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Screening for Human Immunodeficiency Virus, Hepatitis B, High Blood Pressure, and Diabetes Mellitus in the General Population of South Kivu

—Results of World AIDS Day 2016

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Abstract

Background: It has been well-established that a program to fight HIV can accomplish the same results with noncommunicable diseases (NCDs). Such a strategy has not yet been the subject of a trial in the Democratic Republic of the Congo (DRC). The aim of this study was to test the feasibility of HIV concurrent and respectively other chronic infectious and NCDs in the general population of South Kivu. **Methods:** Between 1 December 2016 and 15 January 2017, HIV, hepatitis B, high blood pressure (HBP) and diabetes mellitus (DM) were tested in the general adult population ≥ 15 years, respectively, in the towns of Bukavu and Uvira, and the rural areas Nyangezi and Walungu, on World AIDS Day 2016. Previous screening of these diseases has been sought, but the association between them was modeled in a multiple logistic regression. **Results:** Among the three thousand eight hundred and sixty-three (3863) adult subjects > 15 years (52.1% of men) tested voluntarily, the previous screening and prevalence were 33.8% and 1.2% respectively for HIV, 1.3% and 8.3% for hepatitis B, 18.2% and 25.1% for HBP and 9.5% and 4.8% for DM. The acceptance rate for current screening was significantly higher ($p < 0.0001$) for HIV (97.5%) than for HBP (84.6%) as well as DM (64.6%). Fi-

nally, age ≥ 60 years (adjusted OR = 1.74; $p = 0.01$), HBP (adjusted OR = 1.82; $p = 0.004$) and above all HIV (adjusted OR = 3.94; $p = 0.008$) showed an independent effect on the likelihood of DM. **Conclusion:** This study did more HIV testing than screens for other diseases. Finally, these problems can be managed (at a reasonable cost) with a view similar to the objectives of the World Health Organization (WHO).

Keywords

Screening, HIV, Pressure, Diabetes, Aids, Kivu

1. Introduction

Communicable diseases (CDs) account for 30% of the world's deaths and 39% of the world's disabilities, including human immunodeficiency virus (HIV) infection, hepatitis B and C, tuberculosis (TBC) and malaria [1]. As for non-communicable diseases (NCDs), which cause more than 63% of deaths worldwide, they are mainly due to cardiovascular disease, cancer, chronic respiratory diseases and diabetes mellitus (DM) [2]. Studies have shown a correlation between infectious diseases and NCDs via complex mechanisms [3], and include HIV and metabolic syndrome [4], TBC and DM [5], chronic respiratory disease [6], kidney disease [7] [8], and cardiovascular disease [9] plus hepatitis C and DM [10].

Regions in full epidemiological transition, such as sub-Saharan Africa (SSA), face a double burden of CDs and NCDs, respectively [11]. In addition, 80% of deaths due to NCDs and almost all deaths due to CDs are registered in these countries [2]. It is therefore clear that a significant number of the patients concomitantly display the two types of conditions [3] [12]; versus in the developed countries, the multimorbidity mainly involves NCDs [13].

The prognosis is negative in the event of a CD and NCD. This is the case for the association of DM and TBC [5] [14]. The prognosis is poor with such an association, but some strategies have recently been adopted. This includes a systematic screening of active TBC in diabetic patients and a search for DM in TB patients [15]. HIV infection is used to support NCD programmes [16] [17] as their integration is now recommended: models are used in South Africa for concurrent management of HIV, DM, HBP, asthma, epilepsy, chronic respiratory disease, and mental illness [3].

In the Democratic Republic of Congo (DRC), no initiative on the integration of CDs and NCDs has been carried out. However, studies have shown an increased prevalence of arterial hypertension (AHT) and DM respectively [18] [19]. Such a situation is linked to the lack of screening programs for NCDs in this country. On the other hand, the trend is for the decline in the prevalence of HIV through funded programs.

Thus, in order to support the NCD programs, the National Multisectoral AIDS Program (PNMLS) in South Kivu, the eastern region of the Democratic

Republic of Congo (DRC), experimented with the model with HIV testing, DM, HBP, and hepatitis B on World AIDS Day 2016.

This work presents the results of this screening.

2. Methods

2.1. Type of Study and Population Studied

Adults ≥ 15 years of age living in Ibanda, Kadutu, and Bagira 1) in the town of Bukavu (n = 873,092 inhabitants), 2) in the health zone of Uvira (in Uvira, n = 315,008 inhabitants), 3) in the rural health zone of Nyangezi (n = 145,846 inhabitants), and 4) in the rural health zone of Walungu (n = 252,269 inhabitants), all were eligible for the HIV infection screening campaign for World AIDS Day, 2016. This screening was coupled with hepatitis B, High Blood Pressure (HBP), and DM, as these health areas were chosen for their accessibility. At the level of each one, sites are available to screening teams by the local authorities (classrooms, auditoriums, churches, tents, or other enclosed spaces). In addition, the teams were itinerant and moved around according to the influx of volunteers to assist with the screening.

Previously, the general population was informed about the coupled HIV screening and other infections, as well as NCDs through the media (television, radio, posters, newspapers, community relays) by leaders of this policy (the provincial Minister of Health), and the community (religious, civil society groups). The subjects were voluntarily present at the end of the study.

This screening ran from 1 December 2016 to 15 January 2017.

2.2. Ethics Approval and Consent to Participate

The PNMLS is authorized by the National Ethics Committee to conduct screening in the general population. Informed consent was obtained prior to screening. The questionnaire was designed to be anonymous, and informed consent was obtained from every respondent. The data were kept confidential and the results would not identify the respondents personally.

2.3. Data Collection

After training and awareness-raising, investigators and supervisors were deployed to the field to carry out interviews, anthropometric and physical measurements, and biological screening. The volunteers worked in confidence after a brief counseling session.

2.4. Interview

The interview focused on sociodemographic characteristics and the previous levels for HIV, hypertension, DM, and hepatitis B screening.

2.5. Obesity and Hypertension Screening

Being barefoot and in lightweight clothing, weight was measured at 100 g with

an electronic scale brand Tanita Digital bathroom scale, HD-3251® (Tokyo, Japan).

The population's size was measured with a brand SECA body meter measuring tape 206 (CM)® mark (SEC, Hamburg, Germany). Recording of one's BP and pulse with an electronic device (OMRONHem7001E, Kyoto, Japan) was carried out on the right arm at the height of the heart, with the subject relaxed for five minutes in a seated position. The average of two consecutive measurements was used for analysis. A third measure was obtained if the first two differed by more than 10 mmHg.

2.6. Diabetes Mellitus Screening

A capillary blood sample was collected and used for the determination of glycaemia with Code Free® brand strips (CITY, Japan).

2.7. HIV and Hepatitis B Screening

Five milliliters of blood were collected from an antecubital vein and centrifuged, as plasma was used to search for HIV antibodies on the Determine test®. In the event of a positive or indeterminate result, the search continued with the UniGold test® (Toronto, Canada). Another sample of plasma was retained for further research with HbS antigens.

2.8. Announcement of Results and Support

Results were noted on a coded fact sheet, brought to the team physician responsible for announcing them. Subjects with pathological results were directed to hospital center in order to confirm their diagnosis and get the care they needed.

2.9. Operational Definitions

The diagnosis of HIV infection and hepatitis B was used in positive biological tests. The subject was considered hypertensive when the systolic blood pressure (SBP) ≥ 140 mmHg and/or diastolic blood pressure (DBP) ≥ 90 mmHg [20], and diabetic when the fasting glucose ≥ 126 mg/dl [21]. Married subjects who lived with another person included widowers and divorcees.

2.10. Statistical Analysis Results

The data were presented in the form of frequencies or mean ± standard deviation as appropriate. Student's T-test was used to compare averages and Chi-square was used for proportions. The probability of a detected disease (HIV, hepatitis B, HBP and DM), based on assumed risk factors, were modeled in a multiple logistic regression. Data were processed with EPI Info® software version 7.2.0.1 (Centers for Disease Control and Prevention, Atlanta, GA, USA), MedCalc® version 12.4.0 (MedCalc Software, Ostend, Belgium) and MetaXL® version 5.3.

3. Results

3.1. General Characteristics of the Studied Population

Table 1 shows general characteristics of the studied population. A total of three thousand eight hundred sixty-three (3863) adult subjects > 15 years (52.1% of men) were voluntarily screened, in which 2893 (75.0%) live in urban settings and 965 (25.0%) in rural areas. The average age was 37.0 ± 16.4 years, with those from 20 to 39 years being predominant (55.1%).

3.2. Previous Levels for HIV, Hypertension, DM, and Hepatitis B

Table 2 shows the screening for previous levels.

For HIV, 33.8% (n = 1307) of volunteers had already conducted one rapid HIV test.

For HBP, 18.2% (n = 702) of subjects had a measurement of blood pressure.

For DM, 9.5% (n = 366) of the subjects had performed one blood glucose test.

For hepatitis B, 1.3% (n = 50) of the subjects had conducted a screening test for the disease. The difference was statistically significant when comparing the rate of HIV testing against that of three other diseases ($p < 0.0001$).

The previous level of screening was significantly influenced by age and marital status, except for hepatitis B by education level ($p < 0.05$).

3.3. Adherence to Current Screening

For current screening (Table 3) of the 3863 voluntary subjects, 3767 (97.5%) accepted the HIV test versus 3270 (84.6%) for a BP intake, and 2497 (64.6%) for blood glucose dosage, so that the difference was statistically significant ($p < 0.0001$).

Screening acceptance was significantly higher in rural areas than in urban settings ($p < 0.0001$).

For hepatitis B, we searched the Hbs Ag for 2404 subjects, corresponding to the number of tests available for the survey.

3.4. Prevalence of Detected Diseases and Associated Risk Factors

3.4.1. HIV

HIV prevalence was 1.2%, and was significantly influenced by gender (female), marital status, illiteracy, and DM ($p < 0.05$). However, in multiple logistic regression, only DM was independently associated with HIV risk (adjusted OR = 4.35; $p = 0.02$) (Figure 1).

3.4.2. Hepatitis B

The prevalence of hepatitis B was 8.3%, which was significantly influenced by age < 60 years ($p = 0.01$) (Figure 2).

3.4.3. High Blood Pressure

The prevalence of HBP was 25.1%. This prevalence was significantly influenced by age ≥ 60 years, marital status, illiteracy, urban environment, and DM ($p < 0.05$).

Table 1. General Characteristics of the studied population.

	Whole Group	Urban areas	Rural areas	*p*
n (%)	3863 (100)	2893 (75.0)	965 (25.0)	<0.0001
male, n (%)	2011 (52.1)	1676 (57.9)	335 (34.7)	<0.0001
Age (years), average ± SD	37.0 ± 16.4	36.0 ± 15.9	40.1 ± 17.5	<0.0001
<20 years, n (%)	287 (7.4)	229 (7.9)	58 (6.0)	0.6
20 - 39 years, n (%)	2129 (55.1)	1654 (57.1)	475 (49.2)	<0.0001
40 - 59 years, n (%)	921 (23.8)	668 (23.0)	253 (26.2)	0.04
≥60 years, n (%)	526 (13.6)	347 (11.9)	179 (18.5)	<0.0001
IMC (Kg/m^2), average ± SD	23.0 ± 4.6	23.2 ± 4.0	22.5 ± 5.9	<0.0001
IMC > 25 Kg/m^2 (%)	890 (23.0)	715 (24.7)	175 (18.1)	<0.0001
SBP (mmHg), average ± SD	123.5 ± 22.7	124.4 ± 22.9	120.6 ± 21.8	<0.0001
DBP (mmHg), average ± SD	77.4 ± 14.4	78.2 ± 14.4	75.3 ± 13.9	<0.0001
Glycaemia (mg/dl), average ± SD	114.0 ± 51.0	114.4 ± 47.3	113.3 ± 58.7	0.62
Marital status				
Married, (%)	67.1	62.4	80.9	<0.0001
Single, n (%)	32.9	37.6	19.1	<0.0001
Education Level				
Illiterate/primary school	45.3	39.2	65.0	<0.0001
Secondary school	38.2	40.4	31.3	<0.0001
University	16.1	20.2	3.5	<0.0001
Proportion of subjects who have accepted				
HIV test, n (%)	3767 (97.5)	2807 (97.0)	960 (99.4)	<0.0001
Glycaemia dosage	2497 (64.6)*	1741 (60.1)	756 (78.3)	<0.0001
Blood pressure intake	3270 (84.6)*	2327 (80.4)	943 (97.7)	<0.0001

*$p < 0.0001$ compared to the HIV screening acceptance.

In multiple logistic regression, only age ≥ 60 years (adjusted OR = 3.21; $p < 0.0001$), marital status (adjusted OR = 1.56; $p = 0.03$), and urban environment (adjusted OR = 1.74; $p = 0.0001$) showed an independent effect on the likelihood of HBP (Figure 3).

3.4.4. Diabetes Mellitus

DM was 4.8%, which was significantly influenced by age ≥ 60 years, marital status, illiteracy, HIV, and HBP ($p < 0.05$). In multiple logistic regression, only age ≥ 60 years (adjusted OR = 1.74; $p = 0.01$), HBP (adjusted OR = 1.82; $p = 0.004$) and HIV (adjusted gold = 3.94; $p = 0.008$) showed an independent effect on the likelihood of DM (Figure 4).

4. Discussion

The present study involved 3863 adult Congolese subjects who underwent voluntary screening for HIV, hepatitis B, HBP, and DM. The rate of acceptance for

Table 2. Previous levels for HIV, high blood pressure, diabetes mellitus and hepatitis B.

	HIV testing	Screening for hepatitis B	Screening for HBP	Screening for DM
n (%)	1307 (33.8)	50 (1.3)	702 (18.2)	366 (9.5)
Age range (years) (%)				
<20	16.0	0.3	2.7	0.3
20 - 39	39.4	1.1	11.6	6.1
40 - 59	36.8	1.4	27.9	14.3
≥60	15.5	2.0	35.7	19.3
p	<0.0001	0.03	<0.0001	<0.0001
Sex (%)				
Male	34.8	1.2	11.8	8.7
Female	32.7	1.2	25.0	10.2
p	0.19	0.89	<0.0001	0.12
Marital status (%)				
Single	29.8	1.1	4.8	3.5
Married	35.7	1.3	24.7	12.3
p	0.0003	0.77	<0.0001	<0.0001
Education level (%)				
Illiterate/Primary school	23.9	0.8	12.2	9.7
Secondary school	39.7	1.3	12.7	8.1
University	48.1	2.4	24.7	11.7
p	<0.0001	0.003	<0.0001	0.03

HIV testing (and a previous level of screening) was significantly higher compared to that for other diseases ($p < 0.0001$). Screening was significantly influenced by age, education level, and marital status.

Prevalence was 1.2% for HIV, 8.3% for hepatitis B, 25.1% for HBP, and 4.8% for DM, respectively. Singularly, HIV was associated independently with risk of DM.

This study is a first in the DRC, as it conducted concurrent screening of four chronic diseases, including two infectious diseases (HIV, hepatitis B) and two NCDs (HBP and DM) in a large general population of 3863 adult subjects, allowing for examination of multimorbidity.

First, the prevalence of these diseases are consistent with those found by other authors in the DRC: 1.1% for HIV in the general population in 2013 by PNMLS [22], 8% for hepatitis B, for those living with HIV, and for those negative for HIV in South Kivu by Kabinda *et al.* [23], 3.5% for DM [24], and 40.6% for HBP in the general population [18] by Katchunga B.P *et al.*

Second, we found that integrating the management of CDs and NCDs into one programme was the best option. This model could achieve one of the goals of WHO to set up updated strategies for NCDs in sub-Saharan Africa, particularly

Table 3. Prevalence of detected diseases and associated risk factors.

(n)	HIV (n = 3767)	Hepatitis B (n = 2404)	HBP (n = 3270)	DM (n = 2497)
		Detected diseases, n (%)		
Global, n (%)	47 (1.2)	199 (8.3)	821 (25.1)	120 (4.8)
		Age (years)		
<60	1.3	8.8	20.8	4.0
≥60	0.5	4.7	50.9	8.1
p	0.19	0.01	<0.0001	0.0004
		Sex		
Male	0.8	8.5	25.3	4.2
Female	1.6	8.0	24.8	5.3
p	0.04	0.73	0.79	0.23
		Marital status		
Single	0.5	8.2	16.3	2.5
Married	1.5	8.3	29.0	5.2
p	0.02	0.98	<0.0001	0.03
		Education level		
Iliterate/primary school	1.7	8.4	28.7	6.1
Secondary school	1.0	8.5	21.5	3.3
University	0.1	7.0	22.8	3.0
p	0.002	0.65	0.0002	0.001
		Area		
Urban	1.2	8.2	26.2	4.3
Rural	1.1	8.0	22.1	5.8
p	0.87	0.92	0.01	0.14
		HIV		
Yes	-	16.6	39.0	16.6
Non	-	8.0	24.9	4.7
p	-	0.16	0.06	0.009
		Hepatitis B		
Yes	2.6	-	19.5	2.3
Non	1.1	-	24.9	4.9
p	0.16	-	0.12	0.28
		HBP		
Yes	1.9	7.0	-	7.7
Non	1.0	9.3	-	3.8
p	0.06	0.12	-	0.0002
		DM		
Yes	4.1	4.1	44.8	-
Non	1.0	8.4	27.8	-
p	0.009	0.28	0.0002	-

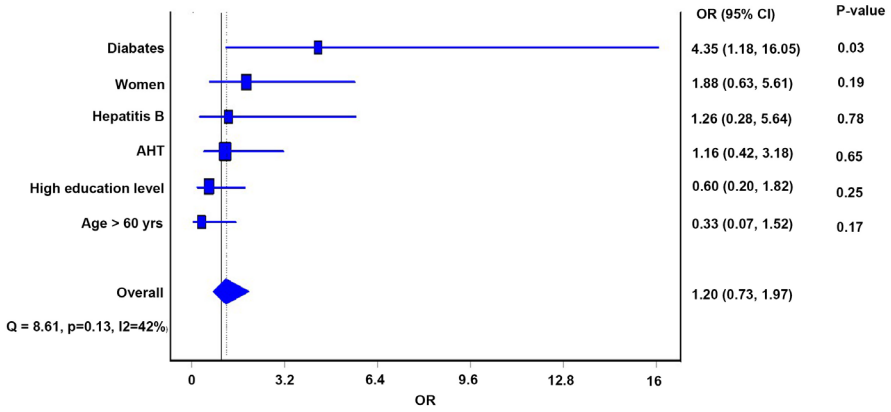

Figure 1. Odd ratio for HIV by risk factors supposed.

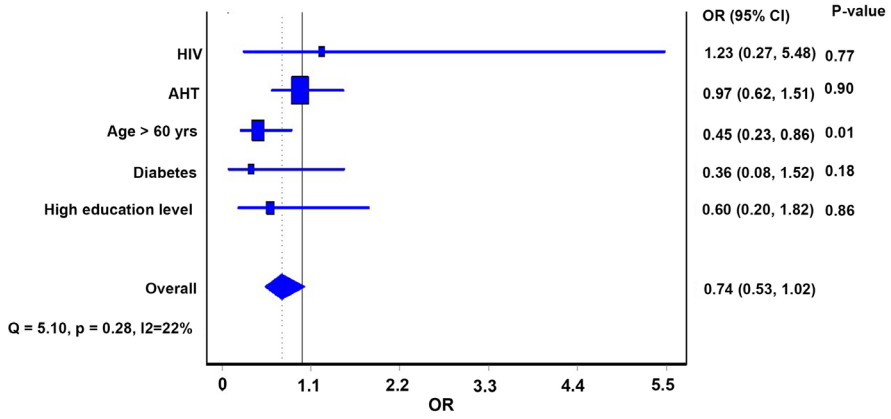

Figure 2. Odd ratio for Hepatitis B by risk factors supposed.

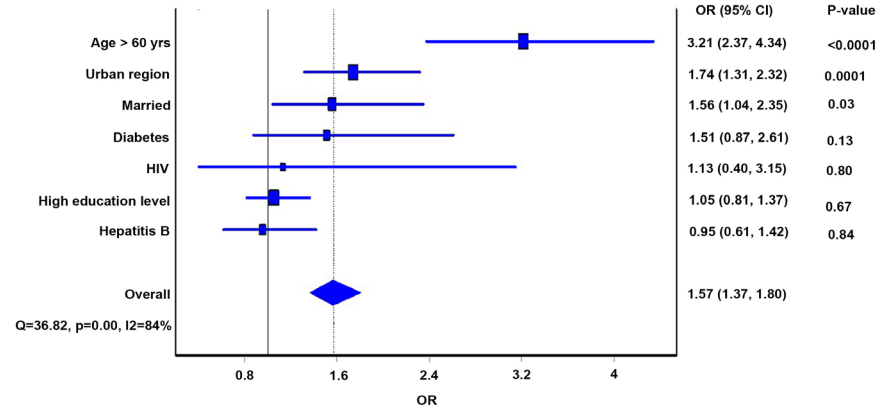

Figure 3. Odd ratio for high blood pressure by risk factors supposed.

HBP and DM [25]. In this region, NCD programmes are not operational due to lack of funding to fight infectious diseases (malaria, HIV, and TB).

Third, this work demonstrates the impact of a supported and funded programme in improving the management of disease [26]. The rate of acceptance of HIV testing before and during the study was significantly higher compared to other diseases, particularly DM. Illiterate subjects had a higher frequency of

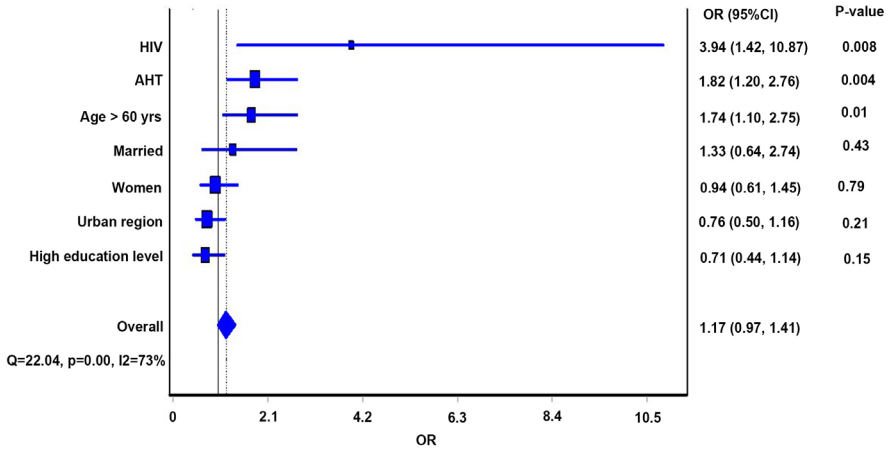

Figure 4. Odd ratio for diabetes mellitus by risk factors supposed.

disease than more educated subjects, in agreement with other studies. We showed that educational programmes reduce risk factors, disease, and their complications [26].

Finally, the present work noted a correlation between CDs and NCDs, particularly between HIV and DM in the general population, with our results corroborating the literature [3]. In South Africa, among 19% of patients living with HIV and receiving antiretroviral treatment, 77% and 17% had an antihypertensive and antidiabetic response, respectively [26]. This association further strengthens the strategy of integrating CD and NCD programmes. Our results suggest that multimorbidity is the consequence of CDs and NCDs during epidemiological transition; however, in western societies, it has been linked to at least two NCDs [13].

This research has some limitations: there was a selection bias due to voluntary participation in the screening process. Second, our study could not demonstrate a causal link between exposure factors and occurrence of disease. Limited financial resources did not allow the study to be extended to other health areas to examine other chronic conditions.

5. Conclusion

This work demonstrated how it is possible to link HIV testing to chronic infections and NCDs, and to study the multimorbidity in the general population of South Kivu. There is a connection between the two types of diseases. The programme and management of CDs and NCDs in limited-resource countries makes it possible to achieve WHO goals at a reasonable cost.

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Conflicts of Interest

The authors declare that they have no competing interests.

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