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Journal of AIDS and HIV Research

Full Length Research Paper

Societal awareness of stigma and discrimination against persons living with Human Immunodeficiency Virus (HIV) (PLHIV): Experience of clinicians, PLHIV, general population, and persons who are vulnerable to HIV

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The objective of this study was to explore societal awareness of stigma and discrimination against persons living with Human Immunodeficiency Virus (HIV) (PLHIV) through the experience of clinicians, PLHIV, the general population and persons who are vulnerable to HIV. This was a cross-sectional survey which used questionnaires to collect data during May to July, 2013. The sampling unit was eight target provinces of the National AIDS Program Plan (NAP) for 2012 to 16. The sample respondents include 300 persons in Internet on-line groups, 1,937 factory workers, 334 female sex workers (FSW), 317 men who have sex with men (MSM), 101 persons who inject drugs (PWID), 352 HIV clinicians and counselors, and 1,880 PLHIV. The sampling methods used a combination of time-location sampling and quota sampling. The factory workers were sampled with probability proportional to size and quota sampling. PLHIV were purposively selected at anti-retroviral therapy (ART) clinics. This study found that the respondents felt that Thai society still views PLHIV in a negative light and fear the consequences for themselves and their family if others knew they were HIV+. Self-stigma among vulnerable populations is still quite prevalent. MSM have less self-stigma than FSW, PLHIV and PWID. All of the vulnerable groups reported being treated differently (in a negative way) from the mainstream population, though this discrimination was not severe. Clinicians reported a slight amount of discrimination against the vulnerable populations but, generally, the goal was to treat all clients equally, without prejudice or stigma and discrimination, based on principles of human rights, regardless of gender or sexuality. Nevertheless, Thailand needs to continue to improve awareness and provide training in human rights, fundamental sex rights, and gender equity for health providers and other relevant individuals. There is a need for monitoring stigma and discrimination, and elimination of violence due to sexual diversity, both at the national and sub-national levels. Mass media is a crucial channel for improving attitudes, beliefs, knowledge and understanding in the area of human rights and respect for others rights, including empowering those impacted by stigma and discrimination, so that they know how to identify rights violations, seek protections from violations and redressing violations.

Key words: Stigma, discrimination, societal awareness, HIV/AIDS, Thailand clinicians, persons living with Human Immunodeficiency Virus (HIV) (PLHIV), general population, vulnerability to HIV impacts.

INTRODUCTION

During the early stages of the Human Immunodeficiency Virus (HIV) epidemic in Thailand, society at-large was very fearful because of lack of knowledge and lack of understanding of how HIV was transmitted, and how infectious a persons living with Human Immunodeficiency Virus **(**HIV) (PLHIV) was (Boer and Emons, 2004).

Accordingly, the government, private sector and Civil Society conducted numerous campaigns to build understanding in the general population about Human immunodeficiency virus infection and acquired immune deficiency syndrome (HIV/AIDS). In addition, outreach education was directed to those presumed to be at highest risk for contracting HIV such as female sex workers (FSW) and their clients, men who have sex with men (MSM) and persons who inject drugs (PWID). Because these vulnerable populations were also marginalized in society already (that is, as promiscuous, immoral, or criminal), the association with HIV risk created a double stigma, which reinforced the negative prejudice of general society against these groups (Brown et al., 2003; Letamo, 2003).

This prejudice spilled over into a general loathing of anyone with HIV infection, regardless of how they contracted it, with society assuming that they must have done something wrong or, at least, needed to be shunned. Thus, for many years into the Thai epidemic, PLHIV who knew their HIV+ status took every effort to keep that a secret, and this took a toll on their physical and mental health, as well as adversely impacting on their daily life, work, and social status, especially when symptoms of infection started to manifest (Boer, 2004), If a person was known or suspected to be HIV+, they were generally scorned, ostracized and rejected, not only by society at-large, but often by relatives and neighbors. HIV infection was routinely a cause for dismissal from one's job, or refusal to be hired. Many companies and organizations began introducing HIV screening protocols once the HIV test became available and affordable (Ministry of Public Health, 2012). This further marginalized the PLHIV and, because there was no effective treatment for AIDS in the first decade of the Thai HIV epidemic, most avoided visiting the hospital or counseling centers since doing so might expose them to stigma and discrimination from family members, acquaintances, co-workers or employers (Wailoo, 2001). Common forms of stigma and discrimination against PLHIV during the early phase of the epidemic included:

1). Reduced access to social and health services and clinical care.
2). Denial of admission to school, expulsion from school, or segregation from the general population of students.
3). Compulsory HIV screening for new employees or applicants, or dismissal of employees found to be HIV+.
4). Compulsory screening for HIV before ordination as a monk, denial of PLHIV to obtain life insurance, membership in community cremation funds, or ability to take out loans from community funds (Link and Phelan, 2006).

This stigma and discrimination has adverse impacts on the daily life and basic sense of honor and self-worth of the PLHIV, and the people close to them (Valdiserri, 2012). The 2007 Thai constitution asserts the right of all Thais to respect the human rights and equality of all members of society. Also, the UN Declaration of Commitment on HIV/AIDS (which Thailand is a signatory to) stresses that respect for human rights and basic freedoms is central to reducing risk for HIV and eliminating all forms of discriminations, so that PLHIV and other vulnerable persons can have equal access to education, employment, health and social services, disease prevention, information and legal protection and respect for right to privacy (Alonzo and Reynolds, 1995; Bollinger, 2005).

Thailand has achieved international recognition for being one of the few countries to reverse the HIV epidemic before its natural peak. However, in the past three to four years, there is mounting concern that HIV might be returning as a new threat in different forms than in the past, and in ways that may be even more difficult to control (Ministry of Public Health, 2012). For example, female commercial sex work have transitioned from venue-based establishments into indirect and free-lance interactions, which are much harder to intervene with and monitor. Results from HIV surveillance show that the prevalence of HIV among MSM remains high. Also, intravenous drug use is evolving from heroin to other drugs such as methamphetamines without any reduction in risk from needle-sharing. At present, it is estimated that a cumulative number of 1.2 million Thais contracted HIV and, of these, about one-half have died. Of the remaining 600,000 persons living with HIV (PLHIV) nearly 10,000 die each year from AIDS, and this number is decreasing annually due to improved coverage and efficacy of ART and early (pre-symptomatic) voluntary counseling and testing (VCT). Projections of the number of Thai HIV infections during 2012 to 2016 using the Asian Epidemic Model estimate that 62% of new HIV infections occur in the higher-risk populations of MSM, FSW and PWID (National AIDS Prevention and Alleviation Committee, 2012).

Stigma, discrimination and human rights violations

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towards people living with HIV are also a particularly significant problem in the health sector in Thailand. The Stigma Index revealed 20% of respondents were denied health services, and 20% reported discriminatory reactions of health service providers on discovering the respondent's HIV positive status. People living with HIV in Thailand also reported high levels of internalized stigma manifesting as shame, guilt and low self-esteem and because of this, many avoided clinics and hospitals despite needing access medical services (Asia Pacific Regional Analysis, 2011). Stigma, discrimination and human rights violations in the health sector, both real and perceived, deters people from undertaking HIV-testing or adhering to medication regimens, reducing quality of life for HIV patients, and driving new infections.

The HIV epidemic in Thailand is concentrated in key affected populations including men who have sex with men, sex workers and injecting drug users. These groups already experience significant stigma, discrimination, human rights violations and gender inequality in the community. A 2009 USAID study demonstrated that men who have sex with men and transgenders experienced high levels of discrimination in the form of violence, with 24% of men who have sex with men and 33% of transgenders out of a total of 86 respondents reporting physical violence, and 63% of men who have sex with men and 78% of transgenders reporting emotional violence in the past 12 month (Myra, 2009). It is probable that people living with HIV experience stigma, discrimination, human rights violations and gender inequality not only due to the virus but also because of their identities or associated behaviours.

Thailand's National AIDS Committee (NAC) has set the goal of eliminating the threat of HIV/AIDS by 2030, and the country is currently implemented the NAP for 2012 to 2016. The plan calls for a focus on those most at risk of contracting HIV and endorses the international "Three Zeroes" strategy (0 HIV incidence, 0 AIDS mortality, and 0 stigma and discrimination). The plan is being implemented by government and Civil Society organizations (Sriwanichakorn et al., 2014).

Often, stigma and discrimination arises from myths and misconceptions ascribed to persons with unconventional behavior or behavior which is considered immoral or against cultural norms (Holzemer et al., 2009; Makoae et al., 2008). Also, stigma and discrimination can be an outgrowth of class prejudice (for example, HIV risk is mostly in the lower income groups). An important cause of stigma and discrimination is fear of the unknown and perceived threat (Herek et al., 2002). These various causes feed off each other and further embed prejudice against certain groups of individuals and have the insidious effect of spreading denial, and self-stigma among those at risk who should seek prevention education services (International Parenthood Federation, 2008).

The literature on stigma has expanded considerably in the era of HIV/AIDS, given that having HIV disease is viewed more negatively than many other stigmatized conditions, such as mental illness and other physical health problems (Corrigan, 2000; Crawford, 1996; Stewart and Pulerwitz, 2002). Conceptually, it is well known that HIV/AIDS stigma is multi-layered or compounded with already marginalized behaviors, such as sex work, drug use, and homosexual sexual practices; and vulnerable groups, such as prisoners or migrant populations (UNAIDS, 2005). People are also more aware of the many underlying factors at the community or social levels that may predispose to HIV/AIDS stigma, including lack of knowledge or understanding about the illness; misconceptions about how HIV is transmitted; lack of access to treatment; how media shapes the reporting on the epidemic; the incurability of AIDS; and existing prejudice and fear toward specific groups (UNAIDS, 2005) (Sengupta et al, 2010) (Mahajan et al., 2008). Furthermore, the concepts of perceived, enacted, internalized, and/or compounded stigma have been advanced by the development of quantitative measurements (some of them validated) to assess the types of stigma persons living with HIV/AIDS (PLWHA) are feeling or experiencing, or to assess non HIV-infected individuals' perceived or enacted stigma towards PLWHA (Earnshaw, 2009). Lastly, a large body of research suggests that HIV/AIDS stigma is a barrier associated with disclosure and negative health outcomes, impacting HIV preventive behaviors (Sengupta et al., 2010); HIV care-seeking behaviors (Prachakul et al., 2007; Sayles et al, 2007); quality of care for PLWHA (Vanable et al, 2006); and treatment of PLWHA among loved ones (Bogart, 2008) health care providers (Sayles et al, 2007), and the larger community (Foster, 2007). The negative health outcomes resulting from HIV/AIDS stigma have made it necessary for HIV prevention and treatment programs to direct greater efforts on reducing HIV/AIDS stigma.

Stigma and discrimination (S&D) are identified as essential targets of the National HIV Program and are prioritized as critical areas in progressing towards zero new infections and zero discrimination. Yet little is known about these issues, how best to address them, and in particular, how to know the societal awareness of stigma and discrimination against PLHIV through the experience of clinicians, PLHIV, the general population, and persons who are vulnerable to HIV.

This research was conducted to study the societal awareness of stigma and discrimination against PLHIV through the experience of clinicians, PLHIV, the general population, and persons who are vulnerable to HIV

MATERIALS AND METHODS

This research is a cross-sectional study and used a questionnaire which focused on knowledge of HIV testing, understanding of test results, knowledge of service outlets, the right to free service,

Table 1. Sample size by type of respondent.

Type of respondent		Selection of site	Selection of respondents	N
Persons with vulnerability to HIV/AIDS	MSM	Time location sampling (TLS) of popular places for congregating	Purposive selection	317
	FSW	TLS of popular places for congregating		334
	PWID	TLS of popular places for congregating outside the hospital		101
General population	Factory workers	Probability proportional to size sampling of large factories (with at least 200 workers)		1,937
On-line groups	Six websites were selected: www.adamslove.org; www.aidsaccess.com; www.teenpath.net; www.thaiplus.net; www.tnca.or.th; www.prachatai.com during December, 2012 to May, 2013		Snowball technique	300
Clinicians	AIDS physicians	One provincial and two district hospitals from each of eight provinces which are priority areas of the NAP for 2012-16	Purposive selection	24
	Nurses and counselors tending PLHIV			328
PLHIV	Not yet on ART		Age 18 years or older, appearing at the clinic	462
	On ART			1,418

protection of confidentiality, and stigma/discrimination. Data were collected between May and July, 2013 by experienced data collection staff recruited from the target populations themselves.

Data were collected in eight purposively-selected provinces, which are a sub-set of the focus area of 31 provinces for the 2012 to 2016 National AIDS Program Plan. Selection of these eight was based on mortality rate of PLHIV in the first 12 months after initiating ART, overall mortality, lack of ART continuity, and intensity of Global Fund to fight HIV/AIDS, TB and Malaria (GFATM)-funded activities. Provinces were stratified by high and low performance levels and geographic region. Selection was also based on HIV prevalence in the three focus populations.

The method for selecting key affected populations (KAPs) respondents used a two-stage, time-location quota sampling method. In the first stage, data were collected on the location, time and number of the target population gathering there. Location data included the name of site, the manager or supervisor, address, phone contact, and contact information of the owner of the location. Mostly, these data were collected from discussions with organizations or agencies which work with the target populations, for example, Rainbow Sky Association, or other groups working with FSW: MSM and PWID. These organizations have extensive information about their beneficiary populations and contact information of peer leaders and other key informants. In the next stage, the research team conducted triangulation to verify the information on location, time and number of congregants. The team might ask locals whether the entertainment establishments in the location were still operating. Next, the locations were classified as venue-based and non-venue-based places where the target populations gather to interact with others. Examples of venues include entertainment establishments, bars, saunas, massage parlors, fitness or beauty salons, or movie theaters. Non-venue-based locations are generally public spaces such as parks, roads or intersections. Normally, these locations are group-specific, that is, there is little overlap of MSM, FSW or PWID in a given location. Next, the researchers conducted a purposive selection of persons who met the study criteria and consented to participate in the data collection. Participants were interviewed until the quota of the sample for a given location was reached (Table 1).

Each day, after the interviews had been completed, the research team inspected the questionnaires for completeness, consistency, and accuracy in order to ensure quality data. Any questionnaire found deficient in these areas was discarded, and additional interviews were conducted to replace them. Data were further edited by computer before analysis. The researchers used the CSPro v. 4.1 software and SPSS to apply descriptive statistics, Chi-Square, and binary logistic regression analysis. The aim was to identify statistically significant associations between the independent variables and the dependent variable, and the level of the associations. Analysis was conducted to predict behaviors of interest by combination of variables.

This research protocol was approved by the ethical review committee and research review board of Mahidol University. All participants were taken through and informed consent process before they participated in the study. The research team gave high priority to professional treatment of the data and strict protection of confidentiality, with no possibility to link the findings with a particular individual.

Instrument

Research on stigma has explored negative social attitudes (perceived stigma), and discriminating behaviors (enacted stigma) toward stigmatized individuals (Corrigan, 1999) (Pryor et al, 2004). Self-stigma (or internalized stigma) has also been examined, which results from fear of enacted stigma (Rüsch et al, 2005). Some examples of self-stigma include individuals hiding their diagnoses or socially isolating themselves from others, or feeling ashamed of having a particular disease/condition. A survey tool for people living with HIV and health service providers aimed to gain an understanding of the factors that may give rise to discriminatory treatment towards people living with HIV in the health care sector and a survey tool for general population and KAPs in order to better understand their experiences of stigma and discrimination in the community and health care sector. The main themes and issues emerging from the consultation interviews are outlined and discussed in Table 2.

Table 2. Instrument of stigma and discrimination survey by target.

Target	Questions	Issue
PLHIV	Sense of wrong-doing by being HIV+	Self-stigma
	Feel less worthy than others because HIV+	
	Telling others of one's serostatus puts one at risk of aversion	Fear of consequences of revealing HIV+ serostatus
	Most acquaintances do not know one's HIV+ serostatus	
	Most people speak negatively about PLHIV	Perception of negative social bias
	Most people are not comfortable living in the proximity of PLHIV	
	Experience of negative gossip because HIV+	Discrimination
	Denied from participating in social activities with other community members because HIV+	
	Denied health service or treated badly by health service providers because HIV+	
	Mistreated or discriminated against in the workplace, government offices, school, or other social setting because HIV+	
Providers	Persons are infected with HIV because of bad behavior	Negative social stigma toward PLHIV
	PLHIV should not be allowed to get pregnant	
	If I could choose, I would prefer not to provide services to PLHIV	Discrimination
	If I could choose, I would prefer not to provide services to IDU	
	If I could choose, I would prefer not to provide services to MSM	
	If I could choose, I would prefer not to provide services to sex workers	
	If I could choose, I would prefer not to provide services to transgender	
General population: Factory worker and online survey	Fear of contracting HIV if in contact with the saliva of PLHIV	Fear of the infected
	A PLHIV, even if asymptomatic, should not be allowed to be a school teacher	
	Children with HIV should not be allowed in classrooms with other uninfected children	
	Would not like to buy food from a PLHIV vendor	
	Most people speak negatively about PLHIV	Perception of negative social bias
	Most PLHIV are treated poorly in general	
	Most people would not be comfortable associating with PLHIV in the neighborhood	
	People don't go for HIV testing because of fear of aversion if found to be HIV+	Fear of consequences of revealing HIV+ serostatus
	If a family member was HIV+, that should be kept secret	
	It would be a source of shame if a family member was HIV+	
	If an employer finds out that a worker is HIV+ they are likely to be fired or let go	
KAPs	Fear of contracting HIV if in contact with the saliva of PLHIV	Fear of the infected
	A PLHIV, even if asymptomatic, should not be allowed to be a school teacher	
	Children with HIV should not be allowed in classrooms with other uninfected children	
	Would not like to buy food from a PLHIV vendor	
	Most people speak negatively about PLHIV	Perception of negative social bias
	Most PLHIV are treated poorly in general	

Table 2. Cont'd.

	Most people would not be comfortable associating with PLHIV in the neighborhood	
	It would be a source of shame if a family member was HIV+	Fear of consequences of revealing HIV+ serostatus
	People don't go for HIV testing because of fear of aversion if found to be HIV+	
	If a family member was HIV+, that should be kept secret	
	If an employer finds out that a worker is HIV+ they are likely to be fired or let go	
	Feel shame for going for an HIV test	Self-stigma
	Feel it was wrong to have risk behavior for HIV	
	Feel self-destructive	
	Lack self-confidence	
	Feel less worthy than others	
	Telling others that one is in a higher risk group will result in disdain	
	That society views higher-risk populations negatively reduces one's self-esteem	
	A member of the higher-risk group who is HIV+ would be treated badly by family members, friends, co-workers, and members of the same group or neighborhood	
	Would not seek an intimate relationship or sex partner if infected with HIV	
	PLHIV who are members of a higher risk group experience more S&D than general population PLHIV	
	In the past 12 months, experienced impolite treatment, manner, facial expression, tone of voice or other negative discrimination or denial because of being in a higher-risk group	Discrimination
	In the past 12 months felt concern that acquaintances, family members or others would treat them badly if they knew they were HIV+ and this deters them from seeking HIV testing	
	In the past 12 months, experienced negative gossip behind one's back because of being in a higher-risk group	
	In the past 12 months, was often or regularly denied participation in social activities because of being in a higher-risk group or HIV+	
	Was discriminated against when going for health services because of being in a higher-risk group or HIV+	

RESULTS AND DISCUSSION

Characteristics of the general population and vulnerable populations

Over half the MSM were under 25 years of age, while nearly all PWID were 25 years or older. Fully 70% of the FSW were age 25 years or more. Most FSW, MSM and PWID had high school education; over half of the on-line community respondents had a bachelor degree, while half of factory workers had commercial college or a bachelor degree education. About one-third of MSM and on-line respondents were in school. Over half of PWID were employed in general wage labor jobs. Half of the on-line respondents lived in Bangkok and nearly two-thirds were male. Similar proportions of factory worker respondents were male and female (though females outnumbered males) (Table 3).

Stigma and discrimination

There are many different dimensions of stigma and discrimination, but the following five are central:

(1). Fear of contracting HIV from contact with PLHIV

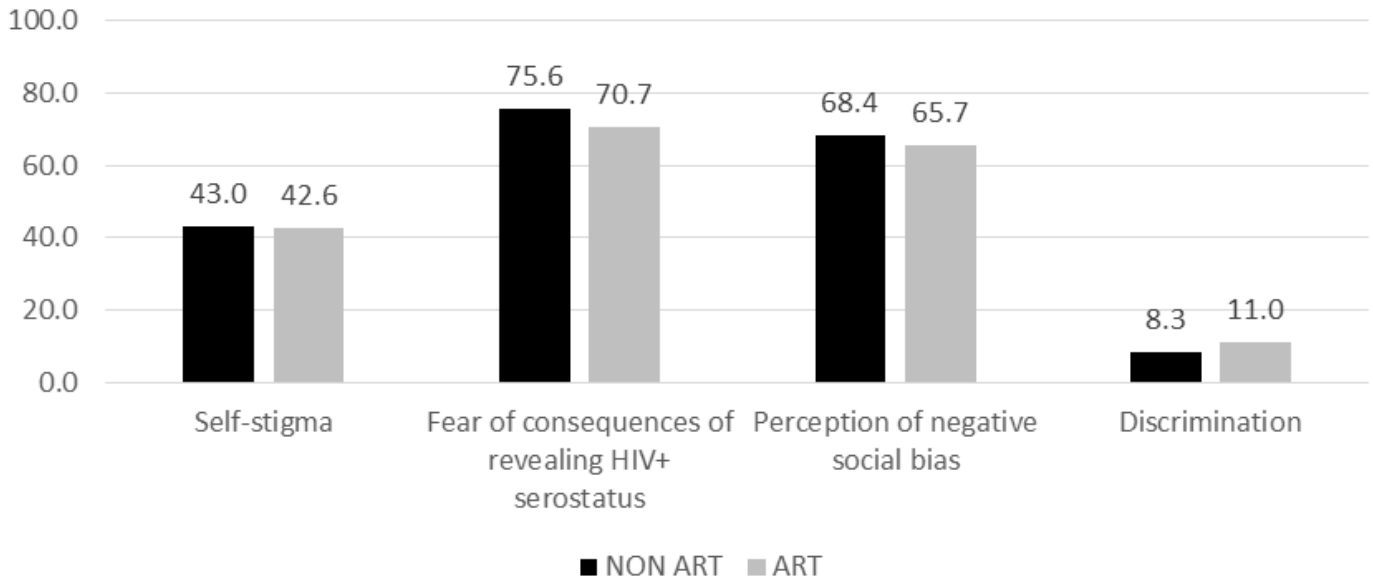

Figure 1. Proportion of PLHIV Service Recipients Responding to Items on stigma and discrimination.

which leads to avoidance, such as not buying products from a PLHIV vendor.
(2).Reduced self-esteem resulting from PLHIV resignation that they are now lower status than others, and this can lead to self-destructive behaviors, self-blame, and withdrawing from society.
3). Anticipated stigma from disclosure of serostatus or by association (for example, by taking ART).
4). Perceived discrimination or being treated differently from others in society (Kahn, 2004; Sriwanichakorn et al., 2014).

The findings of the evaluation on stigma and discrimination are presented by different population groups since their experience and perceptions differ somewhat (Table 4).

PLHIV

The questions on stigma and discrimination spanned across four dimensions:

1).Self-stigma
2).Fear of consequences of revealing HIV+ serostatus
3).Perception of negative social prejudice; and
4).Experience of discrimination, either verbal or by denial.

About half of the respondents felt that it is wrong that they are infected, while one-third felt they are less worthy because of their infection. There is more fear of others knowing one's serostatus than other dimensions, and pre-ART PLHIV were more concerned than ART clients about this. A rather high proportion perceived that society views PLHIV negatively. Small percentages reported experiencing verbal discrimination or denial of services or freedoms because of their infection (Figure 1).

Clinicians and counselors

ART clinic staffs were asked if they felt that society has a negative view of PLHIV, and whether they felt PLHIV should not have children. Over half of the respondents felt that there remains a negative social stigma about being HIV+. They felt that most common target of prejudice is PWID, followed by FSW, MSM and transgender populations. While experience of actual discrimination may be low, client perception of discrimination could be preventing many from seeking care. Nurses and physicians have similar patterns of response (Figure 2).

General population

Respondents in the population of factory workers and on-line communities were presented with 11 statements across three dimensions of S&D:
1). Fear of contracting HIV from contact with a PLHIV and avoidance of PLHIV;
2). Feel that society views PLHIV negatively; and
3). Fear of consequences if they are HIV+ or if others knew of HIV+ serostatus.

This evaluation found that fear of contracting HIV from casual contact with a PLHIV caused people to avoid

Table 3. Characteristics of the general and vulnerable populations.

Characteristic	Online survey (n=300)		FW (n=1,937)		FSW (n=334)		MSM (n=317)		PWID (n=100)	
	n	%	n	%	n	%	n	%	n	%
Sex										
Female	85	28.3	1,096	56.6	334	100.0	-	-	-	-
Male	194	64.7	826	42.6	-	-	-	-	100	100.0
Other	21	7.0	15	0.8	-	-	317	100.0	-	-
Age										
< 24 year-olds	114	38.0	435	22.5	98	29.3	169	53.3	11	11.0
>=24 year-olds	186	62.0	1,502	77.5	236	70.7	148	46.7	89	89.0
Education										
Primary school	3	1.0	288	14.9	108	32.3	11	3.5	23	23.0
Secondary school	52	17.3	649	33.6	175	52.4	180	56.8	61	61.0
Vocational School	18	6.0	498	25.8	17	5.1	30	9.5	9	9.0
Bachelor	157	52.3	456	23.6	5	1.5	75	23.7	1	1.0
Other	70	23.3	38	2.0	29	8.7	21	6.6	6	6.0
Occupation										
Students	93	31.0	-	-	-	-	108	34.1	-	-
Agriculture	1	0.3	-	-	-	-	-	-	-	-
Wage labor	13	4.3	-	-	-	-	26	8.2	55	55.0
No work	15	5.0	-	-	-	-	-	-	13	13.0
Government office	53	17.7	-	-	-	-	22	6.9	-	-
Worker	74	24.7	-	-	-	-	38	12.0	11	11.0
Private	25	8.3	-	-	-	-	37	11.7	14	14.0
Other	26	8.7	-	-	-	-	86	27.1	7	7.0

Table 4. Data collection on stigma and discrimination by method and population.

Issue	Source of data by population								
	FW	FSW	MSM	PWID	Gen pop	Pre-ART	ART	MD	Nurse
1.Stigma and social prejudice									
Fear of the infected	✓	✓	✓	✓	✓	-	-	-	-
Perception of negative social bias	✓	✓	✓	✓	✓	✓	✓	✓	✓
Fear of consequences of revealing HIV+ serostatus	✓	✓	✓	✓	✓	✓	✓	-	-
2.Self-stigma	-	✓	✓	✓	-	✓	✓		-
3.Discrimination	-	✓	✓	✓	-	✓	✓	✓	✓

them. Factory workers were more concerned about this than the on-line respondents. About three-fourths feared buying food from a PLHIV vendor, while one-third felt there was general negative social stigma about PLHIV. Similar and rather high proportions in both groups felt that there is discrimination against PLHIV, and they personally would be uncomfortable living in the same household with a PLHIV. Similar proportions in both groups of respondents felt concerned about HIV infection and feared the consequences if one are HIV+ serostatus was known (Figure 3).

Higher-risk populations

The traditionally higher-risk populations of FSW, MSM and PWID were asked about stigma and discrimination across the following dimensions:

Table 5. Level of opinion regarding issues related to stigma and discrimination by dimension and population group.

Stigma and discrimination	Higher-risk population			General population		Client		Provider	
	FSW	MSM	PWID	FW	Online	On ART	ART	MD	Nurse
Fear of PLHIV	++	++	++	+++	++				
Level of negative social stigma	++++	++++	++++	++++	++++	++++	++++	+++	++++
Fear of consequences if HIV+ status is revealed to others	++++	++++	++++	++++	++++	++++	++++	-	-
Self-stigma	+++	++	+++	-	-	+++	+++	+	+
Experience of discrimination	+	++	++	-	-	+	+	-	-

Remarks: + denotes only minor stigma (agreement with the statement is under 20%); ++ denotes some stigma (agreement with the statement is 20-40%); +++ denotes considerable stigma (agreement with the statement is 41-60%); ++++ denotes high level of stigma (agreement with the statement over 60%).

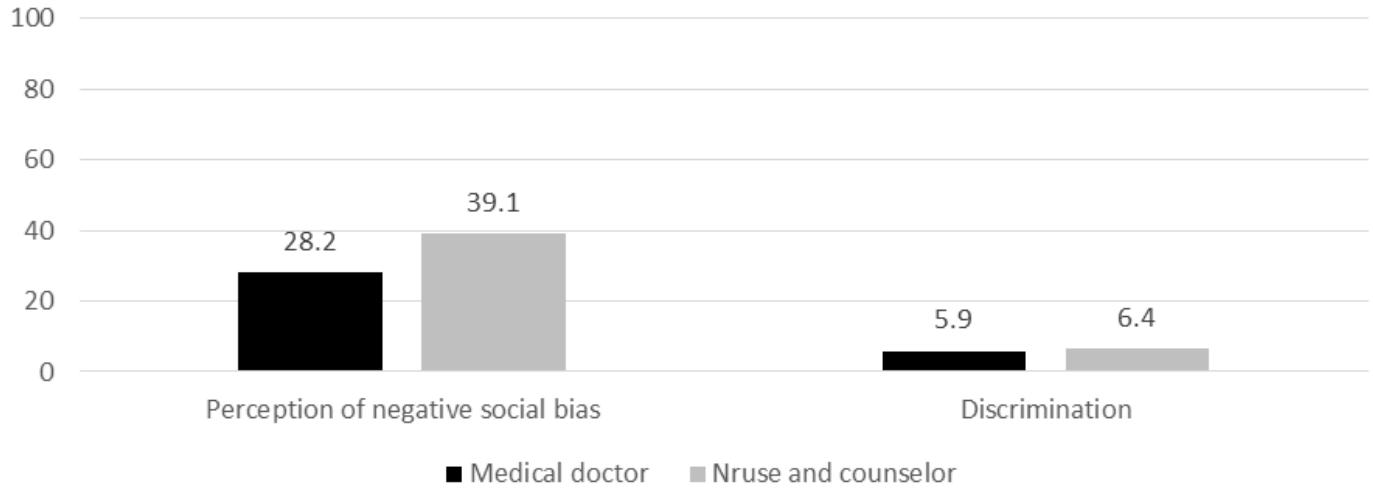

Figure 2. Proportion of providers who agree with various statements about stigma and discrimination.

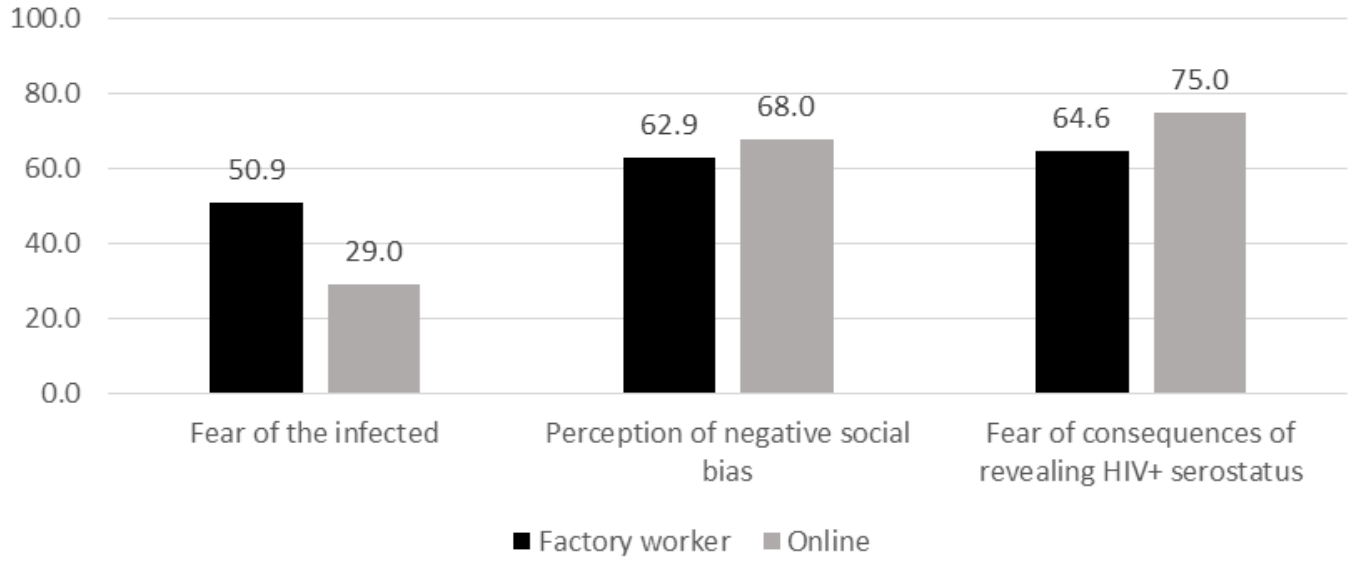

Figure 3. Proportion of factory workers and on-line community respondents who agree with various statements about stigma and discrimination.

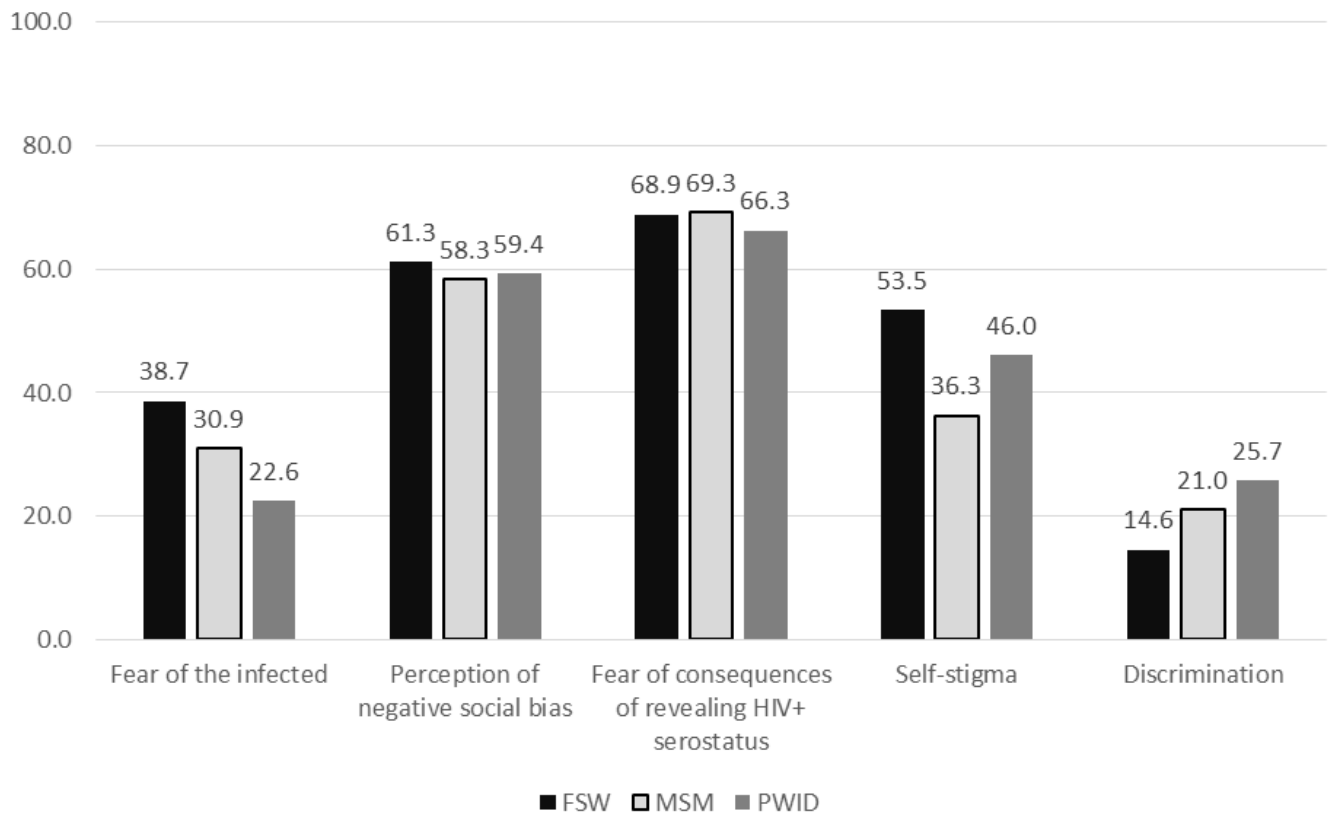

Figure 4. Proportion of high-risk populations who agree with various statements about stigma and discrimination.

(1) Fear of infection from contact with a PLHIV.
(2) Perception of negative social stigma against PLHIV.
(3) Concern of consequences if others know one's HIV+ status.
(4) Self-stigma.
(5) Experience of discrimination (Figure 4).

Prejudice toward others

The higher-risk populations also feared contracting HIV by contact with a PLHIV and, thus, would practice avoidance if possible. However, they felt less concern about PLHIV teacher or student being allowed in the classroom with the general population. FSW and MSM were concerned about HIV infection from contact with saliva of a PLHIV more than the PWID. Two-thirds agreed that there is still negative social stigma against PLHIV and they would not like to live with a PLHIV, and feared consequences for themselves, their family, their job security if HIV+ and their status was known. One-third would feel ashamed if a family member was HIV+.

Self-stigma

The higher-risk populations were presented with ten statements regarding acceptance of prejudice and self-esteem or feelings of self-blame, and reclusion from society. This evaluation found that half of MSM and PWID felt that they practiced behavior in the past that was risky for HIV. One-third would feel shameful about going for an HIV test, lack self-confidence and have lower self-esteem as a result. Over half of FSW and PWID felt that disclosing higher-risk group status would result in disdain, and three-fourths believe that higher-risk populations who are HIV+ experience more stigma and discrimination than general population PLHIV.

Experience of stigma and discrimination

Members of the higher-risk groups were asked about experience of stigma and discrimination in the past year, both verbal and denial of participation in social activities or other freedoms. Two-thirds of MSM and PWID had experienced impolite treatment by other's facial expression, tone of voice, manner, or segregation. They were concerned about negative treatment by people around them if it was known that they went for HIV testing, and thus, are reluctant to be tested. PWID were treated poorly by some providers because of their drug addiction. FSW reported less experience of stigma and discrimination (only one-fifth). But they were concerned

that if acquaintances and neighbors knew they were HIV+ they would be treated negatively. This discouraged them from seeking HIV status.

DISCUSSION

Overall, it is clear that stigma and discrimination related to HIV/AIDS is still a significant issue in Thai society. However, it is also true that the widespread availability and use of affordable ART is helping to reduce AIDS stigma and discrimination, and encouraging more people to seek diagnosis and early treatment (Ogden and Nyblade, 2005; Caster and Famer, 2005).

However, due to the several decades of societal prejudice and negative views of AIDS and those most vulnerable, it will take some time for stigma and discrimination to be totally eradicated (Nyblade, 2006). The many levels of stigma and discrimination also make its elimination a complex process requiring multiple levels and types of interventions (Kalichman et al., 2005). This is complicated by the fact that much of the population either under- or over-estimates its risk for HIV. Thus, programs need to continue to help people accurately assess their risk for HIV. For vulnerable populations, self-stigma continues to be a barrier to seeking prevention education, diagnosis and, if necessary, timely treatment. As HIV diagnostics improve (with speed, accuracy and availability), more people in the vulnerable groups are likely to know their serostatus. Also, as ART continues to improve, society will eventually view AIDS as a manageable chronic condition, not unlike diabetes or hypertension. At that point, stigma and discrimination should become insignificant (Herek, 2002; Carael et al., 2002).

The study also found that about two-thirds of all respondents fear the consequences of revealing HIV+sero status (Kuteesa et al., 2014). The findings from this study were similar to several studies in Africa found that AIDS epidemic has often been associated with severe negative public reactions ranging from banning entry of HIV infected individuals to isolating an individual in the family, deserting a pregnant wife on knowing her HIV status in the hospital, or removing a person from his job, or even denying a child admission in school. These negative reactions have shaped the behaviour of infected individuals, and have limited the effectiveness of prevention efforts (Goudge et al., 2009). HIV stigma is also shown to negatively affect the quality of life of people living with HIV infection, their adherence to medication and their access to care (Skinner and Mfecane, 2004). Few studies have documented HIV stigma by association as experienced by nurses or other health care workers who care for people living with HIV infection (William et al., 2009).

Yet Thailand should continue to intensify interventions and campaigns to accelerate the elimination of AIDS stigma and discrimination in order to achieve its own goals and the global strategy of the Three Zeros. To measure progress toward these objectives, Thailand needs to continue to develop and implement monitoring and evaluation tools to track improvements toward eliminating stigma and discrimination, and identify gaps and areas for extra effort (Lee et al., 2002). Mass media is a crucial channel for improving attitudes, beliefs, knowledge and understanding in the area of human rights and respect for others rights, including empowering those impacted by stigma and discrimination, so that they will know how to identify rights violations, seek protections from violations and redressing violations (Banteyerga et al., 2004; Stewart and Pulerwitz, 2002).

Conclusion

The populations in this study, including AIDS clinicians and counselors, PLHIV, members from the general population and higher-risk groups felt that there are negative consequences to disclosing one's HIV+ sero status, and over two-thirds of all groups felt that HIV infection reflects negatively on a person's character. The higher-risk populations and PLHIV felt self-stigma, with some having self-destructive emotions. Despite the fact that there is now widely available and affordable first-line ART throughout the country, the lingering negative stigma and discrimination against AIDS and PLHIV is an important barrier to seeking VCT, HIV testing, ART, and continuing care and treatment. Efforts to combat stigma need to employ a variety of strategies at different levels. There are issues of actual and perceived stigma, different degrees of prejudice among family, friends and co-workers. There is a need for training in coping skills. Sometimes a PLHIV or member of a higher-risk group may perceive discrimination or prejudice when in fact there is none. Other times, the discrimination is genuine. This effort is in accordance with universal principles of human rights protection and acceptance of diversity of the population (Wolitski et al., 2005). The ultimate goal should be a society that is free from social prejudices, with equal access to basic health, education, and productive employment for all. Thailand should also examine the experience of other countries and programs to eradicate AIDS stigma and discrimination, and adapt the best practices so that they are suitable for the Thai context (Apinundecha et al., 2007; Deacon et al., 2009; Wu, 2008). Much of the rhetoric and literature has cited the complexity of HIV stigma, and its diversity in different cultural settings as the primary reasons for the limited response to this pervasive phenomenon (Parker and Aggelton, 2003; Ogden, 2005). The complexity of the phenomenon has led to difficulties and disagreement about how to define HIV stigma and sometimes, to an erroneous conflation of stigma with its related concept of discrimination.

The manifestation of HIV stigma not only varies by cultural/national setting, but also by whether one is

considering intrapersonal versus societal levels of stigma. The variability in manifestations of stigma by setting and level has led to difficulty in measuring the extent of stigma, assessing the impact of stigma on the effectiveness of HIV prevention/treatment programs, and devising interventions to reduce stigma. These four challenges – defining, measuring, assessing impact of, and reducing stigma – among others have hampered local and global efforts to address HIV stigma.

Limitations of the study

The clinicians in this study are probably not representative of the larger population of clinicians since the sample for this study was drawn from AIDS clinic physicians, nurses and counselors who service PLHIV. Also, the questionnaire content differed among groups of respondents to be consistent with their occupation or risk status.

Conflict of Interests

The authors have not declared any conflict of interests.

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Full Length Research Paper

Comparing the glucose metabolism derangement in human immunodeficiency virus infection patients on antiretroviral treatment with drug naïve patients at Lagos State University Teaching Hospital

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People living with HIV and AIDS are exposed to the challenges of aging and diet related diseases due to prolonged survival by retroviral drugs. The presence of chronic inflammatory state and the metabolic effects of antiretroviral therapy are additional burden. This study was designed to determine the changes in glucose metabolism in HIV infection. This was a case-control study carried out at the adult HIV clinic. Consenting participants were grouped into four; those on nucleoside reverse transcriptase inhibitor/non-nucleoside reverse transcriptase inhibitor (NRTI/NNRTI) (group 1), those on NRTI/PI (group 2), those that were treatment naïve (group 3) and age and sex matched HIV negative controls (group 4). Questionnaires were used to assess the demography of participants. The weight and height of participants were done. Blood was collected for fasting blood sugar, 2 h post prandial glucose and CD4 count. The body mass index (BMI) was significantly lower in the participants on protease inhibitors. The control group had lower 2HPP glucose despite a higher FBS than the other groups that were HIV positive. Treatment naïve (group 3) tend to have higher 2-hour post-prandial blood sugar (2HPP) glucose tests (p= 0.04). The male HIV positive participants on PI also had significantly higher 2HPP glucose tests (p=0.01). The females had lower fasting blood sugar (FBS) and 2HPP glucose tests than the males. There were no correlations of glucose metabolism with CD4 count, age or BMI. The higher 2HPP glucose tests in participants who are treatment naïve may be explained by insulin resistance associated with chronic inflammatory state. It is therefore recommended that HAART be commenced early.

Key words: Human immunodeficiency virus, glucose metabolism, highly active antiretroviral therapy.

INTRODUCTION

Patients with human immunodeficiency virus (HIV) and acquired immunodeficiency syndrome (AIDS) are increasing in number. This is partly due to improved screening, early diagnosis, improved therapy and greater

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access to treatment, as well as acceptance of therapy (Kalra et al., 2011). With improved survival, HIV patients are exposed to age related diseases such as hypertension, diabetes, cancers, myocardiopathies and dyslipidemia in association with the long term metabolic effects of highly active antiretroviral therapy (HAART) and chronic inflammation of HIV infection (Saves et al., 2002; Levitt and Bradshaw, 2006). The consequences are the emergence of metabolic syndromes such as lipodystrophy, cardiovascular disease and disorders of glucose metabolism among people living with HIV and AIDS (Samaras, 2012).

Since the advent of HAART, diabetes has become a leading cause of morbidity in North American and European patients with HIV (Saves et al., 2002; Samaras, 2012). Emerging data from across Africa also indicate that the prevalence of diabetes and dyslipidemia is increasing as people are living longer on HAART (Levitt and Bradshaw, 2006). However, the rising prevalence of diabetes among PLWHA in Africa is only partly explained by the scale-up of HAART because societal factors including urbanization are having a significant impact on the epidemiology of diabetes across the continent (Kalra et al., 2011).

HAART drugs are classified as non-nucleoside reverse transcriptase inhibitors (NNRTIs), nucleoside reverse transcriptase inhibitors (NRTIs), protease inhibitors (PIs), fusion inhibitors, integrase inhibitors, and chemokine-CCR5 receptor inhibitors. Abnormal glucose metabolism (e.g. diabetes mellitus) can result from insulin resistance or defects in insulin secretion or both. NRTIs directly affect mitochondrial function (Brown et al., 2005). Mitochondrial dysfunction has been implicated in the pathogenesis of insulin resistance. Short-term exposure to stavudine, for example, can reduce insulin sensitivity in healthy volunteers (Fleischman et al., 2007). It is also associated with accelerated development of lipodystrophy and pancreatitis leading to development of diabetes (Carr et al., 2003; Daar et al., 2011). Some NNRTIs have been implicated in development of dyslipidemia with increase in low density lipoproteins (LDL) and increase in cholesterol and triglyceride (Daar et al., 2011; Van der Valk et al., 2001; Taylor et al., 2010).

Protease inhibitors (PIs) have different capacities to induce insulin resistance and the risk of diabetes is dose and duration dependent (Taylor et al., 2010; Lee et al., 2004) Some suggested mechanisms include the down regulation of GLUT-4, inhibition of peroxisome proliferator-activated receptor ϒ activity and reduction in beta cell function (Ruddich et al., 2005; Vigouroux et al., 2003; Woerle et al., 2003; Young et al., 2005; Behrens et al., 1999).

This study was designed to evaluate the changes in glucose metabolism in HIV-AIDS patients in hospital care. The Lagos University Teaching Hospital had been treating HIV and AIDS with free access to HAART for about 8 years before the study was done in 2014. During the period, the guideline recommended commencement of HAART if the CD4 count was less than 350 cells per microliter or if the clinical stage was stage 3 and above. It was an opportunity to investigate treatment naïve patients in care. It was expected that the outcome of the study will increase awareness among clinicians and contribute to knowledge on those at risk, when to screen and the appropriate but simple parameter to monitor.

METHODOLOGY

This was a case-control study carried out in Lagos State University Teaching Hospital (LASUTH) Ikeja. The study populations were HIV and AIDS patients attending the adult hematology clinic and the controls were blood donors. Questionnaires were administered to the participants after obtaining informed consent. Eligibility criteria included subjects with previously documented HIV infection who have been on HAART for more than a month, stable HIV seropositive subjects who are HAART naive, age between 18 and 50 years. This is to limit the influence of underlying asymptomatic glucose intolerance associated with aging. Both sexes were recruited. The following were excluded to avoid the influence of chronic inflammation, multiple organ damage, common chronic non infectious diseases on diet, food consumption and metabolism: History of chronic co-morbid conditions like pulmonary tuberculosis, anemia, hypertension, renal or liver disease predating HIV infection, personal or family history of diabetes mellitus, hyper-insulinemia, impaired fasting glucose, glucose intolerance or diabetes based on 2-hour oral glucose tolerance test before diagnosis of HIV. Subjects exposed to other drugs known to alter glucose metabolism, alcohol, pregnancy or on contraceptives were also excluded. Ethical approval was obtained from the Hospital's Health Research Ethical Committee (LASUTH-HREC- LREC/10/06/226).

The patients were grouped according to the kind of drugs the subjects use: Group 1 were on 1 NNRTI + 2 NRTI; Group 2 were the subjects on 1 PI + 2 NRTI; Group 3 were the HIV subjects not on drugs otherwise called treatment naive and the controls, Group 4, who were non-HIV age and sex matched volunteers. In the clinic, the NNRTI drugs of choice were Efavirenz, Nevirapine; NRTI were Zidovudine, Lamivudine, Abacavir, Tenofovir and PI were Ritonavir, Lopinavir and Atazanavir. The first line combination was one NNRTI combined with two NRTI. While the second line combination was a PI combined with two NRTI.

Blood samples were withdrawn by trained phlebotomist. Free flowing blood samples from the ante-cubital vein were collected into a fluoride oxalate (4 ml) and di-potassium ethylene-diamine tetra-acetic acid (K2-EDTA) vacutainers (4 ml) after a 12 to 14 h fast. After which, 75 g of glucose in 1 L of water was administered to all the participants. Another sample was collected 2 h later into fluoride oxalate bottle for glucose estimation (World Health Organization/International Diabetes Federation (WHO/IDF) criteria for diagnosis of impaired fasting glucose (IFG) Impaired glucose tolerance (IGT) and diabetes mellitus). All glucose estimations were automatically analyzed using a VITROS 350 chemistry analyzer by ortho-clinical diagnostics using its VITROS-GLU slides and VITROS chemistry product calibrator kit 1. CD4 counts were estimated from the K2-EDTA vacutainer within 6 h of sample collection using the counter 2 flow-cytometry by PATHEC. The subject's height and weight were measured for the calculation of body mass index (BMI).

Statistical analysis

The variables were presented in averages and one way ANOVA

Table 1. Demography of Subjects recruited in this study.

S/N	Groups	Number	% Female	Age (years)	BMI (kg/m^2)
1	NNRTIs +NRTIS	93	75	36.98 ±6.6	28.31± 4.83
2	Pls + NRTIs	31	71	36.48 ±7.31	21.17 ±3.74
3	NAÏVE HIV	60	73	34.86 ±8.45	26.28 ±3.87
4	NON-HIV	56	71	37.00 ±6.76	24.21 ±3.69

Table 2. Descriptive statistics of the subjects analyzed (mean and standard deviation-SD)

S/N	Groups	FBS (mmol/L)	2HPP (mmol/L)	Drug comm. (Months)	CD4 (cells/uL)
1	NNRTIs+NRTIS	4.36 ±0.71	5.08 ±1.00	44.24 ±30.34	397 ±222
2	Pls + NRTIs	4.29 ±0.54	5.14 ±1.09	35.09 ±28.15	454 ±177
3	NAÏVE HIV	4.32 ±0.76	5.41 ±1.36	N/A	271 ±154
4	NON-HIV	4.44 ±0.59*	4.94 ±0.99*	N/A	851 ±270

N/A = Not applicable. Drug Comm= Period of Drug Commencement (months).

was done to evaluate the differences in the variables. This was followed by post-test to explore the significant differences between groups. The differences were considered to be statistically significant provided the p-value was less than 0.05 ($p<0.05$). Multiple regression was used to test the correlation of the glucose levels with age, BMI, CD4 counts and period on retroviral drugs. Further tests were done to estimate the contribution of each variable to changes in the glucose level. The contribution was statistically significant if p- value was less than 0.05 ($p<0.05$). The statistical package used was the GraphPad InStat.

RESULTS

The total number of subjects was 241, of which 73% were females. The age range was 22 to 50 years with a mean of 38 ± 7 years. The mean body mass index was 25 kg/m^2 ± 4. There was no significant difference in the age of the different groups ($p = 0.29$) as shown in Table 1.

There was significant difference when the means of the BMI were compared among the four groups ($p = < 0.0001$), a post test done showed that there were significant differences in BMI of the control group and the other groups ($p< 0.05$). The average BMI in subjects on PIs was less than the BMI in control. While BMI of participants on NNRTIs and of treatment naïve subjects were higher than in control subjects (Table 1).

The mean of the fasting blood sugar was 4.35±0.65 mmol/L and that of the 2 h post prandial was 5.14±1.11 mmol/L and all the subjects had fasting blood sugar and 2 hour post prandial sugar within the normal range (<6.1 mmol/L and <7.8 mmol/L respectively) (WHO/IDF, 2006). Using analysis of variance (ANOVA), there was no significant difference in the means of fasting blood sugar in the four groups ($p= 0.3654$). Similarly, there was no significant difference in the means of the 2 hour post prandial blood sugar of the four groups ($p=0.2370$).

In Table 2, the fasting blood sugar (4.44 ±0.59) was slightly higher in controls while the 2 hour post prandial sugar (4.94 ±0.99) was slightly lower compared to those of HIV patients though this was not statistically significant.

Comparing the means of each group with that of the control, HIV patients who were naïve to HAART had significantly higher 2HPP ($p= 0.04$). But there was no statistical difference between the control and those on HAART (Table 2).

There was a sex difference when the means of FBS and 2HPP in males and females were compared. From Table 3, the FBS in all groups of HIV females were significantly lower than in controls ($p=0.045$, $p=0.014$, $p=0.026$). Whereas, there was no statistical difference in the FBS of males in all HIV groups compared to the control ($p=0.53$).

However, in males, the 2HPP sugar of HIV patients on Protease inhibitor was statistically higher than that of control ($p=0.01$) (Table 4). While in females, the 2HPP was statistically higher in treatment naïve HIV patients as against controls ($p=0.02$).

There was no difference in the means of the age, BMI and CD4 counts of males and females. Except in group 1 where there was a significant difference among the sexes in age ($p<0.001$) (Tables 3 and 4).

There was no correlation between FBS/2HPP with other variables that is Age, BMI, CD4 count, period on drugs, using the correlation matrix of all groups.

The correlation coefficient, r, between CD4 and FBS/2HPP were -0.239 and -0.136 respectively. Indicating an inverse or opposite relationship and covariation of 23.9 and 13.6% respectively. The period on HAART had a statistically significant contribution ($p = 0.0485$).

DISCUSSION

From Table 3, demographic characteristics indicate that

Table 3. Descriptive statistics for female subjects in this study.

S/N	Groups	Age (years)	BMIkg/m^2	FBSmml/L	2HPPmmol/L	CD4cells/ul
1	NNRTIS+NRTIS	35.89±6.20	28.77±4.85	4.27±0.61	4.96±0.85	420±226
2	Pi +NRTIS	35.77±7.28	27.57±4.06	4.20±0.40	4.75±0.69	483±180
3	NAÏVE-HIV	34.00±8.86	26.25±3.58	4.34±0.84	5.50±1.26	271±163
4	NON-HIV	35.68±6.99	24.15±3.61	4.51±0.59	4.95±0.90	826±245

Table 4. Descriptive statistics for male subjects in this study.

S/N	Groups	Age (years)	BMIkg/m^2	FBSmmol/L	2HPPmmol/L	CD4cells/ul
1	NNRTIS+NRTIS	40.30±6.86	26.89±4.61	4.62±0.93	5.43±1.34*	327±196
2	Pi +NRTIS	38.22±7.53	26.19±4.06	4.52±0.79	6.10±1.34*	383±156
3	NAÏVE-HIV	37.25±6.88	26.38±4.71	4.27±0.50	5.16±1.64*	270±130
4	NON-HIV	40.31±4.94	24.38±4.00	4.27±0.55	4.93±1.22	913±327

there were no differences in the sex ratio and age between the groups though there were more females in the study which reflected the proportion of females attending the clinic. The only difference within the groups is seen in the BMI. Therefore the differences in glucose metabolism might be explained by the difference in BMI.

Subjects did not show abnormality in glucose metabolism, the FBS and 2HPP being within normal limits in all the groups. This is contrary to other findings where 2 to 40% of HIV patients have been found to have diabetes (Brown et al., 2005, Hadigan et al., 2001; Glass et al., 2006). This may be due to the facts that these subjects have been on HAART for a short period (mean period of 44 months, from Table 4); the sample size might be small; the exclusion criteria that excluded history of impaired glucose metabolism and the fact that the drugs frequently involved in glucose metabolism like stavudine and didanosine were not being used by these subjects. The mean period subjects were on lopinavir and ritonavir (PI) was also short (35 months) (Lee et al., 2004; Ruddich et al., 2005).

This study also showed that treatment naïve HIV subjects had significantly higher 2HPP than the control group (p=0.04) (Table 4), while those on HAART showed no significant difference in FBS and 2HPP when compared to controls (p>0.05). This suggests that the increased inflammatory state in untreated HIV infection may have been antagonistic to insulin. This is in agreement with findings that the inflammatory states lead to decrease adeponectin levels and an increased insulin resistance (Reid et al., 2012). Presence of a chronic inflammation may also explain why treatment naïve HIV subjects also had significantly Lower BMI.

The study showed that female HIV subjects seem to tolerate glucose better than their male counterpart. When the sexes were considered, the females showed a significantly lower FBS than the control. While the males had higher FBS than the controls, though not statistically significant. This is in agreement with several studies from high income countries which suggest that HIV-infected women on HAART have a lower risk of developing diabetes (Reid et al., 2012).

In this study, the 2HPP was significantly higher in male subjects (p=0.01) on PI and in female treatment naïve subjects (p=0.02). The 2HPP therefore seems to be more sensitive than FBS in detecting abnormality in glucose metabolism (See glucose concentrations for 2HPP in Tables 3 and 4).

The study did not find any correlation between FBS or 2HPP with age, BMI, CD4 count and period of therapy (Tables 5 to 8). This supports Capeau et al. (2012) study in that there is no direct relationship between CD4 and risk of diabetes in HIV subjects (Capeau et al., 2012). Age and BMI may have a threshold effect rather than trend on glucose metabolism.

The CD4 was significantly higher in control subjects (p=0001). CD4 count was improved in subjects using HAART both in males and females compared to treatment naive HIV subjects. Therefore, treatment not only restored immunity, it prevents inflammatory state and thereby reduce insulin resistance except in men on protease inhibitors.

Limitations

The main challenge to this study is the sample size especially in the group on PI. This may have been the reason why we could not demonstrate glucose intolerance. The subjects were on therapy for a short period of 44 months. A longer cohort study might show significant derangement in glucose metabolism.

Conclusion

From this study, 2HPP test is a more sensitive screening

Table 5: The Correlation Matrix For Group one

Age	BMI	Drug C	FBS	2HPP	CD4
1.000	0.096	0.182	0.128	0.072	-0.013
0.096	1.000	0.330	-0.061	0.080	0.170
0.182	0.330	1.000	-0.260	-0.137	0.315
0.128	0.061	-0.260	1.000	0.216	-0.239
0.072	0.080	-0.137	0.216	1.000	-0.136
0.013	0.170	0.315	-0.239	-0.136	1.000

*Drug C = Drug commencement; BMI = Body mass index; FBS = Fasting blood sugar; 2HPP = 2 hour post prandial; CD4

Table 6: Correlation Matrix for Group 2

Age	BMI	Drug C	FBS	2HPP	CD4
1.000	0.406	0.239	0.128	0.384	0.265
0.406	1.000	0.372	0.125	0.286	0.335
0.239	0.372	1.000	0.065	-0.006	0.347
0.128	0.125	0.065	1.000	0.134	-0.076
0.384	0.286	-0.006	0.134	1.000	-0.289
0.265	0.335	0.347	-0.076	-0.289	1.000

*Drug C = Drug commencement; BMI = Body mass index; FBS = Fasting blood sugar; 2HPP = 2 hour post prandial; CD4

Table 7: Group 3 Correlation Matrix

Age	FBS	2HPP	CD4	BMI
1.000	-0.031	-0.177	-0.045	0.161
-0.031	1.000	0.345	-0.073	0.009
-0.177	0.345	1.000	-0.074	0.058
-0.045	-0.073	-0.074	1.000	-0.046
0.161	0.009	0.058	-0.046	1.000

*Drug C = Drug commencement; BMI = Body mass index; FBS = Fasting blood sugar; 2HPP = 2 hour post prandial; CD4

Table 8: Group 4 Correlation Matrix

Age	BMI	FBS	2HPP	CD4
1.000	0.112	0.135	0.253	-0.022
0.122	1.000	-0.124	0.290	0.013
0.135	-0.124	1.000	0.224	0.103
0.253	0.290	0.224	1.000	-0.051
-0.022	0.013	0.103	-0.051	1.000

*Drug C = Drug commencement; BMI = Body mass index; FBS = Fasting blood sugar; 2HPP = 2 hour post prandial; CD4

test for monitoring glucose metabolism in HIV patients than FBS alone. The 2HPP is significantly higher in treatment naïve subjects than subjects on HAART and controls. This may be due to effect of chronic inflammation which is reduced on commencing HAART. Early commencement of HAART is therefore recommended. Those on PI should have their glucose tests done at regular intervals. Female HIV subjects tend to tolerate glucose better than the male counterparts. Therefore, the need to have separate reference values in HIV patients may be determined by further studies.

Conflict of Interests

The authors have not declared any conflict of interests.

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