Supplementary Material

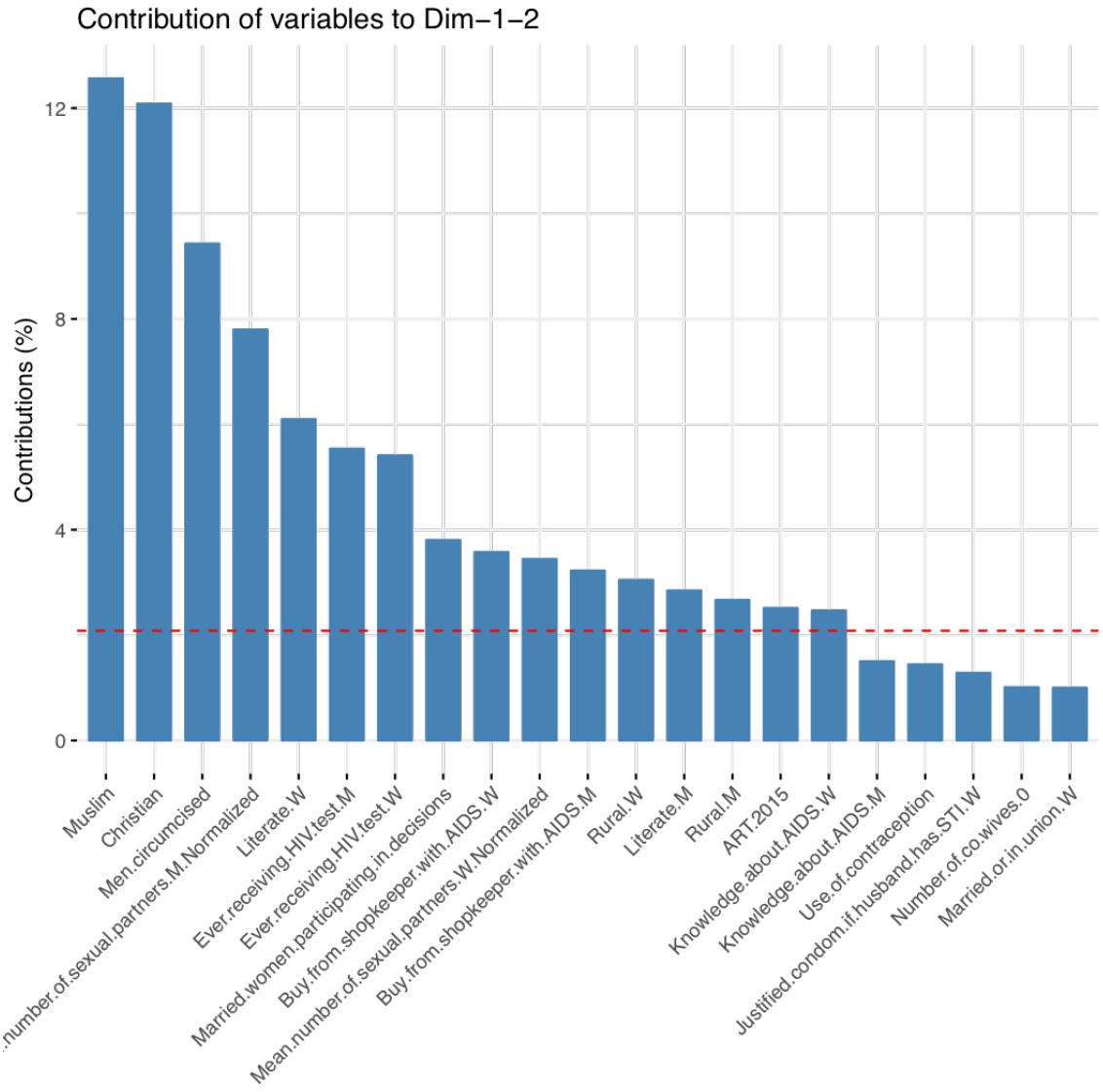
Countries, DHS data and HIV incidence and prevalence

Table S1- List of 29 sub-Saharan countries with their estimated HIV incidence (age 15-49) and prevalence (age 15-49) in 2010 and 2016 (UNAIDS's 2018 estimates *[1]* produced by Spectrum software).

ID	Country	DHS year	HIV incidence per 1000 population (15-49)		HIV prevalence (15-49) (%)	
			2010	2016	2010	2016
1	Angola	2015-16	2.13	1.68	1.8	1.9
2	Benin	2011-12	0.69	0.63	1.1	1.0
3	Burkina Faso	2010	0.37	0.39	1.0	0.8
4	Burundi	2016-17	0.46	0.51	1.5	1.1
5	Cameroon	2011	2.98	2.21	4.6	3.8
6	Chad	2014-15	0.85	0.65	1.6	1.3
7	Congo, Rep.	2011-12	2.70	2.53	3.2	3.2
8	Congo, Dem. Rep.	2013-14	0.41	0.28	1.2	0.7
9	Cote d'Ivoire	2011-12	2.03	2.03	3.6	2.8
10	Ethiopia	2016	0.19	0.21	1.4	1
121	Gabon	2012	3.30	2.67	4.2	4.3
12	Gambia	2013	1.79	1.23	2.1	1.7
13	Ghana	2014	1.27	1.07	2.0	1.7
14	Kenya	2014	3.46	2.16	5.6	5.0
15	Lesotho	2014	22.00	19.70	22.2	23.9
16	Liberia	2013	1.05	0.92	2.0	1.5
17	Malawi	2015-16	8.70	5.00	10.9	9.9
18	Mali	2012-13	1.07	0.95	1.4	1.3
19	Mozambique	2011	14.53	9.79	13.3	12.7
20	Namibia	2013	9.06	6.34	13.0	12.3
21	Niger	2012	0.20	0.14	0.5	0.3
22	Nigeria	2013	2.32	1.89	3.2	2.8
23	Rwanda	2014-15	1.47	1.12	3.2	2.8
24	Senegal	2017	0.22	0.14	0.6	0.4
25	Sierra Leone	2013	1.16	0.78	1.6	1.4
26	Togo	2013-14	6.56	2.97	3.0	2.2
27	Uganda	2016	9.78	6.75	6.7	6.1
28	Zambia	2013-14	11.00	6.33	12.3	11.8
29	Zimbabwe	2015	2.13	1.68	15.0	13.7

Variable contribution to Principle Components PC1 and PC2

Figure S1- Variables sorted by their contribution to the first two Principle Components *[2]*, **which explain 69% of the sociobehavioural variance between SSA countries**. Only variables that contributed more than 1% are displayed.



Similarity/Dissimilarity measure

Given that each country is described by an n-dimensional vector, the dissimilarity $d_{i,j}$ between two countries i and j is defined using the Euclidian distance:

Equation S1 - Dissimilarity measure between countries.

$$d_{i,j} = \sqrt{\sum_{k=1}^{n} \left(c_{i,k} - c_{j,k}\right)^2},$$

where $n = 48$ is the total number of variables used in our analysis to describe a country. $c_{i,k}$ and $c_{j,k}$ are the k^{th} element of the n-dimensional vectors c_i and c_j, respectively.

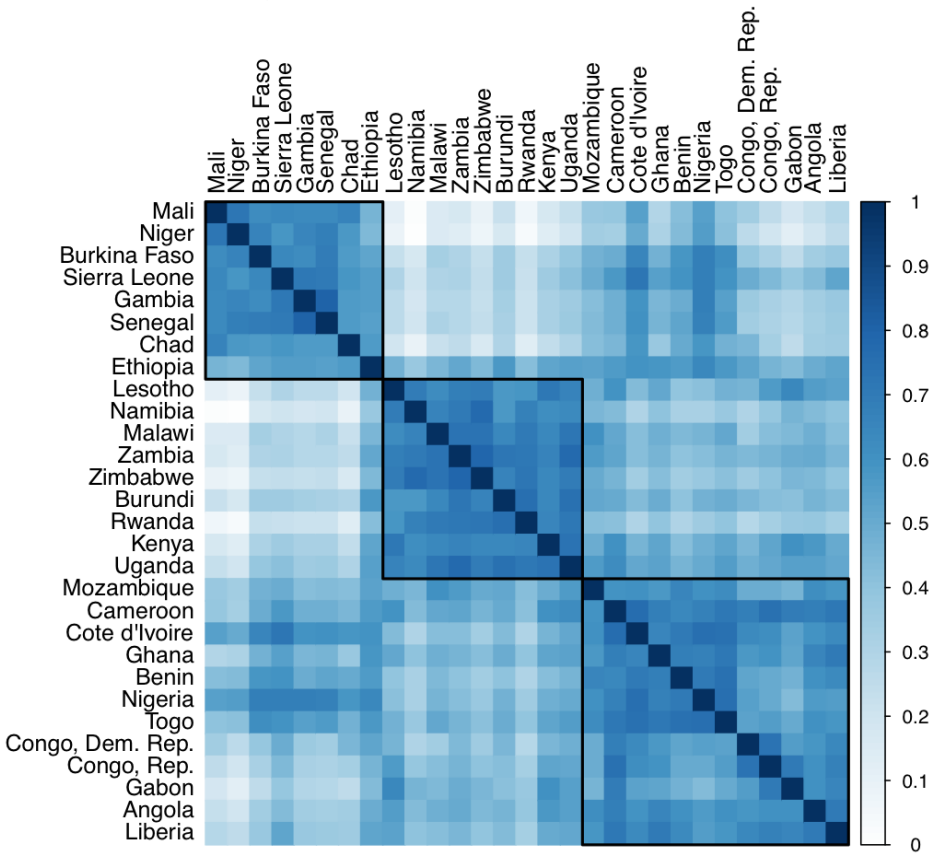
The similarity measure $s_{i,j}$ between countries i and j is then defined as follows:

Equation S2 - Euclidian similarity measure.

$$s_{i,j} = 1 - \frac{d_{i,j}}{\max(d_{i,j})}$$

All pairwise countries similarity (or dissimilarity) data are represented by an $m \times m$ matrix S (or D), with $m = 29$ being the number of countries. Each row and column of matrix S (or D) represents a country, and each element S_{ij} (or D_{ij}) is the degree of similarity (or dissimilarity), between two countries (**Figure S2**).

Figure S2 - Similarity matrix S=($s_{i,j}$) between countries.



Silhouette index

The Silhouette index is used to measure the quality of a clustering. It considers optimizing both cluster compactness and separation by minimizing the inner distance between elements of the same cluster and maximizing the distance between elements of different clusters.

For each observation (i.e. country) c_i, the *silhouette width* $sil(c_i)$ is defined as follows:

Equation S3 - Silhouette width.

$$sil(c_i) = \frac{b(c_i) - a(c_i)}{max\big(a(c_i), b(c_i)\big)},$$

where:

- $a(c_i)$ is the mean dissimilarity between c_i and all other points (i.e. countries) of the cluster to which c_i belongs, and
- $b(c_i) = d(c_i, C_{closest}) = \min_C d(c_i, C)$ is the dissimilarity between c_i and its closest cluster $C_{closest}$, with $d(c_i, C)$ being the mean distance from c_i to all observations of a cluster C to which it does not belong.

The silhouette index is then obtained by averaging the silhouette widths over the whole data set:

Equation S4 - Silhouette Index.

$$SI = \sum_{i=1}^{m} sil(c_i),$$

where $m = 29$ is the total number of countries included in the analysis.

References

1. Estimates Methods 2018 [Internet]. [cited 2020 Jan 24]. Available from: http://aidsinfo.unaids.org/documents/estimates_methods_2018.pdf

2. PCA - Principal Component Analysis Essentials - Articles - STHDA [Internet]. [cited 2020 Jan 6]. Available from: http://www.sthda.com/english/articles/31-principal-component-methods-in-r-practical-guide/112-pca-principal-component-analysis-essentials/