidence, irrespective of the CD4+ cell counts (Skiest and Crosby, 2003; International Collaboration on HIV and cancer, 2000; Kirk et al., 2001; Matthews et al., 2000; Gerrald et al., 2002; Vaccher et al., 2003). The WHO recognised this problem in its guidelines for scaling up antiretroviral use in resource poor settings. It has recommended the use of TLC in addition to WHO clinical staging criteria in an alternative algorithm. The WHO has suggested that in the absence of information or the ability to count CD4+ T-cells, a TLC of 1200 cells/ $\mu$ l is typically equivalent to a CD4+ T-cell count of 200 cells/ $\mu$ l (WHO, 2003).

TLC is calculated by multiplying the total WBC by the lymphocyte percentage (Taiwo and Murphy, 2008). The lymphocyte percentage of total WBC, which is necessary to calculate the TLC, is most accurate if determined within a few hours of phlebotomy (Taiwo and Murphy, 2008; Breen et al., 2004; Shelburne et al., 2005; Karavellas et al., 2001; Jenny-Avital and Abadi, 2002; Stone et al., 2002; Hsieh et al., 2001; Skiest and Crosby, 2003; International Collaboration on HIV and cancer, 2000; Kirk et al., 2001; Matthews et al., 2000; Gerrald et al., 2002; Vaccher et al., 2003; WHO, 2003; Akinola et al., 2004). Many haematology workstations in resource-limited settings are unable to meet this stringent criterion, and there are unavoidable excursions in ambient temperature that accelerate the degradation of laboratory samples. As such, TLC calculations are prone to error (Levine et al., 2004; Anonymous, 2003; Colebunders et al., 2006).

Another factor that can unravel potential correlation between TLC and CD4+ T-cell count is that TLC captures both B and T-cell subsets. Accordingly, a person with low CD4+ T-cell could have relatively high TLC if high amounts

of B-cells are expressed due to immune hyperactivation from exposure to the wide variety of circulating antigens in sub-Saharan Africa (Taiwo and Murphy, 2008; Chen et al., 2007)..

Severe anaemia is very common in HIV infected patients, with 40% of HIV infected patients developing various degrees of anaemia in the advanced stage of disease (Sullivan et al., 1998; Bolge et al., 2007; Sloand, 2005; Fangman and Scadden, 2005). This study is in agreement with previous studies that observed that anaemia is not related to disease progression or low CD4+ T-cell count (< 200 cells/ $\mu$ l), although anaemia can be significantly improved by HAART (Bolge et al., 2007; Fangman and Scadden, 2005).

Previous studies have shown that TLC counts, an haemoglobin concentration in peripheral blood, decline significantly in HIV-infected patients before the onset of AIDS, particularly in the presence of opportunistic infections (Sloand, 2005; Moylett and Shearer, 2002). Thus, TLC and haemoglobin concentrations may be used in resource-limited settings as an indicator for the initiation of HAART. The Government of Nigeria with the support of implementing partners such as President's Emergency Plan for AIDS Relief (PEPFAR) Project provides free antiviral drugs, but routine detection of HIV RNA and CD4+ T-cells is neither available nor affordable in most clinical units, rendering necessary the urgent provision of additional monitoring indicators. Blood profiles of patients with AIDS receiving HAART were followed up for 30 months in the infectious diseases unit at the University of Maiduguri Teaching Hospital, Maiduguri to search for additional monitoring indicators. It was found that CD4+ T-cell count and haemoglobin concentration increased shortly after HAART was initiated.

The present study found that haemoglobin concentration improved with HAART, and remained stable in both antiviral success and antiviral failure group. However, the increase in CD4 count was only observed in antiviral success group, this suggests that the haemoglobin concentration is not related to the efficacy of HAART. There was no significant change in WBC, regardless of the success or failure of HAART regimen. WBC is known to be influenced by other factors such as opportunistic infections (Moylett and Shearer, 2002; Yang et al., 2008). The findings of the present study suggest, therefore, that WBC is not suitable for determining when to begin or monitor the efficacy of HAART. The absence of change in platelet count in relation to increased CD4+ T-cell count in response to HAART in this study confirms the findings of others (Lau et al., 2005).

The use of CD4 count to monitor the long-term efficacy of therapy in the absence of viral load may still remain the consistent option in our environment. Haemoglobin concentration, white blood cell count and platelets are not

related to disease progression in HIV patients on HAART in this study.

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Full Length Research Paper

## Situating morality in housing debate: A case of Matapi hostels (Harare)

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For quite a long time, in the long history of urban housing in Zimbabwe, the quandary of people living in previously known as 'bachelors' hostels in various urban centres, particularly Matapi hostels in Mbare (Harare, Zimbabwe), has often been overlooked. Thousands of people from distinct backgrounds currently occupy these hostels. This has inevitably brought a number of social ills that are detrimental to human well-being. Severe health problems are emanating uncontrollably due to the hostels incapacity to accommodate ever-increasing numbers. The question of urban health is greatly being compromised by this situation. Even morality, which is firmly rooted in religious and cultural backgrounds, is a case for concern. The uncontrolled manner of moral dissipation and momentous termination of the ubuntu of the habitants warrants research. As a result, this paper elaborates, explains and analyse the living conditions of the habitants in the hostels. Though the paper is largely qualitative, some quantitative evidence to augment discussions are not totally omitted, and its photographs of the case were also used.

**Key words:** Housing, morality, hostel, Matapi, policy, Harare.

### INTRODUCTION

To date, Matapi hostels as is the case with other old hostels, accommodates a sizeable number of households. These households live in squalid conditions not fit human survival. The state of the hostels are nothing but an odious experience to live in. However, the habitants seem not concerned about the precarious idiosyncrasy state they find themselves in. To them, it has become a normality to live in those conditions. In this age, where the word sustainable development has become a household name, one wonders how these inhabitants continue not to care about their well-being (Schlyter, 2003).

The people are caught in a difficult situation, as housing challenges in the capital is a cause for concern. One way or the other, they have to accept whatever is on offer. To them, housing has seem to be just a roof over

their heads. It is against this, this paper sifts through in order to find a footing for morality in the housing debate (UNCHS, 1998; UNHABITAT, 2003).

### Overview of the accomodation crisis in Zimbabwe

Housing and accommodation challenges in Zimbabwe emerged in full force about three decades ago (Mubvami, 2001; Hall, 2001). They are a direct product of the weak policy framework implemented soon after the government took over from the white government, which had restricted laws on the movement of people from rural areas to urban areas (Chirisa and Munzwa, 2008). Zimbabweans then were left with only two mutually-exclusive options, either to be in employment to qualify to

be in the urban centres but on a semi-permanent basis, or to be in the rural areas (called 'reserves' or 'tribal trusts' land' (TTLs)) for life. This resulted in lower population living in urban centres. The takeover of the new black government led by (Mutekede and Sigauke, 2007; Mutizwa-Mangiza, 1985) Robert Mugabe ushered in a new era in terms of the movement of people in the restricted centres. People started to flock into the urban areas, exerting pressure on the already planned settlements that were solely designed for a specific number of people. Although the government tried to offer new houses for the people, its approach was rather too lackadaisical considering the magnitude of the immigration, especially in Harare, which is the capital city of the country. Chirisa and Dumba (2010) and Mutizwa-Mangiza, (1985) opine that during the first five years of attaining independence, the country's leadership overstayed in political honeymoon and forgot to address the pertinent issues affecting the country then.

In addition, it must be noted that the majority of women were found outside the bracket of those who qualified to be in the towns. Consequently, the city was a prerogative of the whites and very few African men. As for the black females, the city was for those but few who were chanced to get employment as housemaids and nannies (in the lower bracket) or those who got places to train in urban hospitals as nurses or clerks (in the higher bracket). It must be stressed that the colonial Afro-insensitive laws ascertained that the Africans were wholly tied to the rural communal tribal land that he or she could never voice for equal rights to get to parity with whites (Mubvami, 2001). Though these policies and regulations were repellent, oppressive and inhibiting, and irrationally tilted towards European interests, they assisted much to discourage 'invasion of the city' by Africans.

However, in the 1970s, with the growing pressure in the rural areas of the war for independence (1966 to 1979), rural populations migrated into the urban zones because the space promised peace, security and prosperity. This trickling into urban space, at that time (especially the mid and late 1970s), was at a very diminutive rate. It was not hurried, yet indicative of the difficulties of habituating in the TTLs and the eye-catching glamour of the city (Patels and Adams, 1981). The push factors of the rural areas, levelled against the seemingly good pull factors of the city, produced a brighter atmosphere for the poor migrants. Until independence, the dual economy between whites and blacks made it conspicuously noticeable that the racial divide was not along social lines but also physical, for the European areas were too unreachably better than the African residential areas in terms of class (Cormack, 1983). Whites segregated themselves to the flashy northern and eastern suburbs whilst blacks were living to the southern regions.

### **Opening of the floodgates: An ushering in of disaster**

The coming of the country's independence brought a new

lease of life to the black majority who were once restricted to the TTLs, and unknown realities came out clearly. The people who had formerly not known freedom now had to feel the benefits that freedom carries. The new government in power was liberal and compassionate enough to guarantee that the people reap the fruits of the promises it had made, albeit, wartime propaganda. Walls that once divided the white area and the African area (the 1930 Land Apportionment Act (replaced by the 1969 Land Tenure Act; the 1951 Land Husbandry Act; the vagrancy and pass laws) were, in a way, broken down.

Floodgates were opened as some may want to call it. That glimpsed golden future time of the promise became a close inhabitable reality. Milk and honey became drinkable realities in the likeliest of possibility. It was now not so much a matter of desire but having the means (commensurate fares for transport and wielding the highest of hopes for the city) to take anyone to the once sacred and predominantly white-only city. In this vein, there grew a huge influx of blacks in the urban areas. The few jobs in the city got packed (this has given way to the rise and expansion of the informal city, as people have had to create self-employment by informal sector means). The few houses in the black townships got fully occupied; in effect, there developed a prevalence of the lodger population than had been witnessed before in these areas.

The city, (Government of Zimbabwe, 1991a; 1991b) formerly chiefly for African men, became city for the family (as women and children became more accommodated) - what can be termed the 'familiarisation' of urban centres in Zimbabwe. Added to that, the reconciliation policy adopted by the new government also tolerated the beauty of multi-racial and multi-ethnic mix than more than in the days of colonial mastery and hegemony. What a 'melting pot position' cities and towns were placed in! It must be noted that the gendering and 'familiarisation' of the city also came with their own challenges. Personal interactions increased at a more tremendous rate relative to colonial days. These interactions, one can observe, were happening not in most spacious of places but in the over-urbanising black townships. Harare, for instance was a city created but for a small population (Zinyama et al., 1983)

That inelasticity implied that any growth would exert untold pressure on the existing resources hence a float above the carrying capacity of the city. It logically follows that crime (thefts, mugging, larceny, prostitution, to mention these few) was to grow as an opportunity cost of employment; that over-crowdedness with its indicators (slum dwelling, squatter developments and backyard developments) would make its place in lieu of conventional housing (Cormack, 1983). By way of proximate indicators, one can say that the happening of these inhuman activities in the urban territory of Zimbabwe are a reflection of the deep decadence of morals in the persons harboured in it.

It is unfortunate that a few years into Zimbabwe's black

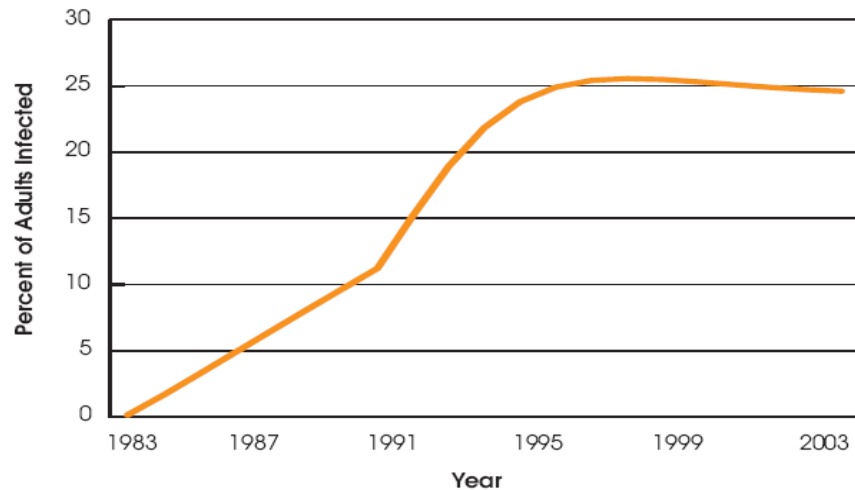


Figure 1. Estimated HIV prevalence, ages 15 to 49, 1983 to 2003

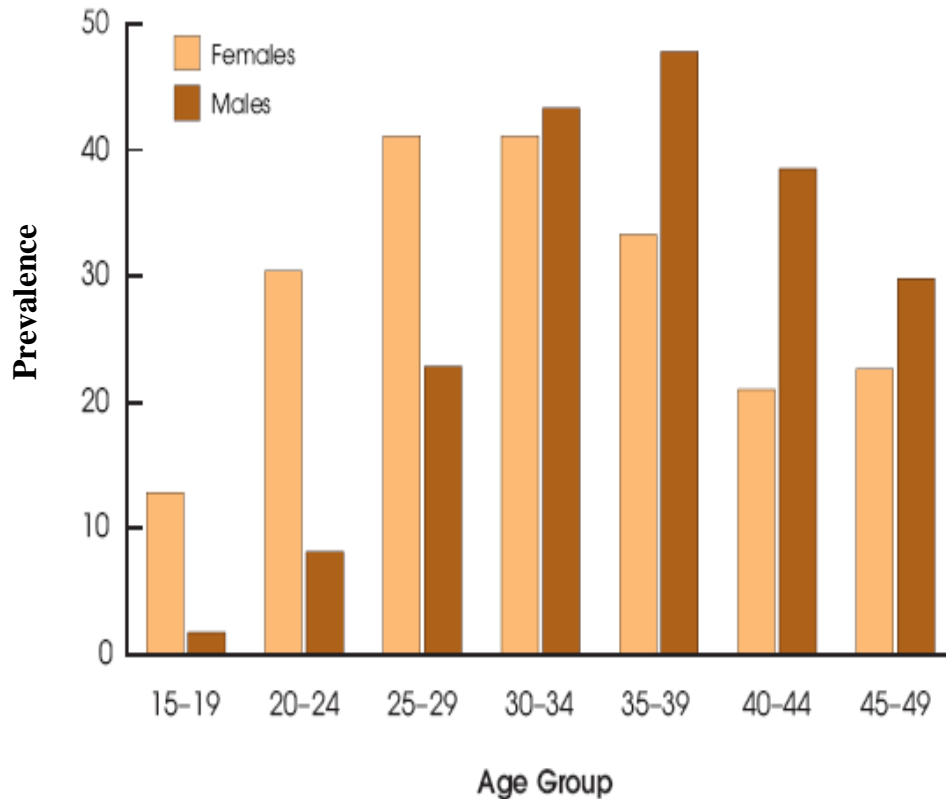
independence, the above-stated scenario got into picture—a reflection of the frustrating city. During the same time, human immune deficiency virus (HIV) and acquired immune deficiency syndrome (AIDS) emerged on the horizon. In those 1980s and early 1990s, the majority was caught unaware by this deadly disease (Figure 1) (Ministry of Health and Child Welfare (MOHCW) and National AIDS Council (NAC), 2004). The number of people, predominantly the able-bodied, young and middle-aged men and women (Figure 2), who got affected by the deadly pandemic, grew by the day. It is gloomy to learn that during this time (when prostitution and drug abuse grew), stigmatization of victims and secretisation of HIV and AIDS were also very widespread. As such, many died; many were anathematized, detested and left to 'bear the brunt of their sexual sins.' However, innocent children died too. Yet, promiscuity continued. There was little, if any, knowledge about antiretroviral (ARV) drugs, only rumours of some traditional healers here or there who had discovered the 'medicine'—*the African potato*, 'let the infected sleep with a newly born baby', 'let them sleep with their sister of brother', to mention but a few. This was a false gospel entrenched in the culverts of misery, selfishness, debauchery, and incest.

One can blame moralists for the cost of lives that continued unabated because a 'spade was never called a spade'. People did not want to be open about the pandemic. It was more of a secret. Yet, it is also blame-worthy on the housing conditions to which the majority of African urban dwellers were subjected to (Kamete, 2006). The once sparsely distributed rural dwellers were now in concentrated enclaves of which hostels and flats, as well as the mushrooming backyards shacks, were the biggest types (Tevera and Chimhowu, 2000). The former rural free, in terms of human interactions, were now caged with increased informal interactions, especially of

opposite sexes. This is not to limit morals to sexuality alone or to attribute the astronomical rise of AIDS cases to it only, but to try to narrate how the morality hitch evolved and the epiphenomenal effects it might have brought to the social fabric we now have in urban Zimbabwe. As already alluded, the problem is largely embedded in the housing problem (Kamete, 2006; Chirisa and Munzwa, 2008).

Regarding the causal links of the morality quandary about Matapi Hostels in Mbare, many explanations are possible. These include the increase of urban interactions in confined urban space, the increase in the disposable income of some households with the father of the house keeping much to himself and then hiring out lovers (including commercial sex workers, pimping school girls, and the like), and the prevalence of many idle housewives. Nevertheless, one can see that these issues revolve around the home which element is a housing issue. Some may not see how the two issues (housing and morals) directly interlink and downplay of the debate as a topical issue, and the implications to society are large. They define the sustainability of urban centre and the subsequent health status of the population concerned (Nsiah-Gyabaah Kwasi, 2004). A city and human habitat that ignores the civic debate of life stands inevitably will not withstand stormy times (Davidson, 2007). Morality is the foundation of the civility.

There are a number of definitions to the word 'morality'. From the definitions, some 'measurement' can be derived (Robinson and Yeh, 2007). One definition is morality as responsibility. This involves acting in accordance with other people's concerns, rights and expectations. That means not only refraining from doing things that cause harm to others, but also actively pursuing their welfare - it implies the imperative to do as we say and believe. In light of this definition, one can see residents expressing mercy upon each other. This is an aspect of community



**Figure 2.** Age-sex distribution of infected persons 15 to 49, 2003.

reciprocity and comradeship. The local authority, the City of Harare, as the property owner has continued to accommodate these home-hungry people in its hostels. It has done so as a subsidiary and arm of government. However, such generosity has failed to address the issue of cultural and religious morality so that children are brought up in a culturally and religiously acceptable environment. Even the elderly and religious sections have taken it as the norm.

The next definition is morality as concern for others (ibid). This involves understanding how others experience a loss. It compels avoidance of imposition of a loss on another. This definition is in congruence with the first definition. It explains what happens in time of adversity, for example how households accommodated each other during the time of operation restore order (where illegal houses were brought down in 2005 in Zimbabwe). One observes how somebody must choose to be irrational and just decide to stay with others at whatever cost. In this regard, to be humane and irrational are synonymous. The third definition is morality as reason (ibid). Robins and Yeh (2007) argue that in this aspect, morals should be justifiable according to an objective set of criteria. Next, morality is viewed as consistency whereby analogous cases are treated similarly without double standards (ibid). Finally, morality is taken to mean universality (ibid). This means that same conditions must

be applied to all concerned, a kind of social justice when dealing with matters affecting community. These definitions are applied variously according to the situation at hand.

Matapi hostels stand out as a critical case for concern due to the accommodation woes in urbanity (Mubvami, 2001). It is not the only place but one exhibiting challenges of social break up due to effects of change in government policy, as well as, individual choices of the inhabitants. Matapi is a Shona term for a type of veld mice found near wet areas (*dambos*). The term is in plural form. The blocks of flats are found on the banks of Mukuvisi River. The waters of the river are heavily polluted but residents have embarked on serious stream bank cultivation. They grow also all sorts of crops and vegetables including maize, sugarcane, potatoes, tomatoes, cabbages and onions, hence greening the banks throughout the year. The allotment of this land is contrary to statutes and regulations.

The Environmental Management Act of 2002 stipulates that no activity of cultivation should take place for some thirty metres from the river. De facto, this is breached, resulting in a number of environmental hazards. Flooding is one of the challenges in the rain season. Tall grasses also grow and they normally go uncut for more than six months. It is not unusual to come across corpses of people who have been killed by muggers. Mbare, of

which Matapi is a segment, is labelled as a place of robbers, thieves, muggers, prostitutes, con-artists, and all kinds of evil. The place is also known to harbour all types of ethnic groups especially those from Malawi, Zambia, Mozambique, and Zimbabwe. Such a picture gives a strong impression of cultural diversity and susceptibility to high morals erosion.

### **The blight: Matapi hostels in Mbare**

Matapi flats are a creation of the colonial local government policy of having unmarried males who came to the city in search of employment be housed. The hostels were sister developments to other hostels constructed in Mbare like Matererini, Mbare, Nyenyere (Magaba) and Shawasha hostels. Each 'bachelor' was allocated one room. Toilets, bath and kitchen were designed for communal use. Illegality or informality in habitation occurs when a house designed for occupation by a single family ends up in usage by more than that intended use. After independence, the issue of lodger accommodation has increased in the wider city of Harare, let alone Matapi. Matapi hostels comprise fourteen blocks of three storey floors (Mangombe, 2005). The average number of rooms in each floor is seventy, implying that each block constitutes about two hundred and ten rooms hence the total number of habitable rooms in the area is about two thousand nine hundred and forty. However, in some blocks, the ground floor was shared (Schlyter, 2003) between accommodation rooms and shops, beer halls and gyms.

Due to viability challenges to these ventures, space have been largely converted and further partitioned for housing to accommodate excess population. Important to note is how the population in Matapi hostels has surged from a static population size. It has grown from about three thousand males in 1980 to a fluctuating population of between twenty four thousand and thirty thousand (a mixture of men, women and children) (Chirisa, 2008). This is a case of outright overpopulation (ibid). the issues of vandalisms of the housing blocks such that the majority no longer have shower tapes. Residents believe thieves have stolen these items only to sell them in the nearby markets like the former Siyaso, in Magaba.

Toilets are messy and half the time blocked. The kitchens have as well been partitioned to house more people. The squalor and compromised environments are a health and moral hazard (Nsiah-Gyabaah Kwasi, 2004). What the habitat looks like is of little doubt the greater reflection of what morals in the hostels are like. The obsolescence of the building is a direct outcome of the abuse of space by residence and the failure by the local authority (since its rented accommodation) to maintain the hostels (Figure 4a to i).

It should be noted that the Matapi hostels has never been marred by the challenge of informal settlements

(though an infinitesimal number of households can be observed on the banks of Mukuvisi River, which flows by the place). In other words, illegal occupations of the space outside hostels has never been endemic to the settlement (cohabitation and multi-habitation refer to the staying together of one or more households in the same room or prime rooms on an informal (if not illegal) basis). Nevertheless, the problem of illegal dumping also threatens the health of the hostel dwellers. Children are the most vulnerable.

Sometimes, they practice scavenging of items thrown away by different households. What kind of items are usually these? Do the children have the discretion to discriminate between dangerous and 'worth' items?. Some of the dangerous materials include both used and unused condoms, opened tin cans and the like. It is thankful that dangerous weapons like hand grenades and land mines are rare in Zimbabwe at large. This is largely to describe outdoor experiences of Matapi. Not only that, it is also widely thought that the majority of street children found in central business district of Harare originate from such places as Mbare and Epworth, where the slum conditions impel children to seek alternative better livelihood sources in the 'bright lights areas'. Yet, in those places, they engage in dangerous activities like drug abuse, prostitution, bag snatching and pick-pocketing (UMP, 2000). The indoor living is tormenting to the inhabitants. Some kind of lodging arrangements subsists in the hostels. Conventionally, this is some form of illegal tenancy. A lodger is usually a person who is accommodated in a single-family housing arrangement and lives as a separate household. He or she pays rent to the house owner or head-tenant in custodianship of the residence premises. The lodger has to live within the stipulations and conditionalities (with own eating and sleeping arrangements) that he or she receives from the owner of the house or room or the head-tenant/responsible tenant.

In the era of economic reforms, that is, Economic Structural Adjustment Programme, ESAP (1991-1995) (GoZ, 1991a), households faced increasing costs of living. This forced many households to find alternative sources of income as many breadwinners were retrenched (GoZ, 1991b). One coping strategy adopted by residents in the hostels was to make returns from the small space of their rooms in return for rent as income (Mangombe, 2005). As economic hardship increased from the 1990s, commoditization of rooms and increased 'lodger' recruitments has been noted. This reflects mercy and sympathy especially for victims of operation restore order. However, the squeezing of people within small space and above its carrying capacity had brought about a serious damage to the environments (in the exterior) and morals (in the internal fabric of community being). The government's ambitious and ill-focused campaign in 2005, for restoring urban Zimbabwe's to the heydays of aesthetically pleasing 'planned' cities and towns was to a

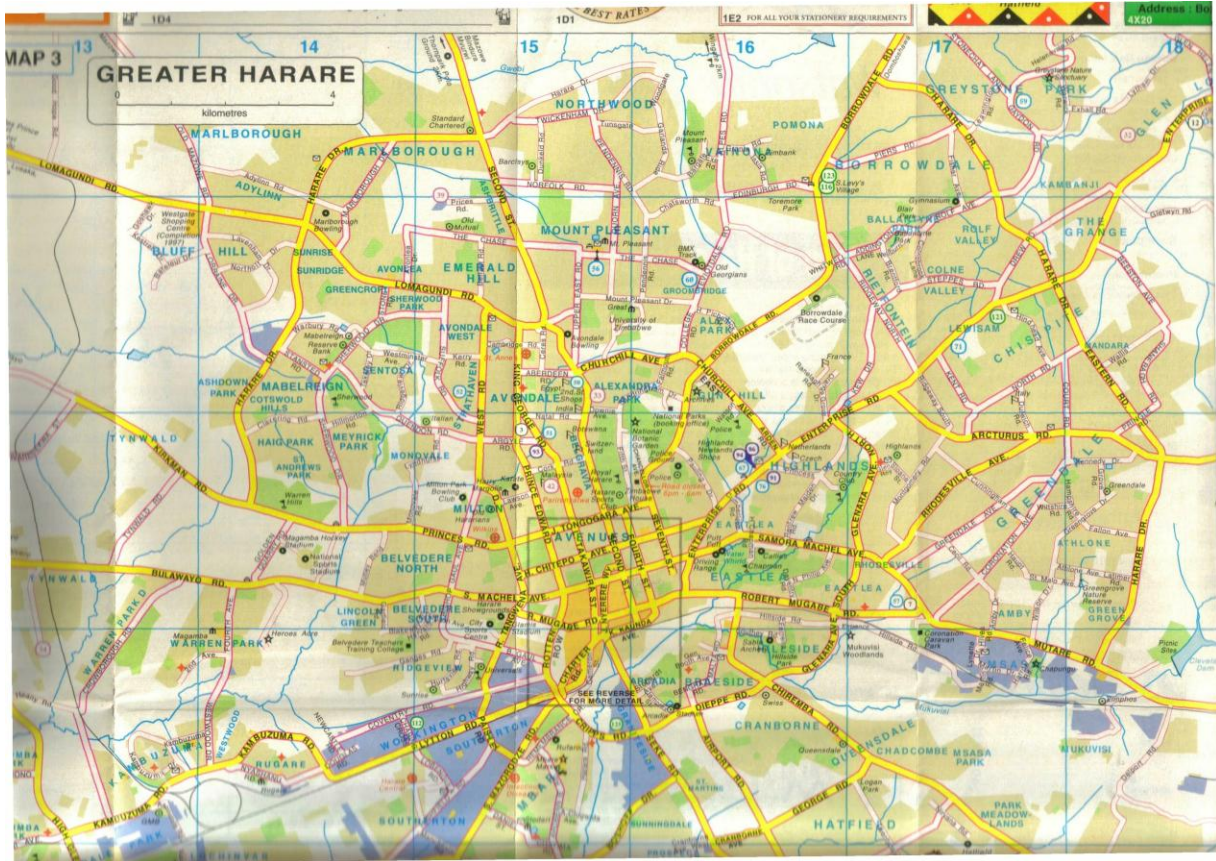


Figure 3. Map of Harare showing the different residential zones.

great extent, a misfired shooting. The crusade was code-named operation restore order or Operation Murambatsvina (Tibajuka, 2005). It left many urbanites homeless. It was targeted at 'unsanctioned' housing developments, slums and informal micro-enterprises.

The subsequent campaign effort, after the 'clean up' crusade, was termed Operation Garikayi/Hlalani Kuhle, meaning 'live well' and it aimed at relocating the adversely affected populations by the earlier campaign (Operation Murambatsvina) into public built houses mainly constructed in identified peri-urban areas. Only very few houses were built relative to the now increased homeless population.

Those who could not find the government-constructed accommodation could return back to rural settlements. This could have been for opportunistic or ethnic reasons because they may have been Mozambicans, Malawians or Zambians. They found themselves either streaming to the settlements created by Operation Garikai in areas like Hopley farm and Whitecliff or 'finding a place to lay their heads' in the same high density residential areas they had been staying in like Mbare, Highfield, Glen Norah, Mufakose, Kambuzuma and Budiriro (Figure 3).

Those who remained in Matapi Hostels, as in any other places of the city, had no other options but to constrict in

the small room space available. The outcome was such that most rooms now accommodated between eight and ten occupants (and an average of three households, a household being a group of persons who partake from the same pot and have collective sleeping arrangements). The post-Murambatsvina accommodation arrangement in the hostels has been worse than ever before. The situation constitutes a housing crisis. The households which found refuge in LDRAs should be better off, at least morally than those who remained in the hostels, however they now face the greater challenge of raising rent in foreign currency (with a room being charged between fifty South African rand and three hundred rand). If the pressure continues to mount the chances of these households, coming back to high-density areas or proceeding to rural areas are very high. In effect, it is generally now agreeable that life in the rural areas (or in the rural-urban fringe) has become better, cheaper and more moral than that offered by the town. Perhaps history is just repeating itself in Zimbabwe so much so that the population is turning *homo ruralis*. From an intentionalist point of view, this is by no means by choice or design but by the pressure exerted by the vagaries of urban living, particularly housing challenges. As pressure mounts humankind groans, meditates,





**Figure 4.** Matapi Habitat, Hostel Buildings and Lifestyle of the Dwellers in 2008. (a) An informal dumpsite in Matapi area. A child is seen sitting on the dump. (b) A child at the entrance of one of the hostel blocks. The hostel is in a messy state. (c) Hostel dwellers use washing lines in commonality. Cases of stolen clothes are many. (d) Another dumpsite just behind hostel block. The ablution area of the block is the worst vandalized. The responsible authorities (City of Harare) has cited financial and fuel problems for failure to discharge the waste collection service. (e) Children play on the dumpsite. See satellite antennae hanging on the walls. The dwellers may be poor in other respects but they thrive to be information-rich. But what is also the challenge of the media. (f) A building in a worst state of deterioration. As residents share the communal ablutions, they quarrel, gossip, preach the gospel one to another and share the latest news. What an admixture of activity and involvement! (g) See the parked cars and the road - full of potholes with water. (h) A less child-friendly environment (i) Compare with (c).

devises and optimizes. Overall, it is morals which have been the worst shredded due to this negative development. Table 1 shows a summary matrix of objectively defined morals according to Matapi residents. It shows the disjunction the reality and the actual arrangements on the ground. As can be noted the negatives outweigh the positives. This shows how the principles of morality are

difficult to follow and adhere to, especially where motley of people of different beliefs, backgrounds and standing are forced, by circumstances beyond their control, to stay together.

Due to these constraints, the majority of the home-seekers are left with no option but to 'adapt, adhere, and accord' to the confines and prisons of the enclaves of the

**Table 1.** Summary matrix of objectively-defined morals according to Matapi residents.

| Criterion for morality (de jure arrangement)  | What is on the ground? (de facto arrangement)   |
|---|---|
| Residents should greet each other when they meet each other in the corridors, the bath, and the streets. Elders should set a good example so that the youth may learn and do the same | Greetings one another is confined to those who are known to each other. Sometimes there are more quarrels than harmony in the communal places. Not all elders are good examples to follow in conduct. Some are known for bad practices including drunkenness and witchcraft.  |
| Residents should not practice promiscuity and adulterous behaviour  | The youth are highly promiscuous. 'Kubika mapoto', which is having, some spare 'housewife is commoner than rare. A new version to this is the 'small house' [arrangement. This is a new form of kubika mapoto, whereby a husband has an informal conjugal arrangement with a woman or many and may stay for weeks or months to the home of the formal marriage. Unlike the 'kubika mapoto' arrangement, the extra-marital relationships are usually intra-urban or inter-urban. This is tantamount to 'conventionally known' prostitution. We can call it prostitution in close proximity with home. The chief reason cited for the engagement is increased affluence or too many resources (normally cash, groceries and other flash commodities like cars) to cater for two or more houses with sexism as the battering price |
| Residents should shun stealing and robbery and try to leave by means of own sweat   | Some households thrive on stealing, mugging and larceny. They may avoid practising it within Matapi but they are seen doing these malpractices in the CBD, or other places of the city – good within community but bad elsewhere  |
| Residents should shun use of vulgar and obscene language  | Vulgar language is very common in the corridors and communal areas. Most walls of the communal areas are scribbled with words of obscenity. Pomography is rampant   |
| Children should respect elders  | The majority do not even respect their parents how much more with strangers   |
| Everyone is entitled to practice his or her self chosen religion  | This happens, to a great extent   |
| Residents should be peaceful  | This is not always true of the place. Violence intensifies in election times as well as public holidays   |
| Residents must keep public toilets and baths clean  | This is a mammoth task. These places are used by a multiplicity of actors – children, adults and elders. Control and monitoring are not easy  |
| Grievances must be brought to the hostels' tribunals so that no one takes the law into his or her own hands   | This is sometimes done. Some of the cases are not civil in nature (but criminal) and they are handled by the police   |
| Other: Residents should not dump garbage everywhere. Children should not scavenge. Residents should avoid noise (from TVs, radios) and other anthropogenic sources                    | The true opposite of this posits usually happens  |

Source: Field Interviews, 2008.

slum environments, like Matapi. These areas are usually nothing but places of immense moral decadence and drifting into the unknown dungeons of social depravity.

## CONCLUSIONS

Accommodation remains one great challenge that urbanity and civilisation has produced to humanity. With more of reactive planning than proactive and pre-active planning, it continues to daunt urban centres with no clear light about its resolution at the end of the tunnel. For Harare, the problem is worsened by the primacy the city has.

Many people view the city as the only place to be. For Matapi, in particular, morals have continued to nose-dive into the dungeon of misery and helplessness. It is not easy to prescribe for social behaviour but a stewardship approach can form the basis for habitability of Matapi. The principle involves stakeholders seeing the problem with the same lenses, debating towards consensus about it, and agreeing on the panacea package. This is not easy but it is practically possible at community level.

The government should strive to engage efforts in finding suitable land for relocating residents, financing or seeking finance partners to the housing development projects, encouraging

households to do self-help housing and revise its housing policy so that crosscutting issues of gender, HIV and AIDS, environment, and morals are clearly defined for implementation. Yet mainstreaming morals into policy seems more abstract than pragmatic. The local authority should also thrive to monitor its properties and make strict controls in the usage of the hostels. Comprehensive renewal of the buildings may not be easy, especially in difficult times such as the country is going through. Indeed, hostel accommodation in Matapi is greatly problematic. Practical solutions are always there if there is political will, community commitment and shared visioning.

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Full Length Research Paper

## Cryptosporidiosis in HIV infected patients with diarrhoea in Kano state, North-western Nigeria

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*Cryptosporidium* is one of the agents associated with diarrhoea in human immune deficiency virus (HIV)/acquired immune deficiency syndrome (AIDS) patients. There is paucity of data in Northwestern Nigeria on the occurrence of this parasite among HIV patients. The study was to determine the prevalence of *Cryptosporidium* among HIV infected patients in Kano, Nigeria. In order to help in management of HIV related opportunistic infections. Stool samples were collected from 100 HIV positive and 50 HIV negative (control) patients presenting with diarrhoea at Murtala Muhammad Specialist Hospital, Kano (MMSH) in Northwestern Nigeria. Concentrated stool sample from each patient was screened for *Cryptosporidium* oocysts with the modified Ziehl Neelson method while direct sample was screened for other enteric parasites. The overall parasite prevalence rate in the diarrhoea patients is 22.7% (34/150) with *Cryptosporidium* spp. 4.0%, *Ascaris lumbricoides* 7.3%, Hookworm 3.3%, *Schistosoma mansoni* 0.7%, *Trichuris trichura* 0.7% and *Entamoeba histolytica* 6.7%. The parasite prevalence rate in HIV infected patients is 25% while in HIV-negative patients, the rate is 18%. The rate is significantly higher among HIV infected patients with diarrhea than among HIV negative with diarrhea ( $P < 0.0001$ ). However, *Cryptosporidium* was found exclusively among HIV-infected patients. When *Cryptosporidium* prevalence was excluded from analysis, the parasite prevalence rates between the two groups was not significantly different ( $X^2 = 0.8002$ ,  $df = 3$ ,  $P = 0.8494$ ). *Cryptosporidium* oocysts have been demonstrated in faeces of HIV infected patients attending Murtala Muhammad Specialist Hospital in Kano, Nigeria. It accounts for 6.0% of cases among this group. Hence should be considered in planning interventions aimed at optimizing management diarrhoeal diseases among HIV and other immune-suppressed patients.

**Key words:** Cryptosporidiosis, human immune deficiency virus (HIV)/acquired immune deficiency syndrome (AIDS), prevalence, Northwestern Nigeria

### INTRODUCTION

*Cryptosporidium*, an intracellular protozoan has changed from that of a rare largely asymptomatic disease to an important cause of diarrhoea in animals and humans worldwide (Flanigan et al., 1992). Reported Cryptosporidiosis prevalence is 3 to 4% in the USA (Mackenzie et

al., 1994), 3.5 to 22.44% in Brazil (Rodrigues et al., 1991) and about 50% in Africa and Haiti (Colebunders et al., 1987). As in HIV infected patients, *Cryptosporidium* is the most frequent microbial cause of diarrhea, usually causing chronic bulky and intermittent diarrhoea with liquid

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non-bloody stools, accompanied by pain and abdominal colic, and a noticeable loss of weight (Kotler, 1995). In North-central Nigeria, Nwabuisi reported prevalence rate of 15.1% among children aged 0 to 14 years with diarrhoea (Nwabuisi, 2001) while a prevalence rate of 4.8% among malnourished children 0 to 5 years were reported (Bamwat et al., 2003).

In Southwestern Nigeria, 52.7% of *Cryptosporidium parvum* was reported as the cause of diarrhoea among HIV patients (Yemisi et al., 2007). Though no case of *Cryptosporidium* oocysts were detected in 2002 in Southeastern Nigeria as the cause of diarrhoea among HIV patients (Nwokediuko et al., 2002), its role as the causative diarrhoeal agent among the subjects is just emerging (Erhabor et al., 2011). In the Niger Delta of Nigeria, a prevalence of 3% was reported among HIV patients. Our study was therefore aimed at determining the prevalence and contribution of Cryptosporidiosis in HIV patients in Northwestern Nigeria in order to help in optimizing management of HIV related opportunistic infections in our environment.

## MATERIALS AND METHODS

### Study area

The study was conducted at Murtala Muhammad Specialist Hospital Kano, a secondary health care facility of the Kano State government between July and September, 2010. HIV/AIDS patients visited GHAIN Laboratory established by the Global HIV/AIDS initiatives Nigeria (GHAIN), Kano Zone – as part of an ongoing prospective cohort study. The hospital serves a large number of HIV/AIDS patients from within and outside the metropolis.

### Subjects

One hundred HIV-infected individuals presenting with diarrhoea were recruited among the HIV – positive patients who attended GHAIN Lab/clinic routinely at 3-monthly intervals as well as at interim visits when acutely unwell, and 50 HIV-negative individuals with diarrhoea who attended outpatients' clinics of the hospital were included as controls. Patients were counseled and recruited into the study after providing written informed consent. HIV was diagnosed using a combination of an HIV-1 enzyme-linked immunosorbent assay (ELISA) and a Western blot confirmatory technique. Diarrhoea was defined as passage of more than 3 loose or watery stools in 24 h and was acute if it lasts for less than 14 days and persistent/chronic if it lasts for 14 or more days (World Health Organization (WHO), 1991).

### Specimen collection

Stool samples were collected from each subject into a clean Universal bottle and transported to the medical microbiology laboratory of Murtala Muhammad specialist Hospital, Kano for analysis. Subjects were interviewed to collect relevant demographic data.

### Parasitological techniques

A direct sample of the stool was made with both saline and iodine mounts on clean grease free slides and examined under the microscope first with 10x and then 40x objective lens for ova and cysts of parasites. A sample of the stool was concentrated using formol ether method concentration technique (Cheesbrough, 1999). Detection of *Cryptosporidium* oocysts in the concentrated stool was done using the modified cold Ziehl Neelsen staining technique (Smith, 1995). Briefly, a concentrated smear of the stool was made on a clean grease-free slide and fixed in methanol for 3 min. The slide was immersed in cold Carbol fuchsin and stained for 15 min. It was then thoroughly rinsed in tap water and decolorized in 1% HCl (v/v) in methanol for 10 to 15 min. After rinsing again in tap water, the slide was counterstained with 0.4% malachite green for 30 s. The slide was then air-dried and observed under the compound light microscope using 40x objective lens for the presence of *Cryptosporidium* oocysts, which was confirmed under the oil-immersion objectives as small pink to red spherules on pale green background

### Data analysis

Demographic and other data obtained were analysed with a PC containing GraphPad software (GraphPad Software Inc, San Diego, USA). Significant differences between categorical variables were determined using Chi square or Fisher exact tests, and  $P < 0.05$  was taken as significant value.

## RESULTS

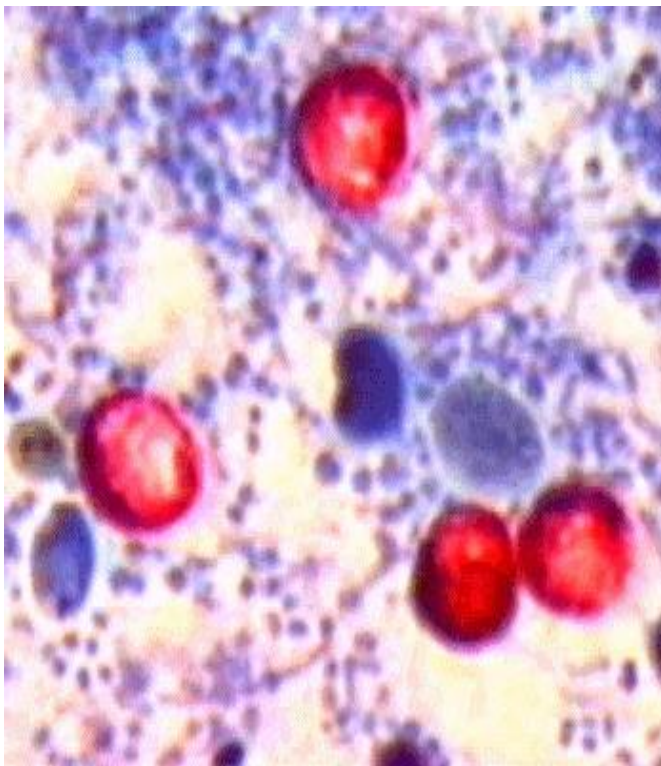
One hundred and fifty patients with diarrhoea were investigated for cryptosporidiosis and other parasites in Murtala Muhammad specialist Hospital Kano, North-western Nigeria. Total of 100 (43 males, 57 females, age range 9 to 54 years, mean age  $32.04 \pm 9.62$ ) were HIV infected and 50 (22 males, 28 females, age range 9 to 56 years, mean age  $28.8 \pm 11.9$ ) were HIV negative and served as controls (Table 1). Figure 1 shows the oocysts of *C. parvum* stained by the acid-fast method.

The overall parasite prevalence rate in the diarrhoea patients is 22.7% (34/150) with *Cryptosporidium parvum* 4.0%, *Ascaris lumbricoides* 7.3%, Hookworm 3.3%, *Schistosoma mansoni* 0.7%, *Trichuris trichura* 0.7% and *Entamoeba histolytica* 6.7% (Table 2). The parasite prevalence rate in HIV infected patients is 25% while in HIV-negative patients, the rate is 18%. The rate is significantly higher among HIV infected patients with diarrhea than among HIV negative with diarrhoea ( $P < 0.0001$ ). *Cryptosporidium* spp. was exclusively detected among HIV- patients in the study. Thus there was no significant difference in term of parasitic infestation among the study groups if *Cryptosporidium* spp. was excluded from the data ( $X^2 = 0.8002$ ,  $df = 3$ ,  $P = 0.8494$ ). The incidence of *Cryptosporidium* among HIV infected patients who had diarrhoea was 6.0%. With the highest prevalence rate in patients aged 46 to 55 years age

**Table 1.** Age and sex distribution of patients presenting to the MMSH with diarrhea.

| Age group | HIV infected patients (test patients) |        |       | HIV Negative patients (control patients) |        |       |
|-----------|---------------------------------------|--------|-------|--|--------|-------|
|           | Male                                  | Female | Total | Male                                     | Female | Total |
| 6-15      | 1                                     | 3      | 4     | 2  | 3      | 5     |
| 16-25     | 10                                    | 12     | 22    | 9  | 8      | 17    |
| 26-35     | 19                                    | 23     | 42    | 6  | 10     | 16    |
| 36-45     | 12                                    | 14     | 26    | 3  | 6      | 9     |
| 46-55     | 1                                     | 5      | 6     | 2  | 1      | 3     |
| Total     | 43                                    | 57     | 100   | 22                                       | 28     | 50    |

Mean age = 28.4 ± 11.19.



**Figure 1.** Oocysts of *Cryptosporidium parvum* stained by the acid-fast method.

group, it was also common among female patients (Table 3).

## DISCUSSION

Diarrhoea is a significant problem in HIV infected patients in Africa (Mann et al., 1986; Mukhopadhyaya et al., 1999). *Cryptosporidium* is a well established cause of diarrhoea among HIV infected patients worldwide with prevalence

of infection ranging from 3% in developed countries to 50% in developing countries (Goldstein et al., 1996). However, the role of this parasite in the occurrence of diarrhoea among adult patients with HIV infection in Nigeria is just emerging (Erhabor et al., 2011). Though *Cryptosporidium* was not detected in stool samples of 189 HIV infected and non-infected patients with diarrhoea in Southeastern Nigeria (Nwokediuko et al., 2002). In Southwestern Nigeria, 52.7% of *C. parvum* was reported as the cause of diarrhoea among HIV patients (Yemisi et al., 2007). A 3% prevalence of *Cryptosporidium* spp. prevalence in HIV patients with diarrhoea was reported in Niger Delta, Nigeria (Erhabor et al., 2011). The reason for these differences can be related to the known fact that HIV opportunistic infections, cryptosporidiosis inclusive, tend to vary from one locality to another and from one country to the other depending on the level of contamination of water, foodstuff and contacts with animals, which are important factors in dissemination of the parasite (Widmer et al., 1996).

Cryptosporidiosis in Nigeria has been reported from tertiary institutions mainly among children in North-central (Nwabuisi et al., 1998; Nwabuisi, 2001; Banwat et al., 2003) and South-south Nigeria (Nkanginieme et al., 1996). It is similar to rates reported from other African countries (Colebunders et al., 1987) indicating that cryptosporidiosis is an important opportunistic parasitic disease causing diarrhoea among HIV infected patients in Nigeria. This is especially so as this parasite was detected in stool samples of only HIV infected patients and this further highlights the association between immunodepression and cryptosporidiosis. Although the overall parasite prevalence rate was higher among HIV infected patients when compared to HIV negative patients with diarrhoea in this study, this was mainly due to the *Cryptosporidium* prevalence of 6.0% among the HIV infected patients. It is pertinent to note that *Cryptosporidium* was not detected among non-HIV subjects. The mechanism by which *Cryptosporidium* cause diarrhoea is not well known, inflammatory response to the

**Table 2.** Distribution of parasites isolated from stool of patients with diarrhoea in MMSH, Kano, Nigeria.

| Parasitic type              | HIV – infected<br>(n=100) | HIV – negative<br>(n=50) | Total (%)<br>(n=150) |
|-----------------------------|---------------------------|--------------------------|----------------------|
| <i>Cryptosporidium</i> spp  | 6                         | 0                        | 6 (4.0)              |
| <i>Ascaris lumbricoides</i> | 8                         | 3                        | 11 (7.3)             |
| Hookworm                    | 3                         | 2                        | 5 (3.3)              |
| <i>Schistosoma mansoni</i>  | 1                         | 0                        | 1 (0.7)              |
| <i>Trichuris trichura</i>   | 1                         | 0                        | 1 (0.7)              |
| <i>Entamoeba</i>            | 6                         | 4                        | 10 (6.7)             |
| Total                       | 25                        | 9                        | 34 (22.7)            |

Fisher exact  $P < 0.0001$ .  $X^2 = 0.8002$ ,  $df = 3$ ,  $P = 0.8494$  (Minus *Cryptosporidium* prevalence).

**Table 3.** Distribution of *Cryptosporidium* by age and sex.

| Age group | Male         |         |                | Female       |         |                |
|-----------|--------------|---------|----------------|--------------|---------|----------------|
|           | No. examined | No. +ve | Prevalence (%) | No. examined | No. +ve | Prevalence (%) |
| 6-15      | 1            | 0       | 0              | 3            | 0       | 0              |
| 16-25     | 10           | 0       | 0              | 12           | 0       | 0              |
| 26-35     | 19           | 1       | 5.3            | 23           | 1       | 4.3            |
| 36-45     | 12           | 1       | 8.3            | 14           | 2       | 14.3           |
| 46-55     | 1            | 0       | 0              | 5            | 1       | 20.0           |
| Total     | 43           | 2       | 4.7            | 57           | 4       | 7.0            |

Mean age =  $28.4 \pm 11.19$ .

infection is variable and may be modified by co-pathogens such as *Cytomegalovirus*. However, histological evidence of gastrointestinal mucosa injury has been reported with clinical manifestations influenced in part by the anatomic distribution of the infection with extensive infections involving both small and large intestines producing the most severe illness (Lumadue et al., 1998).

Higher prevalence of *Cryptosporidium* was observed in females than in males. This may be attributed to higher prevalence of HIV-1 in females than males as reported elsewhere (Atzori et al., 1993) which reported females acquiring HIV-1 infection at a younger age than males. The relatively high prevalence of HIV/AIDS in women of child-bearing age is of particular concern, given the possibility of vertical transmission from mother to child and the strong association between HIV/AIDS and cryptosporidiosis. However, in other studies, the prevalence of *Cryptosporidium* was reported to be higher in males than females (Onah et al., 1998; Akujobi and Ogunsola, 2005). The study has several limitations because only a single stool specimen was examined; the prevalence of the infection may have been underestimated (Blanshard et al., 1996). Furthermore, the role

of bacterial and viral pathogens was not addressed. Finally, CD<sub>4</sub> cell count and HIV viral load was not determined and therefore the true level of immunosuppression is unknown.

## CONCLUSION

*Cryptosporidium* oocysts have been demonstrated in faeces of HIV infected patients attending Murtala Muhammad Specialist Hospital in Kano, Nigeria. It accounts for 6.0% of cases among this group. It is therefore suggested that this should be considered in planning interventions aimed at managing diarrhoeal diseases among HIV and other immune-suppressed patients.

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*Full Length Research Paper*

## Correlation between HIV viral load and alanine aminotransferase (ALT) as marker of liver damage in HIV infected naive patients in North-eastern Nigeria

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Alanine aminotransferase (ALT) is a hepatic enzyme that could be used as markers of hepatocellular injury. Liver enzyme elevations are frequent in human immune deficiency virus (HIV)-infected patients which may be caused by the HIV virus in those without other risk factors for liver damage. This study was designed to evaluate the correlation between HIV viral load and serum levels of ALT, a marker of hepatic damage. This was a cross-sectional analytic study performed among HIV infected naive patients without other risk factor for liver disease. The results of the study shows that of the 166 participants recruited into this study, 104 (62.7%) were females. The participants' mean CD4 count was  $180.04 \pm 38.08$  (95% confidence interval (CI), 164.11 to 195.96). The mean viral load  $\log_{10}$  (copies/ml) was  $5.18 \pm 4.28$ , and ALT (IU/L) was  $24.80 \pm 1.29$  (95% CI, 22.26 to 27.35). Sixty (36.2%) of the studied participants had high viral load  $\geq 100,000$  copies/ml, while 22 (13.3%) had high ALT ( $\geq 40$  IU/L). A positive correlation (Pearson correlation coefficient,  $r = 0.274$ ,  $P = 0.000$ ) between HIV viral load and ALT was observed. After adjusting for age, sex and CD4 count in a multivariable linear regression model, the correlation between HIV viral load and ALT remained significant ( $p = 0.003$ ). The finding of positive correlation between HIV viral load and ALT levels in HIV infected naive patients suggests a linear relation between ALT level and HIV-1 viral load in HIV patients without other risk factor for liver damage. We recommend evaluating patients with high ALT for early anti-retroviral therapy (ART) in those without risk factor for liver damage regardless of the CD4+ cell count, especially where facility for estimating viral load is not available.

**Key words:** Alanine aminotransferase, human immune deficiency (HIV), viral load, CD4 count.

### INTRODUCTION

Liver dysfunction is a major challenge in the management of human immune deficiency (HIV)-infected patients. Among HIV patients, it could be due to opportunistic infections (for example, with cytomegalovirus (CMV) or leishmaniasis), acquired immune deficiency syndrome (AIDS)-related cholangitis associated with parasitic infections (*Schistosoma mansoni*, cryptosporidiosis and microsporidiosis), viral infections (for example, with herpes simplex), mycobacterial infections, tumors (lym-

phoma and Kaposi sarcoma) and drug-related hepatitis (caused by trimetoprim- sulfamethoxazole and other antibiotics, anti tuberculosis medication or anti retroviral therapy (ART). (Price and Thio, 2010; Crum-Cianflone et al., 2010; Ocama et al., 2010; Pol et al., 2004).

The use of ART has completely modified the pattern of hepatic events in HIV infection, and have resulted in a significant decrease in morbidity and mortality among

HIV-infected patients (Cooper, 2007; Gwet and Koulla Shiro 2010). The liver remains an important organ to consider when treating HIV-infected patients as liver enzyme elevations are frequent in HIV-infected patients, even among those treated with ART (Vogel and Rockstroh, 2007; Mocroft et al., 2005). Liver enzyme elevations are a frequent finding in HIV-infected patients as a consequence of several risk factors, however the analysis of these events is limited as precise aetiology is rarely clearly defined. Abnormalities in liver function tests could be produced exclusively by direct inflammation in hepatocytes, caused by the HIV virus. Although the mechanisms by which HIV causes hepatic damage are still unknown, studies have shown that it may be as result of apoptosis (induced by caspases 2, 7 and 8) and mitochondrial dysfunction with decreasing mitochondrial DNA in several tissues. Another injury mechanism is permeability alteration in mitochondrial membrane by HIV proteins which stimulate an inflammatory response (Pol et al., 2004; Miro et al., 2004; Casula et al., 2005; Jacotot et al., 2000). Alanine aminotransferase (ALT) is a hepatic enzyme that may be used as a marker of hepatocellular injury (Pasquazzi and Aceti, 2004). The purpose of the study was to determine the association between HIV viral load with serum levels of ALT as markers of hepatic damage in HIV naive infected patients.

## MATERIALS AND METHODS

This cross-sectional analytic study was performed among HIV infected naive patients that presented for care between July, 2011 to August, 2012 at the Infectious Diseases Clinic of the University of Maiduguri Teaching Hospital, a designated centre of excellence for infectious diseases and immunology. Patients aged 18 years and above were consecutively recruited into this study. Exclusion criteria included hepatitis B surface antigen (HBsAg) seropositivity or detectable hepatitis C virus (HCV) antibody, alcohol consumption in the last three months due to its hepatotoxicity and presence of active opportunistic infections. Patients on drugs with hepatotoxic potential were also excluded. Socio demographic characteristics and medical history were documented. Each participant underwent physical examination to exclude those with active opportunistic infection or AIDS defining infections.

### Analytical methods

Alanine aminotransaminase (ALT) level was estimated by automated clinical chemistry autoanalyzer (Hitachi 902 Roche Diagnostic GmbH, Mannheim Germany). Normal reference values for ALT in normal Nigerian subjects is 3 to 15 U/L. The CD4+ T lymphocyte cell count was estimated by Cyflow counter (Partec GmbH, Gortitz Germany). Samples for CD4+ T cell count was collected between 9:00 to 10:00 am and assayed within 6 h of collection of whole blood using standardized flow cytometric Cyflow machine (Cytex, Partec, Germany 2005). Haemoglobin (Hb) and white blood count (WBC) were analysed using a Haematology analyzer (Sysmex®, Corporation Kobe, Japan). Enzyme linked immunosorbent assay kits was employed to detect the presence of HBsAg and HCV antibodies (DIA, PRO, Diagnostic Bioprobes Sri, via columella no 20128 Milano-Italy). Plasma HIV RNA levels was measured using freshly frozen plasma specimen separated within 6 h of phlebotomy

utilizing the Amplicor HIV-1 Monitor Test, version 1.5 by Roche® Germany, with a minimum cut off value of 200 copies per ml.

### Statistical analysis

Results were expressed as mean  $\pm$  standard deviation ( $\pm$ SD). The strength of relationship between HIV viral load and ALT was estimated by a Pearson correlation coefficient. To adjust for the effects of potential confounders, a linear regression model was used. A p-value of  $< 0.05$  was considered statistically significant.

## RESULTS

### Clinical and laboratory parameter

One hundred and sixty-six (166) participants that fulfilled the inclusion criteria were consecutively recruited for the study. They consisted of 104 (62.7%) females. The mean age of the studied participants was  $39.39 \pm 9.21$  (95% CI, 38.04 to 40.71). Males with mean age of  $43.02 \pm 7.50$  were significantly older than females with a mean age of  $37.28 \pm 9.51$  ( $p < 0.05$ ). The mean body mass index (BMI) was  $20.71 \pm 4.50$  (95% CI, 19.81 to 21.62). A total of 22 (13.3%) patients had high ALT ( $\geq 40$  IU/L) with overall mean  $\pm$  SEM of  $24.80 \pm 1.29$  (22.26 to 27.35). The mean  $\pm$  SEM (95% CI) of the participants CD4 count was  $180.04 \pm 38.08$  (164.11 to 195.96). The viral load  $\log_{10}$  (copies/ml) was  $5.18 \pm 4.28$ , with 60 (36.2%) of the studied participants having a high viral load of  $\geq 100,000$  copies/ml. The clinical and laboratory parameters are as depicted in Table 1.

### Correlation between serum HIV-1 viral load and alanine aminotransferase (ALT) level

The distribution of participants with high ALT ( $\geq 40$  U/L) across stratified levels of viral load is as shown in Table 2. Mean ALT level linearly increased with increase in mean HIV-1 viral load. However, linear increase in the frequency of abnormal ALT in cohort with increase viral load  $\geq$  was not observed. As shown in Figure 1, there was also a significantly mild strong, positive correlation between HIV viral load and ALT (Pearson correlation coefficient,  $r = 0.274$ ,  $P = 0.000$ ). Even after adjusting for age, sex and CD4 count in a multivariable linear regression model, the correlation between HIV viral load and ALT remains significant ( $p = 0.003$ ).

## DISCUSSION

Our report showed a positive correlation between alanine aminotransaminase and HIV-1 RNA among ART naive HIV positive cohort without viral hepatitis co-infection or opportunistic infections. Our finding is consistent with reports from Mexico (Mata-Marín et al., 2009) and North

**Table 1.** Baseline characteristics of the study participants.

| Clinical characteristic                            | Mean±SD                                 |
|--|---|
| Age (years)  | 39.39±9.21 (95% CI, 38.04-40.71)        |
| Females  | 37.28±9.51 (95% CI, 35.55-39.00)        |
| Males  | 43.02±7.50 (95% CI, 41.14-44.89)        |
| Sex  |   |
| Females, no (%)                                    | 104 (62.7%)                             |
| BMI (kg/m <sup>2</sup> ), mean±SD                  | 20.71±4.50 (95% CI, 19.81-21.62)        |
| <b>Laboratory parameter</b>                        |   |
| Hb (g/dl), mean±SD                                 | 10.58 ± 2.18 (95% CI, 10.28-10.87)      |
| WBC (10 <sup>9</sup> /l), mean±SD                  | 5.11 ± 2.17 (95% CI, 4.82-5.40)         |
| Platelets count, mean±SD                           | 291.94 ± 103.69 (95% CI, 277.66-306.22) |
| ALT, mean±SEM                                      | 24.80 ± 1.29 (95% CI, 22.26-27.35)      |
| ALT>40 U/L, no (%)                                 | 22 (13.3%)                              |
| CD4 count (cells/μl), mean±SEM                     | 180.04± 38.08 (95% CI, 164.11-195.96)   |
| Viral load log <sub>10</sub> (copies/ml), mean±SEM | 5.18±4.28                               |
| Viral load>100000, no (%)                          | 60 (36.2%)                              |

SEM standard mean error.

**Table 2.** Correlation between serum HIV-1 viral load and alanine aminotranferase (ALT) level.

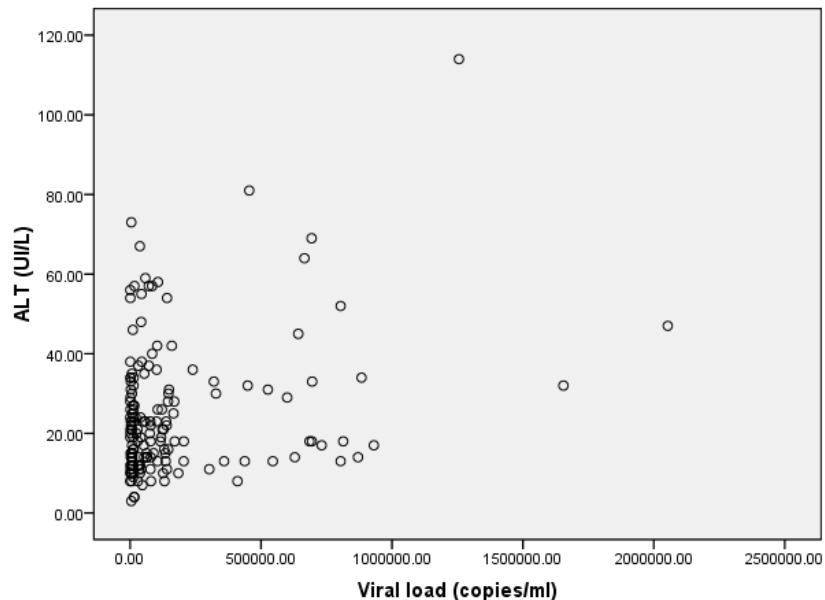
| Serum HIV-1 viral load (copies/ml) | Serum ALT level, mean±SD (min - max) | Abnormal high ALT level (40IU/L) |
|------------------------------------|--------------------------------------|----------------------------------|
| <5,000                             | 23.33±15.10 (3-73)                   | 3/33 (9.0)                       |
| 5000-9,999                         | 17.54±7.85 (8-35)                    | 0/14 (0.0)                       |
| 10,000-49,999                      | 23.18±15.34 (4-67)                   | 5/38 (13.2)                      |
| 50,000-99,999                      | 25.52±15.80 (8-59)                   | 4/21 (19.0)                      |
| ≥100,000                           | 28.05±19.41 (8-114)                  | 10/60 (16.7)                     |

America (DallaPiazza et al., 2010). Alanine aminotranferase is a marker of liver damage, unlike AST it is not affected by other tissue injuries (muscle, lung, and kidney). Several studies have shown that hepatic cells, Kupffer cells and differentiated tissue macrophages that reside in the liver can be infected by HIV *in vivo* (Cao et al., 1992; Housset et al., 1990; Hufert et al., 1993). *In vitro* studies also suggest that HIV infection of primary Kupffer cells leads to progression of HIV infection and liver injury (Gendrault et al., 1991; Schmitt et al., 1990).

HIV-1 RNA has also been detected in sinusoidal cells and hepatocytes *in vivo* (Cao et al., 1992; Housset et al., 1990). Primary human sinusoidal cells have also been shown to be permissive to HIV infection *in vitro* (Steffan et al., 1992). A number of studies have demonstrated HIV infection of hepatocyte cell lines (Cao et al., 1990). Infection of hepatocyte cell lines is thought to be CD4-independent, as most hepatocyte cell lines, primary hepatocytes inclusive, do not express CD4 (Cao et al., 1990). HIV infection of hepatocytes cells may therefore occur via receptor-mediated endocytosis or alternative co-receptors (Berger et al., 1999). Hepatocytes may act

as a transient HIV reservoir and promote CD4+ T cell infection by cell-cell contact (Fromentin et al., 2010). Hepatotoxicity due to ART may be related to agents from a number of classes, including nucleoside reverse transcriptase inhibitors (NRTIs), non-nucleoside reverse transcriptase inhibitors (NNRTIs) and protease inhibitors (Núñez, 2010). The severity of hepatotoxicity may range from transient elevations in transaminase levels to hepatic failure and death, via a variety of mechanisms. NNRTI such as nevirapine and efavirenz may cause hypersensitivity (Chu et al., 2010; Coffie et al., 2010; Mbougua et al., 2010). NRTI, primarily didanosine (ddl), may cause direct mitochondrial toxicity leading to abnormal liver function (Murphy et al., 2007). Other mechanisms by which ART causes liver-related toxicity include direct cell stress and disturbances in lipid/sugar metabolism and steatosis, as seen with protease inhibitors (Núñez, 2010). The protease inhibitors ritonavir, tipranavir and darunavir have all been associated with elevations in ALT (Núñez, 2010).

The early recognition and diagnosis of hepatic events will facilitate the safe and effective use of ART and



**Figure 1.** Scatter plot of HIV viral load and ALT. There is a mildly strong correlation between HIV viral load and ALT ( $r = 0.274$ ,  $p = 0.000$ ).

enhance the survival of HIV-infected patients. Nevertheless, the intricacies of the various pathogenic mechanisms may result in difficulties in the diagnosis, as well as in the management of such patients with liver abnormalities. We suggest monitoring aminotransferases levels, given the observed positive correlation between the HIV viral load and serum levels of alanine aminotransferase enzyme in HIV infected naive patients. Based on our results, patients with elevated ALT level also have high HIV-1 viral load. Liver function tests should be monitored closely in these patients; and we suggest evaluating patients with high ALT for early start of antiretroviral treatment in those without risk factor for liver damage regardless of the CD4+ cell count, especially where facility for estimating viral load is not available.

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Full Length Research Paper

## Assessing the relevance of extending the prevention of mother to child human immunodeficiency virus (HIV) transmission procedure to women with unproductive pregnancies

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In Cameroon, with regards to the national reprisal to human immunodeficiency virus/acquired immune deficiency syndromes (HIV/AIDS), the HIV status of a mother delivering a live baby, when declared unknown is always determined in the delivery room. This protocol is not applicable to women, whose pregnancies have been identified as unproductive. A descriptive study was conducted in three public hospitals in Yaounde from January, 2009 to February, 2012. It aimed at contributing to the reduction of maternal and foetal mortality. A total of 14174 pregnant women were part of this study. The prevalence rates of unproductive pregnancies were 14.9, 14.5 and 15.4% in 2009, 2010 and 2011, respectively. Stillbirths were the most common type and elective abortions the least frequent. HIV prevalence rates were 10.7% for women who delivered live babies and 10.5% for those who had unproductive pregnancies. HIV was not an influential factor on the outcome of pregnancy, neither on the type of unproductive pregnancy. Among the women with unproductive pregnancies and HIV positive status, 52.4% were unaware of their HIV status. They could have returned home in complete ignorance of their HIV status despite their passage through a hospital. Therefore, it may be important to extend prevention of mother-to-child HIV transmission (PMTCT) to such cases.

**Key words:** Unproductive pregnancies, pregnancy adverse outcomes, human immunodeficiency virus (HIV), pregnancy.

### INTRODUCTION

Pregnancy is the set of phenomena that occur in women between fertilization and birth (Fleischman et al., 2010). Generally, it is productive, that is to say, it leads to the birth of a live child. Pregnancy can sometimes be unproductive. Indeed, it may be voluntarily or involuntarily terminated before full-term or upon reaching full-term, resulting in stillbirth (NIS, 2004). There are four types of

unproductive pregnancies namely, ectopic pregnancies, spontaneous abortions, elective abortions and stillbirths (*in utero* death and fetal death during childbirth). In general, there are various causes of unproductive pregnancies. By and large genetic (Hasegawa et al., 1996), uterine (Baba et al., 2011), endocrine (Bussen et al., 1999) or funicular (Winbo et al., 1998) abnormalities,

infectious diseases (Simpson et al., 1996), exogenous factors, chronic diseases or obstetric problems (Winbo et al., 1998) cause unproductive pregnancies. In Cameroon, 25% of women of childbearing age have had at least one unproductive pregnancy (National Institute of Statistics, 2004).

Women are more vulnerable to HIV infection than men. If the prevalence of HIV in Cameroon in 2012 was estimated at 4.3% for the general population, it was twice as high for women of childbearing age than men in the same age bracket (National Institute of Statistics, 2012). Concerning the prevention of mother-to-child HIV transmission (PMTCT), when declared unknown, the HIV status of the mother giving birth to a live child is always determined in the delivery room. This protocol is not applicable to women with pregnancies identified as unproductive.

Generally, considering the high vulnerability of women to HIV infection, and that many of these women who have unproductive pregnancies end up returning to their homes without knowing their HIV status, despite been in a hospital, it was necessary to conduct a study to assess the relevance of extending the PMTCT procedure to such cases. Hence, the prevalence of unproductive pregnancies in three public hospitals in Yaounde was determined and the HIV prevalence among such women was evaluated and compared to that of women who gave birth to a live child. The relationship between HIV and the outcome of a pregnancy was then examined. Lastly, the impact of various factors, such as HIV, on the type of unproductive pregnancy was also evaluated.

## METHODOLOGY

This study was carried out in two parts. The first part was a retrospective study which determined the prevalence of unproductive pregnancies in the Yaounde Central Hospital (HCY) from 2009 to 2011 and the second part was a prospective component consisting in calculating the percentage of unproductive pregnancies recorded from September 2011 to February 2012 in three hospitals in Yaounde, namely, the Yaounde Central Hospital (HCY), the Obstetrics, Gynecology and Pediatrics Hospital (HGOPY) and the Efoulan District Hospital (HDE). This second part also involved the search for anti-HIV1 and 2 antibodies in women with productive pregnancies PP (+) or unproductive pregnancies PP (-) who were hospitalized in the three hospitals. Patients' socio-demographic and clinical data (age, marital status, education, occupation, number of pregnancies, number of unproductive pregnancies, and history of sexually transmitted infections (STIs) other than HIV) were collected. Clearances were obtained from the National Ethics Committee and administrative authorities. Participants were recruited among women hospitalized in the antenatal clinic in these hospitals after receiving adequate information about the study and giving their consent. Screenings were performed according to the national algorithm for HIV care (pre-test counselling, announcement of results, post-test counselling).

### Determination of the prevalence of unproductive pregnancies

It was conducted using the information collected from the maternity records on the number of pregnant women and the number of

women with unproductive pregnancies PP (-).

### Search for antibodies to HIV 1 and 2

After collecting blood samples at the elbow, the search for anti-HIV 1 and 2 was carried out using two immuno-chromatographic tests (Determine HIV 1 and 2 and HIV KHB 1 and 2).

### Statistical analysis of data

Statistical analyses were conducted using the STATA 12.1 software (STATA Corporation, college Station, TX, USA). The  $\chi^2$  test and when sample sizes were too small, Fisher's exact test were used to compare the distribution of the categorical variables between the groups of unproductive pregnancy. For continuous variables, comparisons were based on the non-parametric Mann-Whitney two sample-sample tests. The significance level was set at 0.05 in all cases. The impact of various variables on the type of unproductive pregnancy was studied using "multinomial logit regression". These variables included: HIV status, knowledge of HIV status, age ( $\geq 30$  versus  $< 30$ ), marital status, level of education and history of STIs other than HIV.

## RESULTS

In HCY, 4115, 3893 and 4164, pregnant women were admitted consulted in 2009, 2010 and 2011, respectively of which 615, 565 and 641 were PP (-). So, the prevalence rates of unproductive pregnancies were 14.9, 14.5 and 15.4% in 2009, 2010 and 2011, respectively.

In 2012, 2002 pregnant women were admitted in the three hospitals selected for the study, and 302 were PP (-), giving a 15.1% prevalence rate of unproductive pregnancies. All the PP (+) women and 200 (66.2%) PP (-) women consented to participate in this study. Table 1 illustrates the characteristics of the PP (-) women according to the type of unproductive pregnancy. Out of the 200 PP (-) women, 33.5% had experienced stillbirths (SB), 27.5% had had spontaneous abortions (SA), 25.5% ectopic pregnancies (EP) and 13.5% induced or elective abortions (EA). 182 (10.7%) PP (+) women and 21 (10.5%) PP (-) women turned out to be carriers of antibodies to HIV 1 or 2. Among the latter, 10 (47.6%) declared they had known their HIV status whereas 11 (52.4%) said they were unaware of it.

### Impact of various factors on the type of unproductive pregnancy

#### HIV

"The results obtained from the multivariate multinomial logit model show that the risk of HIV infection was similar among the four groups of PP (-) women, adjusted on age, educational level and marital status. However, HIV infection seemed more frequent among women who had a stillbirth (16.4%) and least among those who had opted

**Table 1.** Characteristics of the women with unproductive pregnancies according to the type of unproductive pregnancy.

| Characteristic                        | Ectopic pregnancies<br>N=51 | Elective abortion<br>N=27 | Spontaneous abortion<br>N=55 | Stillbirths<br>N=67 | P value |
|---------------------------------------|-----------------------------|---------------------------|------------------------------|---------------------|---------|
| <b>HIV status</b>                     |                             |                           |                              |                     |         |
| Positive                              | 5 (9.8%)                    | 1 (3.7%)                  | 4 (7.3%)                     | 11(16.4%)           | 0.272   |
| <b>Aware of HIV status</b>            |                             |                           |                              |                     |         |
| Yes                                   | 36 (70.6%)                  | 25 (92.6%)                | 30 (54.6%)                   | 23 (34.3%)          | <0.001  |
| <b>Age</b>                            |                             |                           |                              |                     |         |
| Median [IQR]                          | 29 [24 - 32]                | 25 [20 - 29]              | 27 [23 - 34]                 | 27 [23 - 31]        | 0.02    |
| ≥ 30                                  | 23 (45.1%)                  | 4 (14.8%)                 | 18 (32.7%)                   | 25 (37.3%)          | 0.054   |
| <b>Marital status</b>                 |                             |                           |                              |                     |         |
| Single                                | 28 (54.9%)                  | 22 (81.5%)                | 25 (45.5%)                   | 33 (49.3%)          | 0.02    |
| Partner                               | 10 (19.6%)                  | 1 (3.7%)                  | 5 (9.1%)                     | 8 (11.9%)           |         |
| Married                               | 13 (25.5%)                  | 4 (14.8%)                 | 25 (45.5%)                   | 26 (38.8%)          |         |
| <b>Education</b>                      |                             |                           |                              |                     |         |
| Primary                               | 11 (21.6%)                  | 6 (22.2%)                 | 9 (16.4%)                    | 23 (34.3%)          | 0.33    |
| Secondary                             | 35 (68.63%)                 | 17 (63%)                  | 38 (69.1%)                   | 39 (58.2%)          |         |
| Higher                                | 5 (9.8%)                    | 4 (14.8%)                 | 8 (14.6%)                    | 5 (7.5%)            |         |
| <b>History of STIs other than HIV</b> |                             |                           |                              |                     |         |
| Positive                              | 16 (31.4%)                  | 2 (7.4%)                  | 9 (3.6%)                     | 18 (26.9%)          | <0.001  |
| Negative                              | 27 (52.9%)                  | 20 (74.1%)                | 34 (61.8%)                   | 34 (50.7%)          |         |
| <b>Occupation</b>                     |                             |                           |                              |                     |         |
| Housewives                            | 13 (25.4%)                  | 10(37%)                   | 19 (34.5%)                   | 34 (50.7%)          | <0.001  |
| Pupils/students                       | 6 (11.8%)                   | 10 (37%)                  | 10 (18.2%)                   | 8 (11.9%)           |         |
| Others                                | 32 (62.7%)                  | 7 (25.9)                  | 26 (47.3%)                   | 25 (37.3%)          |         |

for an elective abortion (3.7%). These differences were not significant ( $p=0.27$ ). Moreover, the proportion of women unaware of their HIV status was statistically different ( $p>0.001$ ) between the four groups of PP (-) women. Hence, women who had stillbirth comprised the majority (65.7%) unaware of their HIV status, whereas those who had elective abortion were in minority (7.4%).

### Age

The median age of PP (-) women was 27 years (interquartile range [IQR] 23 to 31). It was higher in women with ectopic pregnancy, while it was lower among those who had abortion, these differences were statistically significant ( $p=0.02$ ). Thus, PP (-) women below 30 years were four times (relative risk ratio (RRR), 4.21,  $p=0.023$ ) more likely to make an elective abortion than an ectopic pregnancy.

### History of STIs others than HIV

Out of the PP (-) women, 45 (22.5%) reported having had an STI other than HIV, 115 (57.5%) had stated the opposite and 40 (20%) did not know whether they had had an STI or not. Elective abortions were the least common type of unproductive pregnancies for all the women. Stillbirths and ectopic pregnancies were higher in women with a history of STIs than in the others. Among those without a history of STIs, spontaneous abortions and stillbirths were the most common. Their percentages were similar (29.57%). These interactions between history of STIs other than HIV and unproductive pregnancies were statistically significant ( $p<0.001$ ).

### Marital status

As regards marital status, 108 PP (-) women (54%) were



single whereas 92 (46%) were in a relationship. Elective abortions were four times more frequent (20.37%) among single women than among those in a relationship (5.43%). Married PP (-) women were about three times (RRR, 2.73,  $p=0.03$ ) more likely than singles to make a spontaneous abortion than an ectopic pregnancy.

### **Education**

Concerning their level of education, 49 (24.5%) PP (-) women attended primary education while 151 (75.5%) attended secondary education and above. Spontaneous abortions were more common among those with a secondary level of education (30.46%) than among those with primary education (18.37%). Stillbirths were more frequent (46.94%) among those of the primary level than among their secondary level counterparts (29.14%). These interactions were not statistically significant ( $p>0.05$ ) (Figure 5).

### **Occupation**

Concerning occupation, 90 women (45%) were employed, 76 (38%) were housewives and 34 (17%) were pupils/students. Elective abortions were more common among pupils/students than in the other categories. Stillbirths were about twice more common among housewives than in the other two categories. Ectopic pregnancies were twice more common among employed women than among the others. These interactions were statistically significant ( $p<0.001$ ).

## **DISCUSSION**

From 2009 to 2011, the prevalence of unproductive pregnancies were constant in HCY with an average of 14.9%. The values were lower than the 25% measured by the National Institute of Statistics in 2004. This difference could have been generated by the fact that our study was conducted in three hospitals in the country's capital city, that is to say, in a population supposed to have easy access to health care and, in addition, the participants were recruited in hospitals while the National Institute of Statistics study was a national survey that was conducted within populations outside hospitals, both in urban and rural areas. This difference could also be a reflection of the improvement of the mother and child health situation in the country.

Most women with unproductive pregnancies who were recruited for the prospective study did not know if they had contracted diseases such as malaria, toxoplasmosis, listeriosis, brucellosis, or rubella during pregnancy. These results indicate that prenatal testing is not yet mandatory in our country and that despite the progress made, much

remains to be done in terms of protecting maternal-fetal health.

Stillbirths were the most common unproductive type of pregnancy (33%) and elective abortions the least (13.5%). Spontaneous abortions (27.5%) and ectopic pregnancies (25.5%) were in between the two aforementioned. Pursuant to Cameroonian legislation, elective abortions are prohibited. Hence, their occurrence, as the least common type of unproductive pregnancy, may be considered as an illustration of the repressive effect of the law. This result does not testify to the full acceptance of the concerned law by women. It also casts doubts on the true etiology of the so-called spontaneous abortion.

Antibodies against HIV were present in 10.7% of the PP (+) women and in 10.5% of PP (-). These values are approximately 2.4 times higher than the national prevalence (4.3%) published in 2012 by the National Institute of Statistics. This difference could be explained by the fact that our study population was sexually active while the National Institute of Statistics worked in all population groups. These results seem to exclude the possibility of the involvement of HIV in the etiology of unproductive pregnancy. In De Cock et al. (1994) had demonstrated the opposite in Côte d'Ivoire. Their results may have been influenced by the high prevalence of HIV and the prevailing disorganization in the control of the pandemic in the 90s. Nowadays, the control is well organized in most countries and the prevalence has steadily declined. In Cameroon, in order to prevent mother-to-child transmission of HIV, the HIV status of a mother delivering a live baby, when declared unknown is always determined in the delivery room. This provision does not apply to women with unproductive pregnancies. The results of our study show that 52.4% of women with unproductive pregnancies and HIV positive would have been sent home in complete ignorance of their HIV status despite their passage through a hospital.

The HIV status and level of education showed no statistically significant interactions with the type of unproductive pregnancy, unlike age, marital status, occupation, and history of STIs. However, HIV prevalence was higher in the group of women who had a stillbirth (16.4%) than in those who delivered babies (10.7%) or those who voluntarily aborted (3.7%). Nurudeen et al. (2013) described the desire of many HIV seropositive women to have children. Median age was higher in women with ectopic pregnancy, while it was lower among those who had abortion. This result could indicate the probable involvement of physiological factors in the genesis of this type of UP. The frequency of induced abortions decreased with age. This PP (-) was more common among students than among housewives and employed women. This confirms the higher exposure of the still financially dependent younger girls to unwanted pregnancies, and also their boldness since elective abortion is prohibited. These PP(-)s were also four times more common among unmarried women than those in a relationship while

spontaneous abortions occurred conversely. These results fall in line with those obtained by Osborn et al. (2000). They indicate the exposure of single women to unwanted pregnancies and the involvement of physiological factors in the genesis of spontaneous abortions.

Stillbirths and ectopic pregnancies which were more frequent in women with a history of STIs could be due to the weakening of the reproductive system as a result of the STIs. The frequency of stillbirths was higher among housewives (44.74%) than employed women (27.78%), while ectopic pregnancies were more frequent among employed women than among housewives. It is supposed that housewives are more involved in physical hard work while employed women are more submitted to psychological stress.

### Conclusion

Unproductive pregnancies are a serious problem in Cameroon as seen from the high prevalence rate. Stillbirths were the most common type of PP (-) and elective abortions the least frequent. HIV was not an influential factor on the fate of a pregnancy, neither on the type of unproductive pregnancy. However, the percentage of women with HIV infection was higher in the group of women who had stillbirths. A total of 52.4% of HIV positive women with unproductive pregnancies were unaware of their HIV status and may have returned home in complete ignorance despite their passage through a hospital. Therefore, it may be important to extend PMTCT to women who undergo an unproductive pregnancy.

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*Full Length Research Paper*

# Socio-demographic profiles and prevalence of human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS) among voluntary counseling and testing (VCT) clients in Finote Selam, Northwest Ethiopia

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Voluntary counseling and testing (VCT) is an important component of the human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS) prevention and control interventions. The services in Ethiopia are available in government and non-government health facilities. However, very little is known about the profile and HIV prevalence among VCT clients. In fact, any attempt to analyze the epidemiology of HIV in Ethiopia is limited by the lack of sufficient longitudinal, cross-sectional and behavioral data. A retrospective cross-sectional study was employed to determine the socio-demographic profiles and prevalence of HIV among VCT clients. Data were taken from VCT clients' records in Finote Selam Hospital. The quantitative data were entered using Microsoft excel and analyzed with SPSS 15.0 windows evaluation version. The International Training and Education Center for Health (I-TECH) and the woreda HIV/AIDS prevention and control offices are the only interventions. The prevalence of HIV among VCT clients decreased gradually from 6.5% in 2008 to 5.7% in 2009 and 4.3% in 2010. A little over half (55.6%) of HIV positive clients were females. The overwhelming majority of clients screened for HIV were males. Prevalence of HIV infection among VCT clients was estimated to 5.4% and varied by socio-demographic characteristics of the clients. Six in ten of the HIV positive clients were never married and nearly three-fourth of HIV positive clients (73.6%) were urban residents. Farmers and domestic workers accounted for more than half (52.5%) of the total HIV positive clients. Higher prevalence rates were observed in the 25 to 34 age groups, the urban residents, never married, farmers and domestic workers. The prevalence of HIV showed a decreasing pattern from 2008 through 2010; but the distribution was shifting from urban to rural areas. Trying to produce single prevalence estimates for the entire country is inadequate for understanding the scale and heterogeneity of the epidemic. HIV/AIDS programs should be more focused geographically and directed to the regions, districts and communities that exhibit higher prevalence rates and at higher risk and more intensive AIDS control efforts are needed.

**Key words:** Human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS), voluntary counseling and testing (VCT), Finote Selam, prevalence.

## INTRODUCTION

The emergence of the human immunodeficiency virus (HIV) epidemic is one of the biggest public health

challenges the world has ever seen in recent history. In the last three decades, HIV has spread rapidly and affected all sectors of society, young people and adults, men and women, and the rich and the poor. Sub-Saharan Africa is at the epicenter of the epidemic and continues to carry the full brunt of its health and socioeconomic impact. Ethiopia is among the countries most affected by the HIV epidemic (World Health Organization (WHO) and UNAIDS: Acquired Immune Deficiency Syndrome (AIDS) epidemic update, 2006).

HIV infections were first found in Ethiopia one to two years later than in most other sub-Saharan countries, but the main features of the virus resemble those elsewhere in Eastern Africa; the relatively virulent HIV-1 is the major strain in Ethiopia, with transmission largely through heterosexual contact and to a lesser extent through mother-to-child transmission, traditional surgical practices, and probably blood. HIV probably began to spread in Ethiopia in the early 1980s, the first evidence of HIV infection was found from stored serum drawn in 1984. The first two AIDS cases were reported in 1986 from Addis Ababa Hospitals. Since then the virus has continued to spread at a rapid pace (Kloos and Hailemariam, 2000).

The epidemic in Ethiopia is generally considered to be high, with increasing levels of seasonal migration of workers, multipartner sexual contacts, dislocation due to the civil war, high rates of sexually transmitted diseases, increasing sexual activity among youth and high unemployment rates including the demobilized soldiers. However, the size and distribution of high risk groups, sexual networks and bridging groups remain largely unknown, making determinations of epidemic potential largely speculative. In fact, any attempt to analyze the epidemiology of HIV in Ethiopia is limited by the lack of sufficient longitudinal, cross-sectional and behavioral data (Garbus, 2003; Berhane et al., 2008).

In response to the epidemic, the Government of Ethiopia launched the antiretroviral treatment program started with fee based in 2003 and then decentralized and free antiretroviral therapy (ART) program was launched since 2005. The country has scaled up its ART program and is planning to decentralize the service further to existing health facilities (Ministry of Health, Ethiopia, 2007).

Voluntary counseling and testing (VCT) is an important component of the HIV/AIDS prevention and control interventions. It helps people to learn about how HIV is transmitted, practice safer sex, get HIV test, and depending on the result, take steps to avoid becoming infected or infecting others. It should be emphasized that investing in VCT is more cost-effective and its uptake should be taken as critical entry point to Prevention of Mother to Child Transmission (PMTCT) programs (Korra et al., 2005). In the absence of VCT services, most women in Africa have no definitive way of knowing their HIV status until they themselves fall ill with identifiable symptoms of AIDS, or until they give birth to a baby who is diagnosed

with the virus, and eventually dies from AIDS (Sahilu, 1999, 2001; Centers for Disease Control (CDC), 2003; Garbus, 2003).

A recent literature review study and data research in Ethiopia about where HIV/AIDS is leading revealed that Ethiopia is facing an expanded HIV/AIDS epidemic with a rising prevalence and stable incidence. The estimated number of people living with HIV/AIDS rises rapidly in both urban and rural Ethiopia for every projected year between 1983 and 2008, driven by the increasing severity of the epidemic and/or population growth with a tendency of intensifying epidemic in rural areas (Hladik et al., 2006). However, very little is known about the profile and HIV prevalence among VCT clients. Selected characteristics of VCT clients and their serostatus were recorded at the hospital. An analysis of such health facility data (secondary data) particularly on VCT is limited. This study was, therefore, aiming at filling this gap and describing the socio-demographic profile of VCT clients as well as estimating the prevalence of HIV infection of these clients. So this study was assumed to have significance to program planners and implementers on HIV/AIDS in the town and its surrounding areas.

## METHODOLOGY

A retrospective cross-sectional study was employed to determine the socio-demographic profiles and prevalence of HIV among VCT clients. The study was conducted in Finote Selam Hospital in Finote Selam town in West Gojjam zone of Amhara National Regional State. The town is located along the Addis Ababa-to-Metema route and 374 km away from the capital city, Addis Ababa (Figure 1). Recently, the town also became the zonal town, shifted from Bahir Dar since 2010. The study town is home to large numbers of government employees, day laborers, FSWs, and secondary and college students as well as transient populations that temporarily reside in the town (truckers and their assistants, migrant workers and businessmen). It is a marketplace for the surrounding rural communities. The rural men and women frequently visit the town to sell their agricultural products and buy commodities for their household's consumption. The study town has several hotels, bars, and local brew-selling houses (areki and tella bets) where Female Sex Workers (FSWs) operate. Army forces based in Birshaleko/Tatek Military camp also frequently visited the town. Policy makers and program managers need accurate estimates of the size and scope of a country's HIV epidemic and the distribution of HIV infection within a population in order to identify areas with elevated HIV infection rates and higher-risk populations. Moreover, understanding HIV infection offers insight into appropriate interventions for prevention, care and support, and treatment programs.

The data used in these analyses came from special records kept at Finote Selam Hospital HIV counseling and testing center. The recording formats were prepared and filled by the VCT center counselors at the time of pre and post-test counseling. The quantitative data were entered using Microsoft excel and analyzed with SPSS 15.0 windows evaluation version. The study subjects were children (came with their parents or guardians), male and female clients who have visited the center for VCT services between January 2008 and December 2010. VCT service was given for outpatients and inpatients but Inpatient records were incomplete and service was started recently and excluded from the study and hence only outpatient and outreach records (campaign results) were evaluated. A total of 24,661 people have received the



Figure 1. Map of Finote Selam.

services during the specified period and records of these clients were used for analysis.

Ethical Review Committee of Addis Ababa University, Faculty of Medicine, Department of Microbiology, Immunology and Parasitology (DREC) have approved the study for its ethical and scientific merit. Formal letter of cooperation was written from Addis Ababa University, School of Medicine to Finote Selam Hospital. The selected health institution was communicated and has supported the undertaking of this study and all the necessary precautions were taken to make the records confidential. The client's name was not recorded on any of the formats used at the center.

For uniformity of understanding, the approach of key words is given as follows: areki, strong alcoholic beverage (about 75%) made by a local distillation system; cross-generational sex, when a woman age 15 to 24 has non-marital intercourse with a man who is 10 or greater years older than her; generalized epidemic, presence of more than 1% of infection in the population and 5% among high-risk population; kimit, woman who serves as a sexual partner for a man who usually has a legal wife; tella, locally brewed beer with an alcohol content of 5 to 10%; transactional sex, exchange of sex for money or goods; voluntary counseling and testing, the process by which an individual undergoes confidential counseling to enable the individual to make an informed choice about learning his or her HIV status and to take appropriate action [Parents/Guardians were counseled for the < 15 age years old]; woreda, an administrative unit (equivalent to a district); zone, an administrative level consisting of a number of wereddas.

## RESULTS

A total of 24,661 clients were tested for HIV in Finote Selam Hospital VCT center in the years from 2008 to 2010. Of those tested for HIV, 13,621 clients were urban residents and 11,040 were from the rural settings and 1,341 of them were positive for HIV (562 in 2008, 382 in 2009 and 397 in 2010) (Table 1). Of those HIV positives, 987 clients (73.6%) were urban and 354 (26.4%) were

rural residents. The overall prevalence of HIV among VCT clients was 5.4%. The highest prevalence being found in the 25 to 34 age groups and particularly in urban settings, where the prevalence is as high as 7.4%, as opposed to rural settings where prevalence is approximately 3.2%. 55.6% of all people living with HIV were females and 8.5% were children under the age of fifteen (Table 2).

Most infections among VCT clients of Finote Selam Hospital were registered among never married with 332 cases (63.2%) occurring in 2008; 193 cases (36.8 %) in 2009 and 239 cases (60.2%) in 2010. In these three years, unmarried females were more affected than males while more married and widowed males were more affected than females. On the other hand divorced males and females were almost equally affected. Among those that tested HIV positives; 352 (26.3%) were domestic workers, 352 (26.2%) were farmers, 265 (19.8%) were traders, 122 (9.1%) were government employees, 113 (8.4%) were day laborers, 107 (8%) were students and 29 (2.2%) were those who have no jobs (Table 2).

More than half (59%) of the clients screened for HIV were males but higher percentage (55.6%) of HIV positive clients were females. The number of clients screened and tested positive were decreased from 2008 to 2009 and then increased in 2010. The prevalence in each individual years was 6.5% (4.59% in males and 9.9% in females) in the year 2008; 5.7% (4.6% in males and 7.1% in females) in 2009 and 4.3% (3.1% in males and 5.7% in females) in 2010 (Table 1). The trend of prevalence of HIV/AIDS showed a decreasing pattern from 2008 through 2010.

The prevalence of HIV in the adult population (15 to 49 ages) for the three years was 4.7% (5.1% in 2008, 5.26% in 2009 and 4.0% in 2010). Higher (37.7%) HIV infection

**Table 1.** Total number of clients screened and HIV positive population in Finote Selam Hospital in the years 2008 to 2010, February 2011.

| Year  | Total No. of clients tested |             | Total No. of HIV positive clients |            | Prevalence (%) |
|-------|-----------------------------|-------------|-----------------------------------|------------|----------------|
|       | M (%)                       | F (%)       | M (%)                             | F (%)      |                |
| 2008  | 5,508 (22)                  | 3,130 (13)  | 253 (18.9)                        | 309 (23)   | 6.5            |
| 2009  | 3,971 (16)                  | 2,779 (11)  | 184 (13.7)                        | 198 (14.8) | 5.7            |
| 2010  | 5,082 (21)                  | 4,191 (17)  | 159 (11.9)                        | 238 (17.7) | 4.3            |
| Total | 14,561 (59)                 | 10,100 (41) | 596 (44.4)                        | 745 (55.6) | 5.44           |

was registered in the 25 to 34 age group, followed by 35 to 49 (28.04%) and 15 to 24 (21.1%). Lower cases of infection occurred in the >49 years age group in 2008 while in the remaining two years, lower infections were observed in the <15 years age groups (Table 2).

Higher infection was registered in farmers and domestic workers. More male farmers, government employees, traders, day laborers and those who have no jobs were more affected than females. On the other hand, more female students and domestic workers than males were infected by the virus (Table 2).

## DISCUSSION

This three year retrospective cross-sectional study of VCT clients gives an insight into socio-demographic profiles and prevalence of HIV in a hospital setting in Ethiopia. The socio-demographic profile of VCT clients at Finote Selam Hospital revealed that a little over half of the clients were never married and more than 73% of the clients were living in the urban area. Farmers and domestic workers together comprised of half of the HIV positive clients. The highest rate of infection was registered among 25 to 34 age groups and 55.6% of infection occurring in females. The overall HIV prevalence was higher among females (7.4%) than males (4.1%). The ratio of HIV positive females and males in our study area was (1.5:1). A similar finding reported in Ethiopia (Korra et al., 2005) confirms that females are bearing a disproportionate burden of the disease and its impact, because of significant gender inequalities resulting in higher stigma, discrimination, poor access to public health services, lower rates of literacy, early marriage, leave school earlier than males, have little opportunity to participate in decision making and low negotiation skill on the use of condom (safe sex) or men's negligence, concurrent sex among better-off married males and economically disadvantaged young females (referred to as *kimit* and *wushima*), low socioeconomic status of females and engagement in high risk sexual behavior (Derbew, 2009).

The overall HIV prevalence of 5.4% among the study subjects is significantly lower than the prevalence in Addis Ababa, 24.5%. Female clients were more likely to be HIV positive than males. It was also observed that

urban females were more affected than urban males while rural males were more affected than rural females. Both males and females living in urban areas were more exposed to HIV/AIDS than those living in rural areas. Likewise, HIV prevalence was higher in urban residents (7.4%) than in rural populations (3.2%). This difference in prevalence in the urban and rural residents is supported by HIV/AIDS in Ethiopia (Kloos and Hailemariam, 2000) that urban residents were more affected than rural residents. The age pattern for HIV prevalence rates among VCT clients at Finote Selam Hospital revealed that the prevalence is higher among adult clients than younger and older ones as opposed to a study conducted in Addis Ababa in which higher prevalence was observed among older ones (Korra et al., 2005).

The rate of HIV infection among rural males was more than one and half times (2.82%) than females (1.7%) while urban females were more than one and half times as likely as urban males to be infected (4.6% versus 2.84%). There were different types of bridging populations and market related risks that link the low prevalence rural areas with the high prevalence urban communities. There are those who link their rural communities with higher-risk urban hinterlands for employment, education or social reasons and those people who are attending administrative matters, such as rural administrators visiting the town for training, workshops, weekly reports; most farmers, migratory laborers and rural commercial farmers often visit local towns for social and business purposes (Berhane et al., 2008; Derbew, 2009).

Activities specifically associated with agricultural marketing potentially contribute to the spread of the disease. Larger weekly markets attract people from further and may result in stays in the town and many drink alcohol. Drinking on market days is a common and long established practice. Both females and males drink *tella* (a beer made from barley) to quench their thirst (farmers noted that it is not easy to get water on market days, because the *tella* producers wish to sell their brews). Females usually returned to home after one or two drinks whereas males may have several drinks of *tella* or *areki* in houses close to the market. This may lead to unprotected sex with young females serving drinks. Increased market orientation and production of a marketable surplus is also likely to result in more frequent

**Table 2.** Number of HIV positive clients in Finote Selam Hospital (2008 to 2010), February 2011.

| Variable              | Year |     |     | Total | Percentages |
|-----------------------|------|-----|-----|-------|-------------|
|                       | 2008 |     |     |       |             |
| <b>Sex</b>            |      |     |     |       |             |
| Male                  | 253  | 184 | 159 | 596   | 44.4        |
| Female                | 309  | 198 | 238 | 745   | 55.6        |
| <b>Age</b>            |      |     |     |       |             |
| <15                   | 98   | 11  | 5   | 114   | 8.5         |
| 15-24                 | 108  | 78  | 87  | 283   | 21.1        |
| 25-34                 | 168  | 171 | 167 | 506   | 37.7        |
| 35-49                 | 146  | 106 | 114 | 376   | 28.04       |
| >49                   | 25   | 16  | 24  | 62    | 4.6         |
| <b>Residence</b>      |      |     |     |       |             |
| Urban                 | 413  | 278 | 296 | 987   | 73.6        |
| Rural                 | 149  | 104 | 101 | 354   | 26.4        |
| <b>Marital status</b> |      |     |     |       |             |
| Never married         | 339  | 212 | 239 | 790   | 58.9        |
| Married               | 157  | 114 | 112 | 383   | 28.6        |
| Divorced              | 49   | 31  | 34  | 114   | 8.5         |
| Widowed               | 17   | 25  | 12  | 54    | 4.0         |
| <b>Occupation</b>     |      |     |     |       |             |
| Domestic work         | 165  | 71  | 117 | 353   | 26.3        |
| Farmers               | 147  | 101 | 104 | 352   | 26.2        |
| Traders               | 105  | 86  | 74  | 265   | 19.8        |
| Government employee   | 47   | 42  | 33  | 122   | 9.1         |
| Day laborer           | 45   | 36  | 32  | 113   | 8.4         |
| Students              | 44   | 32  | 31  | 107   | 8           |
| No jobs               | 9    | 14  | 6   | 29    | 2.2         |

visits to markets or urban centers where FSW and other Most At Risk Populations (MARPs) are operating (Habte, 2008; Deribew, 2009).

Finote Selam is a marketplace and frequently visited by local businessmen and farmers from the neighboring *woredas*, including Quarit, Sekela, Dembecha, Dangila, Burie and Shindi from where many VCT clients tested for HIV were positive. In addition, truckers and their assistants enter and leave the town every day. The town also hosts large numbers of FSWs operating in hotels, bars, and local brew-selling houses. Army forces based in Birsheleko/Tatek Military camp, have also frequently visited the town which are frequently described as MARPs and with higher HIV prevalence than civilian populations (Whiteside et al., 2006), could contribute for increased prevalence of the disease in the study area by transmitting it to the general population. Cross-generational and transactional sex is common, especially among secondary and college students with uniformed

men, local businessmen and government employees. Alcohol and khat use and inconsistent condom use are among frequently cited reasons for the town's unchecked HIV transmission (Deribew, 2009).

## CONCLUSIONS AND RECOMMENDATIONS

In rural areas, conditions are conducive for further spread of the virus unless risky behaviors are reversed and poverty reduction programs bring about the changes required for an effective response to the epidemic. Strong and sustained support by the regional government as well as collaboration with local communities, private and civil organizations is essential.

Because of the heterogeneity of the epidemic, HIV/AIDS programs should not be based on national-level statistics, but need to be more focused geographically, and directed to regions, districts or communities

exhibiting higher prevalence rates.

Without continued focus on prevention, there would still be a huge potential that the epidemic may continue to be a threat to public health of the town. Prevention and treatment programs in the town and its surrounding areas should be upgraded and scaled up.

Surveillance in rural areas needs to be increased, not only to monitor the spread of the epidemic, but also to continue providing better estimates of the true prevalence of the epidemic in the region whose population remains overwhelmingly rural.

### LIMITATIONS OF THE STUDY

Since the study covered the three years data, clients tested more than once in the three years were not discriminated, especially if they were HIV positives, increasing the prevalence without new infection. Many clients also came from neighboring woredas for screening purposes and if unfortunately tested HIV positive, they may not returned to their home place where they came from, becoming source of infection in the town and hence increasing the prevalence.

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**6th International Meeting on HIV Persistence, Reservoirs and Eradication Strategies,  
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## Conferences and Advert

### **December**

6th International Meeting on HIV Persistence, Reservoirs and Eradication Strategies, Miami, USA, 3 Dec 2013

17th International Conference on AIDS and Sexually Transmitted Infections in Africa, Durban, South Africa, 7 Dec 2013

The background of the entire page is a microscopic image showing various cells and what appears to be a viral particle or a cluster of small green spheres. The colors are primarily green, purple, and brown against a dark background.

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