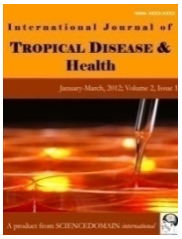

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Epidemiological Patterns of HIV/AIDS and Diabetes in Developing Countries: A Cluster Analysis

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Authors' contributions

This work was carried out in collaboration between all authors. Author TNH designed the study, wrote the protocol, performed the statistical analysis, and wrote the first draft of the manuscript. Authors BO, JE and GS supervised the study and reviewed the manuscript. All authors read and approved the final manuscript.

Research Article

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ABSTRACT

Introduction: HIV/AIDS and Noncommunicable diseases are the major public health threats of developing countries. Analysis of joint epidemiological patterns of these diseases will help in designing and implementing appropriate interventions to mitigate their impacts.
Objectives: The overall aim of this study was to analyze Epidemiological patterns of HIV/AIDS and Diabetes in developing countries.
Methods: Country level HIV/AIDS and Diabetes prevalence data at four time points, between 2000 and 2010, for 68 countries in Sub-Saharan Africa, Southern and South Eastern Asia were transformed and analyzed. Joint geographic and temporal trends were described using numerical and graphic summaries. The level of Covariation between HIV and Diabetes prevalence was measured by Pearson correlation. K-means cluster analysis was conducted after the appropriate number of clusters was determined using scree plot technique. Analysis of variance was used to identify factors that differentiate

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the clusters.
Results: Diabetes had higher mean prevalence with increasing trend while HIV/AIDS had higher disability-weight adjusted mean prevalence with a decreasing trend during the study period. The findings suggest that HIV/AIDS and Diabetes were negatively correlated throughout the study period ($r > 0.3$, $P < .05$ in all four time points). Hence, countries with higher prevalence of Diabetes tend to have lower prevalence of HIV/AIDS and vice versa. Four clusters of countries with size 29, 12, 12 and 14 countries were identified. These clusters were found to have significant variation with respect to their mean HIV and Diabetes prevalences as well as time trends in their mean prevalences.
Conclusions: Diabetes and HIV are heading in reverse directions during the study period in the study regions. The identified clusters were found to describe these patterns of variation across geography and time. The clusters may be useful in considering a set of coordinated country level interventions.

Keywords: Epidemiological patterns; HIV/AIDS; diabetes; cluster analysis.

1. INTRODUCTION

Due to the emergence of Noncommunicable diseases (NCDs) in the developing world, the prevalence of Diabetes has been continuously increasing in developing countries during the last decade. Developing countries currently bear the largest share of magnitude and burden of diabetes mellitus. The current increase in the magnitude of diabetes is attributed to both population growth and actual increase in the incidence of diabetes. Most of diabetes related deaths also occur in developing countries as health systems in these settings are weak and most cases are left undiagnosed or diagnosed at near-miss stage. Currently, Southern and South Eastern Asia regions have highest diabetes prevalence. Sub-Saharan Africa is expected to have to have the highest increase in its diabetes magnitude in the upcoming years [1-6].

Developing countries, especially those in sub-Saharan Africa and Southern and South Eastern Asia, have also been severely affected by the HIV pandemic. Due to the intensified and multi-sectoral response, the HIV prevalence in these regions is currently stabilizing. HIV Deaths and new HIV infections has dramatically decreased in these regions. However, a few countries are still having an increasing number of new HIV infections [7-10].

Recent evidences suggest that there are important relationships between HIV and Diabetes. These relationships are mainly expressed in three forms: Epidemiological overlap, clinical interaction and Health system parallels. The epidemiological overlap indicates that there is a co-occurrence of HIV and Diabetes, double-burden, in developing countries while the clinical interaction addresses the effect of HIV in the risk, management and complications of Diabetes. The parallels in the Health system responses to HIV and Diabetes warrant possible integration of the responses [11-16].

Although Sub-Saharan Africa, South and South Eastern Asia regions are presumed to have Epidemiological overlap of Diabetes and HIV/AIDS, little is known about the joint patterns of HIV and Diabetes in these geographical regions. The joint time and geographical trends, and the relationship in these trends are not well clearly understood. Whether countries with high prevalence or changes in prevalence of diabetes also have the same or opposite patterns in HIV are not well established. Thus, countries which have similar patterns in the joint epidemiological pattern of HIV and Diabetes need to be identified for coordinated responses.

In light of these, the overall aim of this study was to analyze the Epidemiological patterns of HIV and Diabetes in developing countries. The specific objectives were to describe the trends, to determine the level of co-variation, to identify operational clusters of countries and to describe the factors of that differentiate the identified clusters.

2. MATERIALS AND METHODS

2.1 Study Design

This study on the Epidemiological patterns of HIV and Diabetes in developing countries was a time-series cross-sectional study, with cross-sectional dominance on country level prevalence of HIV and Diabetes. Besides the comparison across time and geography for each, HIV and Diabetes prevalence data were also compared at four major time points during the study period.

2.2 Study Period

The analysis period considered for this study was the period from 2000 to 2010. Four time points were considered in this study period. These were 2000, 2003, 2007 and 2010. These points were selected based on the availability of complete HIV and Diabetes prevalence data for the selected countries. This analysis was conducted from Jan to Mar 2012.

2.3 Sample and Sampling

Three regions (based on the UN classification) were purposively selected for this study. The regions were Southern Asia, South Eastern Asia and Sub-Saharan Africa. The purpose of the selection was based on magnitude of HIV and Diabetes. Morbidity and Mortality statistics of HIV and Diabetes in these regions showed that the regions already have high burden of HIV and currently are bearing rapid emergence of diabetes. This study took in to account all countries in the selected regions as units of analysis during the study period. A total of 68 countries with a total population of nearly 3 billion were included in the analysis.

2.4 Data Sources

Country level HIV and Diabetes prevalence data were retrieved from relevant secondary sources including World Health Organization (WHO), Joint United Nations Program on HIV/AIDS (UNAIDS), and International Diabetes Federation (IDF) documents. Other relevant background variables were also collected along with the prevalence data. The background and prevalence data were matched for each country. To ensure completeness of the prevalence data, relevant country level data sources were explored.

2.5 Study Variables

The main study variables used in this study were the prevalence of HIV among the 15-49 years of age group population, and the prevalence of diabetes in the 20-79 years of age population in 2000, 2003, 2007 and 2010 for those selected countries. The rest of the variables were background characteristics of the countries like development category, income group, population size, and Human Development Index (HDI).

2.6 Data Quality Issues

Country level data for those indicators were obtained for the majority of the countries from UNAIDS and IDF data tables and reports of the specific years. For some countries, their Diabetes prevalence (for the year) 2000 was calculated from their estimated number of diabetes cases reported by WHO. For a few countries having only the upper limit of the HIV prevalence, that upper limit was considered in this study. For one country with HIV prevalence reported in intervals only, the mid-point of that interval was taken.

2.7 Data Transformation

As HIV and Diabetes prevalence data were proportions bounded between 0 and 1, they didn't fit with or couldn't be approximated by the normal distribution. Besides, the majority of the data were close to zero making arcsine transformation less appropriate. Therefore, the logit transformation [Y=log(X/(1-X)] was applied to the data before any statistical analysis. Descriptive measures were back-transformed to original data form, i.e. the anti-logit (X= Exp (Y)/ (1+EXP(Y)).

2.8 Data Analysis

2.8.1 Description of trends

Prevalence data were first described using both numerical and graphical summaries of geographical and time trends. After logit transformation, confidence intervals were used to test the statistical significance of the difference between paired values of prevalence figures across groups of countries. HIV and Diabetes prevalence data were also compared across time and geographic regions. The mean prevalence of HIV and Diabetes were adjusted by their respective disability weights to take in to account the severity of the diseases during the comparison.

2.8.2 Assessment of covariation

In order to assess the level of co-variation between the prevalence of HIV and Diabetes across countries at the study time points, Pearson product moment correlation coefficient was used. This was applied on pairs of HIV and Diabetes data at the four time points of analysis. The trend of the Covariation across time was observed. The correlation was also determined at regional and income group levels. The correlation between ratios of Diabetes prevalence to HIV prevalence among the different years was analyzed to see if there were consistencies in the ratio across time. The serial correlation in HIV and Diabetes prevalence was also analyzed. P values less that .05 were considered to indicate statistical significance of the correlation.

2.8.3 Cluster analysis

K-means cluster analysis was used to explore patterns of the prevalence of HIV and Diabetes among the study countries. This method was chosen due to small number of time points involved in the study, a cross-sectional dominance data. The number of clusters was determined by scree plot and its explained variance in the transposed dataset. Iterate and classify method with convergence criterion of zero was used in the cluster analysis. The

resulting clusters were described in terms of their geographical location, development category and income groups.

Analysis of variance was used to determine which variables differentiate between the clusters identified in the cluster analysis. Actual tests of the differences in the mean prevalence of diabetes and HIV at those points of time among the clusters were conducted by multiple comparison (post-hoc) tests. Variables that significantly vary across clusters were considered to be predictors of those specific clusters.

3. RESULTS AND DISCUSSION

3.1 Description of Joint Trends

Persistently high Diabetes prevalence during the study period was observed in Singapore, Seychelles, Mauritius, Brunei, and Reunion. Persistently high HIV prevalence was observed in Swaziland, Botswana, Zimbabwe, Lesotho, Zambia, and South Africa. On the other hand, persistently lower Diabetes prevalence was observed in Eastern Africa region while constantly lowest HIV prevalence was observed in Southern Asia region. As to the overall change in prevalence between 2000 and 2010, Sri Lanka and Reunion had the highest increase in diabetes while Zimbabwe and Namibia had the highest decrease in HIV prevalence.

The overall time trend of HIV and Diabetes prevalence indicated that the HIV prevalence was getting stabilized in the study regions while diabetes prevalence was continuously increasing during the study period. The increase in the mean prevalence of diabetes looks to follow exponential pattern while the decrease in the mean HIV prevalence fits better with the logarithmic pattern. The difference between the mean prevalence of Diabetes and HIV was also getting higher across time. This difference had increased by more than two-fold during the study period. The trends in the mean prevalence of diabetes and HIV in the study area is shown in Fig. 1.

The mean prevalence of HIV and Diabetes across time, separately calculated for the Africa and Asia study regions showed that the Asia region had a wide disparity between prevalence of HIV and Diabetes while the Africa region had narrow disparity between HIV and Diabetes prevalence. The prevalence lines of both HIV and Diabetes for the Africa region lies between the prevalence lines of diabetes and HIV for the Asia region. Besides, there were reversals at two points between the mean prevalence of HIV and Diabetes in the African region.

Adjusting the mean prevalence of HIV and Diabetes by the average disability weights of the two diseases, which were 0.135 and 0.015 for HIV and Diabetes respectively [17], had reversed the trends in the mean prevalence of HIV and Diabetes. This suggested that burden of HIV was still much higher than that of Diabetes even though the prevalence figures informs the opposite in terms of proportions of people with the disease (Fig. 2).

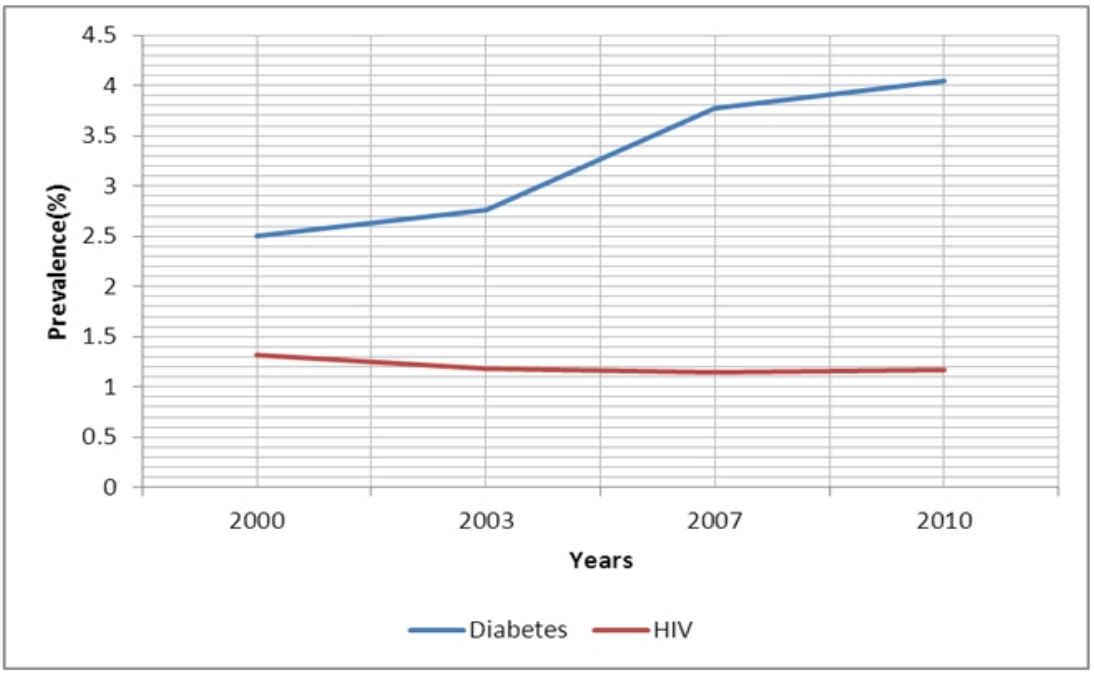

Fig. 1. Trends in the mean prevalence of HIV and Diabetes in the study region (2000-2010)

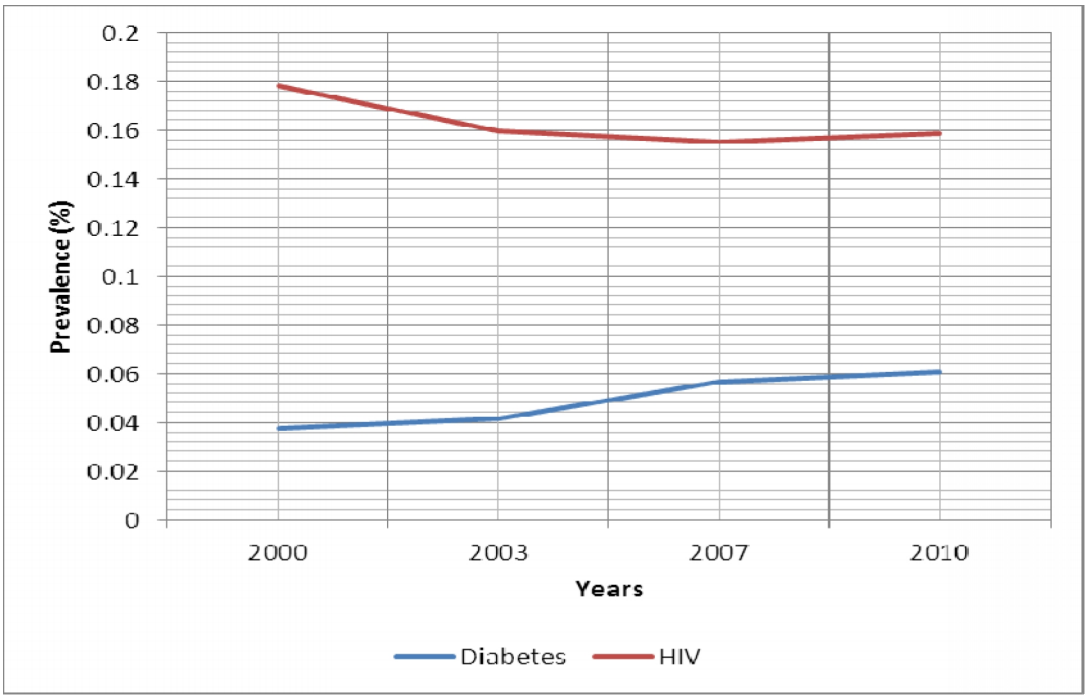

Fig. 2. Disability weight adjusted mean prevalence of HIV and Diabetes (2000-2010)

Disaggregated analysis of adjusted prevalence of HIV and Diabetes for the Africa and Asia regions indicated that the African HIV burden is more than 3-fold of the Asian Diabetes burden which has been demonstrating a rapid increase in the recent years. The Asian HIV and the African Diabetes burden were relatively lower. However, these prevalence figures were showing an increasing pattern in the more recent years.

3.2 Association between HIV and Diabetes Prevalence

The serial correlations between subsequent time points for diabetes prevalence had shown an increasing pattern suggesting persistence in countries' diabetes prevalence. The average serial correlation for Diabetes was 0.624 (0.498 for Asia and 0.655 for Africa). The serial correlations for HIV prevalence had stabilized at higher level and showed minimal increment across time. The average serial correlation for HIV prevalence was 0.955 (0.843 for Asia and 0.953 for Africa).

On the other hand, the serial correlations among the ratios of Diabetes prevalence to HIV prevalence at all the four time points was very high (each more than +0.90 and P=0.000) indicating that the ratio of diabetes to HIV prevalence in countries is persistent across time, i.e. countries which had high ratio in 2000 are still having high ratio in 2010 and vice versa.

The findings of this study suggested that HIV and Diabetes were negatively correlated throughout the study period indicating that countries with higher prevalence of diabetes tend to have lower prevalence of HIV and vice versa. However, the level of correlation is relatively lower though it attained statistical significance at all-time points. The correlation between HIV and Diabetes prevalence had shown a decrement between 2000 (r=-0.434, P <.001) and 2003 (r=-0.281, P=0.02). After this decrement, it was showing a constant increase in 2007 (r=-0.346, P=.004) and 2010 (r=-0.440, P < .001) indicating that the disparity between the prevalence of HIV and Diabetes the study countries was getting higher and higher.

Disaggregated analysis of the correlation between the prevalence of HIV and Diabetes for the Africa and Asia regions indicated no statistically significant correlation except for the Africa region in the year 2000 when the correlation was -0.382 (P=.008). Examination of the correlation between changes in HIV and Diabetes prevalence between 2000 and 2010 indicated that there was no statistically significant correlation between the changes in Diabetes prevalence and the changes in HIV prevalence across countries (r=-0.102, P=.43).

Comparison of the correlation between the prevalence of HIV and Diabetes between low income and non-low income (middle plus higher income) countries indicated that the level of correlation in the low income countries was higher than the overall correlation and the correlation for non-low income countries at all of the time points. The correlation for the years 2000, 2003, 2007 and 2010 were -0.0402,-0.530,-0.472 and -0.475 respectively all with P < .001. The correlation between prevalence of HIV and Diabetes in non-low income countries was statistically significant for the years 2000 (r=-0.361, P <.001) and 2010 (r=-0.424, P < .001) only. In 2003 and 2007, the correlation between HIV and Diabetes prevalence for the non-low income countries was negative but hasn't attained any statistical significance.

3.3 Cluster Analysis

The scree plot on the transposed data using the principal component analysis extraction method indicated that the eigenvalues start to level off at about four components. Hence, the number of clusters was determined to be four. The K-means cluster analysis has thus resulted clusters with cluster sizes of 29, 12, 12 and 14. The cluster analysis was based on the logit transformed prevalence of HIV and Diabetes at the four time points considered in this study. The following are the clusters identified.

Cluster I: This cluster is composed of 3 countries from South Eastern Asia, 5 countries from Eastern Africa, 6 countries from middle Africa, and 15 countries from western Africa. Based on their income groups, this cluster consisted of 18 lower income, 10 middle income and 1 high income countries.

Cluster II: This cluster encompasses 3 countries from South Eastern Asia, 3 Island countries from Africa 3 and 6 countries from Southern Asia. Four of these countries are in the low income group while the rest 6 are in the middle-income group.

Cluster III: This cluster had 3 countries from Southern Asia, 4 countries from Eastern Africa, and 5 countries from South Eastern Asia. In this cluster 2 countries are high income and 2 countries are low income while the rest were middle income groups.

Cluster IV: All the members of this cluster are entirely African countries. Two countries from middle Africa, 5 countries from Southern Africa, and 7 countries from Eastern Africa were the members of this cluster. Half of the countries in this cluster are in low income groups while the rest half are in the middle income groups.

Comparison of the Human Development Index (HDI) for the year 2011 among the clusters indicate a statistically significant difference between cluster I and II which had mean HDI of 0.42 and 0.56 respectively.

Table 1. List of countries by clusters of HIV/AIDS and diabetes prevalence

Clusters	Prevalence categories	List of countries
I	HIV/AIDS: Medium Diabetes: Low	Angola, Chad, Congo, Democratic Republic of Congo, Equatorial Guinea and Gabon, Benin, Burkina Faso, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, Togo, Cambodia, Myanmar, Thailand
II	HIV/AIDS: Very low Diabetes: Medium	Cape Verde, Comoros, Madagascar, Indonesia, Lao PDR and Philippines, Bangladesh, Bhutan, Maldives, Sri Lanka, Afghanistan, Iran
III	HIV/AIDS: Low Diabetes: High	Reunion, Seychelles, Somalia, Sudan, India, Mauritius and Nepal, Brunei Darussalam, Malaysia, Singapore, Timor-Leste, Vietnam
IV	HIV/AIDS: High Diabetes: Low	Cameroon and Central African Republic, Botswana, Lesotho, Namibia, South Africa and Swaziland, Kenya, Malawi, Mozambique, Uganda, Tanzania, Zambia, Zimbabwe

3.4 Patterns of HIV and Diabetes in the Clusters

Analysis of variance indicated that the clusters vary significantly with respect to all HIV and Diabetes prevalence variables. By categorizing the trend in the mean HIV and Diabetes prevalence of the clusters in to high, medium, low and very low, the pattern of HIV and diabetes prevalence in the clusters can be characterized as follows.

Cluster I: The mean prevalence of Diabetes in this cluster had increased from 1.54% to 3.30% between 2000 and 2010. In the same cluster, the mean prevalence of HIV has decreased from 3.19% to 1.76% between 2000 and 2010. In this cluster, there was reversal of mean HIV and Diabetes prevalence between 2000 and 2003.

Cluster II: The HIV prevalence was constantly low in this cluster but with smaller increases across time, about 0.2% in 10 years. Though still at lower level the mean prevalence of Diabetes in this cluster had increased from 2.75% to 5.01% between 2000 and 2010.

Cluster III: The mean Diabetes prevalence for this cluster was above 5% in at all the points of the study period. The general trend in the mean prevalence for this cluster was also increasing. The HIV prevalence in this cluster, though still low, was higher than that of cluster II. The mean HIV prevalence for this cluster had an increasing trend. It had increased from 0.21% to 0.29% during the 10 years study period.

Cluster IV: The mean HIV prevalence in this cluster was still above 10% though it had shown a declining trend between 2000 and 2010. The mean Diabetes prevalence in this cluster had shown an increasing trend from 1.64% to 3.22% between 2000 and 2010.

Mean diabetes prevalence significantly varied between clusters I and III at all-time points. It also significantly varied between cluster III and IV at all points. The difference in mean diabetes prevalence between cluster II and III was also significant for the years 2000 and 2003. All the cluster combinations at all the four years had differences mean HIV prevalence that varies significantly.

On the other hand, mean diabetes prevalence hasn't shown a statistically significant variation between clusters I and II, I and IV and II and IV at all-time points. Besides, the mean difference in diabetes prevalence between cluster III and IV hasn't attained statistical significance for the years 2007 and 2010.

4. DISCUSSION

The prevalence figures indicate that diabetes in the study area had higher magnitude as compared to HIV. The number of people with diabetes is also much higher than that of people living with HIV in the region. However, the burden of HIV, based on the disability weights, was much higher than that of Diabetes at all the time points. This paradox indicates that HIV is putting much burden even though diabetes is affecting more people. But this viewpoint changes when the Sub-Saharan Africa and the Asia study regions are seen separately. The Sub-Saharan Africa had higher magnitude and burden of HIV while Southern and South Eastern Asia had higher magnitude and burden of Diabetes [18,19].

Looking in to the trends of prevalence across time, the prevalence of diabetes was increasing at a rapid rate while the prevalence of HIV was getting stabilized. This implies that

the incidence of diabetes was much higher than that of HIV in these study regions. Clearly, the prevalence of HIV in Sub-Saharan Africa was greater than that of Diabetes, while the prevalence of Diabetes in Southern and South Eastern Asia was greater than that of HIV. But in both regions the incidence of Diabetes was much greater than that of HIV.

The high level of serial correlation in HIV and Diabetes prevalences imply that the relative prevalence of HIV and Diabetes in the study countries had a persistence nature. This means countries tend to 'retain' their relative prevalence during the study period. This was also verified by the serial correlations in the ratio of diabetes to HIV prevalence across time. Both HIV and Diabetes prevalence tend to change in a similar manner among countries.

This study has indicated that correlation between HIV and Diabetes prevalence at all points was negative. This crudely suggests that countries with high HIV prevalence have relatively lower Diabetes prevalence and vice versa. This was partially explained by the high prevalence of HIV in Sub-Saharan Africa and a correspondingly low prevalence of diabetes in the same region, and low prevalence of HIV in the Asian study region which had high diabetes prevalence.

The clusters identified in this study have several importances for public health policy and practice. It informs whether HIV, Diabetes or both should be major priorities among countries in the clusters. The classification also informs what models of integrating HIV and Diabetes services could be applicable for countries in the different clusters. Above and beyond, the cluster analysis has suggested international level focus countries for HIV, Diabetes and both HIV and Diabetes.

There were a few limitations associated with this study. Firstly, the data used in this study were prevalence estimates and all the weaknesses of these data can affect the interpretations of the findings. Secondly, the K-means clustering method was applied as the dataset was very short time-series data. The autocorrelation among the variables may to some extent affect the quality of the cluster analysis. Finally, the study addresses only three major regions of developing countries and thus the findings may not apply to other regions of the world.

5. CONCLUSION

Overall, this study has indicated that the joint epidemiologic patterns of prevalence of HIV and Diabetes tend to be heading in opposite directions suggesting that the incidences of the two diseases are also advancing in opposite direction. This pattern, however, varies from region to region.

CONSENT

Country level HIV/AIDS and Diabetes prevalence data were retrieved from information within the public domain. All the data sources used were cited and acknowledged as per the guidelines provided along with the information. No other form of consent was required as this study didn't involve human subjects at any stage.

ETHICAL APPROVAL

All authors hereby declare that this study is conducted in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki. All the processes involved in this study were carried out as per local and international Ethical requirements.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. International Diabetes Federation. Diabetes Atlas 2000. Imprimerie L Vanmelle SA, Gent/Mariakerke, Belgium.
2. International Diabetes Federation. Diabetes Atlas 2003, second edition. Imprimerie L Vanmelle SA, Gent/Mariakerke, Belgium.
3. International Diabetes Federation. Diabetes Atlas 2007, Third Edition. Accessed Jan 07;2012. Available: http://da3.diabetesatlas.org/index3eec.html.
4. International Diabetes Federation. Diabetes Atlas 2010, Fourth Edition. Accessed Jan 6, 2012. Available: http://archive.diabetesatlas.org/.
5. International Diabetes Federation. Diabetes Atlas 2011, Fifth Edition. Accessed on Jan 7;2012. Available: http://www.idf.org/diabetesatlas/.
6. Mbanya JN, Motala AA, Sobngwi E, Assah FK, Enoru ST. Diabetes in Sub-Saharan Africa. The lancet. 2010;375(9733):2254-2266.
7. UNAIDS. UNAIDS report on the Global AIDS Epidemic 2010. Accessed 28 Dec 2011. Available: http://www.unaids.org/en/resources/unaidspublications/2010/.
8. UNAIDS. UNAIDS 2011 World AIDS day report. Accessed 28 Dec 2011. Available: http://www.unaids.org/en/resources/unaidspublications/2011/.
9. WHO, UNAIDS, UNICEF. Global HIV/AIDS response: Epidemic update and Health sector progress towards universal access. Progress report 2011. Accessed Jan 10, 2012. Available: http://whqlibdoc.who.int/publications/2011/9789241502986_eng.pdf.
10. Avert. World HIV and AIDS Statistics, 2009 and 2010. Accessed Jan 10, 2012. Available: http://www.avert.org/worldstats.htm.
11. UNAIDS. Chronic care of HIV and non-communicable diseases: How to leverage the HIV Experience. UNAIDS report 2011. Accessed Dec 10, 2011. Available: http://www.unaids.org/en/media/unaids/contentassets/documents/unaidspublication/2011/20110526_JC2145_Chronic_care_of_HIV.pdf.
12. Spollett GR. Hyperglycaemia in HIV/AIDS. Diabetes spectrum. 2006;19(3):163-166.
13. Kalra S, Kalra B, Agrawal N, Unnikrishnan AG. Understanding Diabetes in patients with HIV/AIDS. Diabetology and Metabolic syndrome. 2011;3:2.
14. Australasian Society for HIV Medicine. Models of care for chronic diseases: Background paper for the models of access and clinical service delivery project. Accessed Jan 11, 2012. Available: http://www.ashm.org.au/images/resources/policy/macsdchronicdiseasepaper.pdf.

15. Philip S. The challenge of non-communicable diseases in Developing countries: Lessons from HIV and Global Health. Accessed Jan 10, 2012. Available: http://cmpi.org/uploads/File/non-communicable-diseases.pdf.
16. Rabkin M, El-Sadar WM. Why re-invent the wheel? Leveraging the lessons of HIV scale up to confront non-communicable diseases. Global Public Health. 2011;6(3):247-254.
17. World Health Organization. Global burden of disease 2004 update: Disability weights for Diseases and conditions.
18. Avert. Sub-Saharan Africa HIV and AIDS statistics. Accessed Jan 16;2012. Available: http://www.avert.org/africa-hiv-aids-statistics.htm.
19. Diabetes Leadership forum Africa. Diabetes: The hidden pandemic and its impact on Sub-Saharan Africa, 2010. Accessed Jan 16, 2012. Available: http://www.changingdiabetesbarometer.com/docs/Diabetes%20in%20sub-saharan%20Africa.pdf.

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