

1 **Knowledge Gaps of STIs in Africa; Systematic review**

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29 **Abstract**

30 Sexually Transmitted Infections (STIs) are ambiguous burden of tremendous health, social and
31 economic consequences, The current systematic review was conducted in order to determine
32 awareness and knowledge of Africans of sexually transmitted infections, not only concerning
33 HIV/AIDS, but also other STIs such as, gonorrhea, syphilis, HBV, HCV and HPV. A systematic
34 review of the literature was conducted, studies were retrieved and selected after they fulfilled the
35 inclusion criteria and passed the assessment procedure. related data was extracted, quantitative
36 analysis was conducted among participants who responded to questions related to HIV, HBV, HCV,
37 HPV or STIs knowledge, sensitivity analysis as well as subgroup analysis were also conducted.
38 Seventy four articles addressing knowledge among 35 African countries were included and 136
39 questions were analyzed and synthesized. The question "Using condom will reduce HIV
40 transmission?" was answered by 1,799,374 Africans in 35 countries, 66.82% [95% CI; 62.65, 70.98]
41 answered yes. While the question "Is sexual contact a possible route of HBV transmission?" was
42 answered by 7,490 participants in 5 countries; 42.58% [95% CI; 20.45, 64.71] answered yes. The
43 differences observed among populations are highlighting the possibility for containment and control
44 by directing light toward specific populations or countries as well as addressing specific awareness
45 knowledge to ensure that the general as well as the related specific preventive awareness knowledge
46 is improved.

47 **Keywords**

48 Africa, Awareness, Developing countries, Knowledge, STIs, sub-Saharan Africa, Viral infections.

49 **Introduction**

50 Sexually transmitted Infections (STIs) are ambiguous burden of tremendous health, social and
51 economic consequences. Most of them are hidden because many people may feel stigmatized when
52 addressing them. Moreover, the committee on prevention and control of sexually transmitted diseases
53 in USA estimated that the annual costs of selected major STDs are approximately \$10 billion or, if
54 sexually transmitted HIV is included, \$17 billion ^[1].

55 According to UNAIDS; almost 37 million people globally were living with HIV in 2017, sub-Saharan
56 Africa accounted for 66% of the cases, 68% of new adult HIV infections, 92% of new infections in
57 children and 72% of all AIDS-related deaths. Earlier in 2009, Swaziland topped the world's HIV

58 epidemic countries with a 26% prevalence among adults, while South Africa was the country with the
59 world's largest prevalence of people living with HIV as 5.6 million [2,3].

60 On the other hand and according to WHO; an estimated 257 million people are living with HBV
61 infection with the highest prevalence in the Western Pacific Region and the African Region as 6.2%
62 and 6.1% of the adult population are infected, respectively. About 1% of persons living with HBV
63 infection (2.7 million people) are also infected with HIV. Moreover, approximately 399,000 people
64 die each year from hepatitis C infection and the estimated global HPV prevalence is 11.7% with the
65 Sub-Saharan Africa having the largest burden as well (24.0%), [4-6].

66 Africa is considered the continent with the lowest Gross Domestic Product (GDP) as most African
67 countries fall within the lower-middle to low income countries classification. Moreover, In March
68 2013, despite of the predicted uprising in African economy in the following decades, Africa was
69 identified as the world's poorest inhabited continent; Africa's entire combined GDP is estimated to be
70 barely a third of the United States', this could be straightforwardly influencing screening opportunities,
71 medical consultations as well as treatment options. Taking that under consideration; a strategy of STIs
72 containment in Africa should primarily emphasize prevention and its related knowledge. Chan and
73 Tsai in their study represented awareness outcome of data collected from 33 sub-Saharan African
74 countries. Although their study determined the estimated awareness according to data collected from
75 2003 to 2015 as well as a knowledge trend among each participated country was illustrated, awareness
76 of five questions were assessed regarding HIV only. The current systematic review was conducted in
77 order to determine awareness and knowledge of Africans of sexually transmitted infections, not only
78 concerning HIV/AIDS, but also other STIs such as, gonorrhea, syphilis, HBV, HCV and HPV and
79 concerning all awareness determinants that are reported in the literature [7,8].

80 **Materials and methods**

81 **Search strategy**

82 To identify relevant studies, a systematic review of the literature was conducted in the 1st of December
83 2018. The review was conducted in accordance with the PRISMA (Preferred Reporting Items for
84 Systematic Reviews and Meta-Analyses) Statement [8] (Table S1). A comprehensive search was
85 conducted in PubMed, Embase, Google scholar, Scopus, Index Copernicus, DOAJ, EBSCO-CINAHL,
86 Cochrane databases without language limits (studies written in French were later excluded). To obtain
87 a current situation evidence; only studies published in or after 2010 were included. Furthermore, all
88 studies where the data collection process took place before 2010 were also excluded, the only

89 exception was if the collection process continued months/years earlier than 2010 and ended in 2010 or
90 afterwards. The keywords used in PubMed was as follow:

91 ((HIV[Tiab] OR syphilis[Tiab] OR gonorrhea[Tiab] OR sexual behavior[Tiab] OR "men who have sex with
92 men"[Tiab] OR condom[Tiab] OR "herpes simplex virus"[Tiab] OR "sex workers"[Tiab] OR sex [tiab]OR
93 human immunodeficiency virus[Tiab] OR HBV[Tiab] OR HCV[Tiab] OR HPV[Tiab] OR prostitutes[Tiab] OR
94 trichomonas vaginalis[Tiab]) AND (behavior [Ti] OR risk [ti] OR awareness[Ti] OR knowledge[Ti] OR
95 assessment[Ti]) AND (africa[Tiab] OR algeria[Tiab] OR angola[Tiab] OR benin[Tiab] OR botswana[Tiab] OR
96 burkinafaso[Tiab] OR burundi[Tiab] OR caboverde[Tiab] OR cameroon[Tiab] OR central african
97 republic[Tiab] OR CAR[Tiab] OR chad[Tiab] OR comoros[Tiab] OR "democratic republic of the congo"[Tiab]
98 OR "republic of the congo"[Tiab] OR cote d'ivoire[Tiab] OR djibouti[Tiab] OR egypt[Tiab] OR equatorial
99 guinea[Tiab] OR eritrea[Tiab] OR eswatini[Tiab] OR swaziland[Tiab] OR ethiopia[Tiab] OR gabon[Tiab] OR
100 gambia[Tiab] OR ghana[Tiab] OR guinea[Tiab] OR guinea-bissau[Tiab] OR kenya[Tiab] OR lesotho[Tiab] OR
101 liberia[Tiab] OR libya[Tiab] OR madagascar[Tiab] OR malawi[Tiab] OR mali[Tiab] OR mauritania[Tiab] OR
102 mauritius[Tiab] OR morocco[Tiab] OR mozambique[Tiab] OR namibia[Tiab] OR niger[Tiab] OR
103 nigeria[Tiab] OR rwanda[Tiab] OR (sao tome principe[Tiab] OR senegal[Tiab] OR seychelles[Tiab] OR sierra
104 leone[Tiab] OR somalia[Tiab] OR south africa[Tiab] OR south sudan[Tiab] OR sudan[Tiab] OR
105 swaziland[Tiab] OR eswatini[Tiab] OR tanzania[Tiab] OR togo[Tiab] OR tunisia[Tiab] OR uganda[Tiab] OR
106 zambia[Tiab] OR zimbabwe[Tiab])).

107 Moreover, to optimize our search, hand searches of reference lists of included articles were also
108 performed.

109 **Study selection and data extraction**

110 All authors independently assessed titles and abstracts for eligibility, and any disagreement was
111 resolved through discussion. A copy of the full text was obtained for all research articles that were
112 available and approved in principle to be included. Abstraction of data was in accordance with the task
113 separation method; method and result sections in each study were separately abstracted in different
114 occasions to reduce bias ^[9]. Moreover, data abstraction was conducted with no consideration of
115 author's qualifications or expertise. Studies assessed the knowledge of parasitic infections as well as
116 studies conducted among healthcare workers (clinicians, laboratory specialists, nurses, dentists and
117 midwives) were excluded. If a data regarding the period of conduction is missing in a study the
118 reference list was crossed, if any cited study is published after 2010 authors of the current review
119 agreed to predict that the study is conducted after 2010 and hence it was considered for inclusion and
120 it was considered to be addressed later in the review as (conducted after 2010), otherwise the study
121 was excluded. All studies measuring awareness level with scores or if it is generally good or moderate
122 or bad without determining further details were excluded. Each research article was screened for all

123 relevant information and recorded in the data extraction file (Microsoft Excel), as one article may
124 report outcome of awareness and/or knowledge and/or attitude toward specific sexually transmitted
125 infection or toward several STIs, in a single population or among several ones. Moreover, data from
126 each method section was extracted using a predefined set of variables; study characteristics, type of
127 participants, study population size, geographical region and the period of the study conduction.

128 **Assessment of quality**

129 Each included article was evaluated based on a framework for making a summary assessment of the
130 quality. The related published literature was crossed, then a framework was structured specifically to
131 determine the level of representativeness of the studied population and to judge the strength of the
132 estimates provided. Six questions were to be answered in each article, each answer represent either 1
133 score for yes, 0 score for No or 0 score for not available ; A total score for risk of bias and quality was
134 calculated by adding up the scores in all six domains, resulting in a score of between 0 and 6. The
135 highest score indicates the highest quality, studies with a score for quality greater or equal to 3 (higher
136 quality) were included in the review.

137 The six domains were: is the study objective clearly defined?, is the study sample completely
138 determined?, is the study population clearly defined and specified?, is the response rate of participants
139 above 70%?, is the methodology used rigorous? and is the data analysis rigorous?

140 Trim and Fill method was used to assess the risk of publication bias in each question responses in the
141 included studies ^[10]. Publication bias was assessed separately for each question-corresponding
142 responses only if the question was addressed and answered in studies equal or greater than ten.

143 **Quantitative analysis**

144 Meta-analysis was performed - whenever possible using Review Manager Software (Version 5.3). In
145 studies where the Standard Error (SE) is not reported, the following formula was used to calculate it:
146 $SE = \sqrt{p(1-p)/n}$ where p stands for Prevalence. The software automatically provided the Confidence
147 Interval (CI) according to the calculated SE, if the CI is provided in a study; it was introduced
148 accordingly. The heterogeneity of each meta-analysis was assessed, the random effects was favored
149 over the fixed effects model in all meta-analysis established as differences between studies is
150 predicted to be possible due to the diversity of the study populations. Sensitivity analysis was also
151 approached to determine the effect of studies conducted in populations proposed to behave in
152 indifference manners or proposed to be more aware on the overall pooled prevalence. Moreover,
153 subgroup analysis was also conducted -whenever suitable to determine awareness level in specific

154 country or population. A question to take part in the meta-analysis has to be included in at least two
 155 studies. Moreover, for providing the full picture as well as emphasizing potential research gaps; all
 156 HIV-related questions that are proposed to be of interest according to the objective of the current
 157 review and was answered by at least 1,000 Africans but included only in one study were also provided
 158 alongside their related references, however, questions related to other STIs were provided regardless
 159 of the number of participants due to their minority. Questions with similar outcome were proposed to
 160 be the same (i.e. the question "do you think sexual intercourse will increase the risk of HIV
 161 transmission?" and the question "is HIV sexually transmitted?" were considered as one question.

162 Results

163 Studies included

164 A total of 7,540 articles were identified from the search strategy including hand searches of reference
 165 lists of included original research articles and reviews. From these, 7,453 articles were excluded.
 166 Seventy four articles met our inclusion criteria and passed the quality assessment procedure. The
 167 articles reported specific awareness determinants and/or knowledge and/or attitudes of an African
 168 population regarding STIs as general and/or HBV and/or HCV and/or HPV and/or HIV. (Fig. 1)
 169 illustrates the PRISMA flow diagram. The included articles are depicted in (Table 1). Assessment of
 170 the quality of included studies is depicted in (Table S2).

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172 **Fig (1):** Literature search and selection of studies (PRISMA flow diagram).

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174 **Table (1):** Characteristics of included studies

Study	Year of publication	Year/s of conduction	City/Region/Country	study population/s	Assessment of knowledge of	sample size	Gender	Participants' Age
lulai <i>et al</i> (12)	2016	2010	Kintampo North/Brong Ahafo Region/Ghana	Pregnant women	HBV	504	Female	26±6
Abimanyi-Ochom <i>et al</i> (13)	2017	2011	Uganda	General population	HIV	10,969	Both	15-49
Aderemi <i>et al</i> (14)	2013	After 2010	Oyo State/Nigeria	Students	HIV	600	Both	12-19
Adoba <i>et al</i> (15)	2015	2015	Obuasi/Ghana	Barbers	HBV/HCV	200	Male	20-29
Ajide and Balogun (16)	2018	After 2010	Ibadan/Nigeria	Students	HIV	240	Both	16±1
Akokuwebe <i>et al</i> (17)	2016	After 2010	Ikeji-Arakeji/Osun/Nigeria	Adolescents	HIV/STIs	341	Both	16+2
Amu and Adegun (18)	2015	After 2010	Ado Ekiti/Nigeria	Students	HIV/STIs	540	Both	10-14
Appiah-Agyekum <i>et al</i> (19)	2013	After 2010	Accra/Ghana	Students	HIV	260	Female	16- ≥19
Aroke <i>et al</i> (20)	2018	2016	Centre Region, North Region and South	Medical students	HBV	714	Both	22±1

			Region/Cameroon					
Asefa and Beyene (21)	2013	2012	Southern Nations, Nationalities, and Peoples' Region/ Ethiopia	Pregnant women	HIV	1,325	Female	15-49
Audet et al(22)	2012	After 2010	Zambe'zia/Mozambique	General population	HIV	349	Both	Median 32
Azodo et al(23)	2014	2010	Enugu/Nigeria	Dental tech students	HIV	198	Both	20- ≥27
Becker et al(24)	2015	2009-2010	Durban/KwaZulu-Natal/South Africa	General population	HIV	2,477	Both	N.A
Carlos et al(25)	2015	2010	Kinshasa/ Democratic Republic of Congo	Outpatients and blood donors	HIV	1,614	Both	15-49
Chan and Tsai(8)	2018	2003-2015	33 Countries	General population	HIV	1,187,077	Both	N.A
Chaquisse et al (26)	2018	2013-2014	Nampula/Mozambique	Pregnant women	HIV/HBV/HCV	1,186	Female	median 22
Chard et al (27)	2017	After 2010	South Africa	men who indicated an interest in men	HIV	386	Male	mean 33
Cheng et al (28)	2015	2013-2014	Kumasi/Ghana	pregnant women	HBV	209	Female	N.A
Chimoyi et al (29)	2015	2013	Gohannesburg/Gauteng/ South africa	General population	HIV	1146	Both	N.A
Ciampa et al (30)	2012	2011	Zambezia/Mozambique	prenatal care in women	HIV	348	Female	median 24
Darteh et al (31)	2016	2011	Kwesimintsim Zongo/Ghana	adolescents, general population	HIV	902	Both	mean 14
Demsiss et al (32)	2018	2017	South Wollo Zone/Amhara/Ethiopia	medicine and health science students	HBV/HCV	408	Both	mean 26 ± 4
Elbadawi et al (33)	2016	2016	Khartoum/Sudan	university students	HIV	556	Both	N.A
Engelbrecht et al (34)	2017	2012	Moretele Sub-district/Bojanala District/North West province/South Africa	home-based carers	HIV	144	Both	median 35
Eni et al (35)	2018	2016	Lagos, Ogun and Abia/Nigeria	University students, general population	HPV	758	Both	16–39
Ezenwa et al (36)	2013	2012	Shomolu Local Government Area/Lagos/Nigeria	mothers of female adolescents	HPV	290	Female	24–62
Faleye et al (37)	2014	2012-2013	Durban/KwaZulu-Natal/South africa	Male medical circumcision clients	HIV	394	Male	mean 28±9
Faust et al (38)	2017	2013	Nigeria	general population	HIV	56,307	Both	15–49
Faye et al (39)	2013	May, 2010	Senegal	seafarers	HIV	400	Male	38 ±10
Frambo et al (40)	2014	2012	Buea Health District/Cameroon	pregnant women	HBV	176	Female	17-42
Funmilayo et al (41)	2018	2014	Lagos/Nigeria	university students	HPV	280	Both	15-40
George et al (42)	2013	2010	Northern Cape province/South Africa	rural based traditional healers	HIV	186	Both	N.A
Griffith et al (43)	2015	2013	Masiphumelele/Cape Town/South Africa	HIV-Infected and HIV-Uninfected Adolescent Women	HPV	30	Female	16-21
Joda et al (44)	2013	After 2010	Lagos/Nigeria	students	Gonorrhoea/STIs	30	Both	15-35
Kiderlen et al (45)	2015	2011	Namibia	employees in truck transport sector	HIV	483	Both	≤19-≥60
Kufa et al (46)	2018	After 2010	Eastern Cape,Western Cape,Free State,Gauteng/South Africa	STI service attendees	HIV	1,054	Both	23-32
Laraqui et al (47)	2017	2014	Morocco	seafarers	STI,HIV	1447	Male	36±8
Lawan et al(48)	2012	2011	Kano/Nigeria	FSW	HIV	124	Female s	26±2
Makwe et al(49)	2012	2010	Lagos/Nigeria	students	HPV	368	Female s	16-29
Mason et al(50)	2013	after 2010	Gambia	Men Who Have Sex with Men	HIV	207	Males	≥16
Massey et al (51)	2017	2014	Dakar, Thies, Fatick, Mbour and Ziguinchor/Senegal	Adolescents and young adults	HPV	2,286	Both	14-22
Mesfin et al (52)	2013	2013	Harar town/Harari/Ethiopia	Students	HBV	322	Both	20-24
Mkumbo et al (53)	2013	after 2011	Dar es Salaam, Morogoro and Tanga/Tanzania	Students	HIV	362	Both	Mean 25
Mouallif et al (54)	2014	2012	Casablanca, Marrakech, Chaouiya-Ouardiguaaand Tangier/Morocco	parents	HPV	852	Both	19-67
Nabukenya et al (55)	2018	2011	Uganda	older adults	HIV	2,472	Both	45-59

Nawagi et al (56)	2016	2013	Katanga slum/Kampala/Uganda	women of reproductive age	STI	335	Females	18-45
Ngaira et al (57)	2016	2014	Mbagathi/Nairobi/Kenya	pregnant women	HBV	287	Females	15-49
Noubiap et al (58)	2013	2012	Yaoundé/Cameroon	medical students	HBV	111	Both	20-27
Nubed et al(59)	2016	2014	Fako/South West Region/Cameroon	senior secondary school students	HIV	464	Both	13-25
Ojieabu et al (60)	2011	2011	Sagamu/Ogun/Nigeria	Pregnant Women	HIV	403	Females	20- ≥40
Okonkwo et al (61)	2017	2014	Nigeria	Traders	HBV	335	Both	median 29
Okonkwo et al (62)	2018	2015	Cross River State/Nigeria	general population	HBV	1,620	Both	18- ≥18
Oladepo and Fayemi (63)	2011	2010	Ibadan South-West Local Government Area/Oyo/Nigeria	Secondary students	HIV	420	Both	10-19
Omotowo et al (64)	2018	2016	Enugu/Nigeria	Administration staff of a hospital	HBV	3,132	Both	18-75
Oppong and Oti-Boadi (65)	2013	N/A	Accra/Ghana	undergraduate private university students	HIV	324	Both	17-37
Owusu (66)	2015	After 2010	Cape Coast Metropolis/Ghana	primary school children	HIV	120	Both	9-13
Oyekale (67)	2014	2012	All regions of Cameroon	men of reproductive age	HIV	7,191	Male	15-49
Paintsil et al (68)	2015	2013/2014	Accra and Ashanti/Ghana	pediatric caregivers	HIV	298	Both	32-53
Pathmanathan et al (69)	2016	N/A	Malawi	General population	HIV	3,630	Both	15-49
Poole et al(70)	2013	2011	Bamako/ Mali	adults and adolescents in Mali	HPV	51	Both	12-26
Reuter et al (71)	2018	2013	Antsiranana/Madagascar	university students	HIV/HBV/HCV/HPV/STIs	242	Both	23±3
Rukundo et al (72)	2016	2014	Kampala and Buikwe districts/Uganda	school students	HIV	245	Both	10-19
Sahile et al (73)	2015	2014	Ambo/Oromia/Ethiopia	university students	HIV	1,311	Both	18-30
Saleh et al (74)	2014	2011	Menoufia and Giza governorates/Egypt	residents	HCV	67	Both	18-80
Sandqvist et al (75)	2011	2010	Mateete/Central Region/Uganda	pregnant women	HIV	120	Females	15-46
Schwitters et al (76)	2015	2011-2013	Katutura/Namibia	young HIV-negative men	HIV	501	Male	<18
Seyoum and Legesse (77)	2013	2011	Harar town/Harari/Ethiopia	TB patients	HIV	415	Both	16-60
Shiferaw et al (78)	2014	After 2010	Gondar/Amhara/Ethiopia	university students	HIV	384	Both	19-26
Sultan et al(79)	2018	2014	Cairo/Egypt	HCV patients	HCV	203	Both	≥18
Tarekegne et al(80)	2018	2017	Sokota/Ethiopia	workers in an engineering Company	HIV	55	Both	≥15
Umar and Oche (81)	2012	2010	Sokoto/Nigeria	religious leaders	HIV	158	Male	≥30
Wagenaar et al(82)	2012	2010	South Africa	Men Who Have Sex with Men	HIV	1593	Male	≥18
Yaya et al(83)	2018	2013	Nigeria	community dwelling women	HIV	38,948	Females	15-49
Zungu et al(84)	2016	2012	South Africa	medically and traditionally circumcised males	HIV	11,086	Male	≥15

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176 Study characteristics

177 The characteristics of the included studies are depicted in (Table1), among which the oldest were
 178 published in 2010 while the most recent ones were published in 2018. Fifty one research articles
 179 determining HIV awareness level and/or knowledge and/or attitudes were included, while 14 articles
 180 determining HBV awareness level and/or knowledge and/or attitudes were included. Furthermore, 6
 181 and 9 articles concerned of awareness level and/or knowledge and/or attitudes level regarding HCV

182 and HPV were included, respectively. Seven articles determining STIs awareness level and/or
183 knowledge and/or attitudes as general were also included. Two hundred questions were summarized
184 among which 136 questions were analyzed and synthesized from included studies including the
185 subgroup analysis. Publication bias assessment indicated no major asymmetry (data not shown).

186 **Human Immunodeficiency Virus (HIV)**

187 Fifty one included studies assessed the awareness of 1,235,811 Africans in regard to HIV in total of 35
188 countries, eleven studies were conducted in Nigeria [14,16,83,17,18,23,38,48,60,63,81], nine in South Africa
189 [24,27,29,34,37,42,46,82,84], five in each of Ghana [19,31,65,66,68] and Ethiopia [21,73,77,78,80], four in Uganda
190 [13,55,72,75], three in Mozambique [22,26,30], two in each of Namibia [45,76] and Cameroon [59,67], one in each
191 of Congo [25], Sudan [33], Senegal [39], Morocco [47], Gambia [50], Tanzania [53], Madagascar [71] and
192 Egypt [74] while a study provided awareness prevalence in 33 countries [8]. The conduction of the
193 studies ranged from 2010 to 2017. Population under study was distributed among students and
194 adolescents, general population, pregnant women, female sex workers, male sex workers or males
195 who show interest of males, TB patients, seafarers and other occupations (Table 1). Majority of
196 studies were conducted among both genders (34/51), eight studies were toward females only while
197 nine were toward males only. Age of respondents ranged from 10 to 60 years (Table 1). Forty two
198 questions were asked to the participants that are related to the knowledge and awareness of HIV as
199 general, transmission routes, clinical symptoms, pathological consequences and prevention attitude,
200 among which 31 questions were analyzed and synthesized. The question " Using condom will reduce
201 HIV transmission?" was answered by 1,799,374 Africans in Benin, Burkina Faso, Burundi, Cameroon,
202 Chad, Comoros, Cote d'Ivoire, Democratic Republic of Congo, Ethiopia, Gabon, Ghana, Guinea,
203 Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Morocco, Mozambique, Namibia, Niger,
204 Nigeria, Rwanda, São Tomé and Príncipe, Senegal, Sierra Leone, South Africa, Sudan, Swaziland,
205 Tanzania, Togo, Uganda, Zambia and Zimbabwe; 66.82% [95% CI; 62.65, 70.98] answered yes. The
206 question " Is HIV contracted through Sexual intercourse?" was answered by 252,482 participants in
207 South Africa, Ethiopia, Uganda, Madagascar, Ghana, Nigeria, Gambia, Morocco, Namibia, Senegal,
208 Sudan and Mozambique; 72.20% [95% CI; 64.25, 80.16] answered yes. Questions asked, their
209 corresponding articles' data, the pooled prevalence, the pooled prevalence after conducting sensitivity
210 analysis and the confidence intervals are depicted in (Table 2 & Fig 2). Heterogeneity was high in all
211 questions (I^2 more than 80%), except for the question " Is TB associated with HIV infection?" where I^2
212 = 0%.

213

214 **Table (2):** Awareness of HIV-related knowledge among Africans

Question	Country/ies*	Study population/s	Total sample size	References	Pooled prevalence of yes response [95% CI]	Sensitivity analysis **
Have you heard about HIV before?	NI, SD, CR, UG, EG, ET,	students, general population, pregnant Women, men of reproductive age, newly married couples without formal education, TB patients, workers	65,562	[16,33,38,60,67,72,74,77,80]	92.24 [89.68, 94.80]	94.42 [91.82, 97.02]
Can a healthy person be HIV infected?	SD, BE, BF, BR, CR, CH, Comoros, DC, IC, DC, ET, GB, GH, GU, KY, LE, LI MD, MW, ML, MZ, NM, NG, NI, RW, RS, SN, SL, SW, TA, TO, UG, ZM, ZI,	community dwelling women, MSM, pediatric caregivers, men of reproductive age, Students, employees in truck transport sector, pregnant women, Outpatients and blood donors, General population	1,306,715	(8,13,67,68,72,82,83,19,25,30,33,38,45,53,59)	69.67 [66.65, 72.70]	70.99 [67.95, 74.02]
Do you perceive risk of contracting HIV?	SA, NM, GH, NI.	students, men who indicated an interest in men, adolescents, general population, medically and traditionally circumcised males	13,073	(23,27,31,76,84)	39.27 [-5.31, 83.84]	36.97 [13.93, 60.02]
Is it possible to cure HIV?	NI, MZ, SA, TA, CR, UG	Students, Traditional healers, pregnant women, General population	813,382	(16,22,30,42,53,59,72)	41.91 [18.72, 65.10]	39.97 [22.48, 57.45]
Do you know a place to get HIV testing?	NI, GH	students, general population	56,631	(38,65)	85.76 [59.79, 111.73]	
Is social stigma barrier to HIV testing?	SA	General population	1,146	(29)	37.4 [34.6561, 40.14]	
Is ignorance causes stigma to HIV testing?	SA	General population	1,146	(29)	46.3 [43.5561, 49.04]	
Is HIV transmission possible through mosquito bites?	SD, BE, BF, BR, CR, CH, Comoros, DC, IC, DC, ET, GB, GH, GU, KY, LE, LI MD, MW, ML, MZ, NM, NG, NI, RW, RS, SN, SL, SW, TA, TO, UG, ZM, ZI,	community dwelling women, pregnant women, men of reproductive age, Students, seafarers, employees in truck transport sector, Outpatients and blood donors, General population	2,492,259	(8,13,23,25,26,33,38,45,47,53,59,60,66,67,75,83)	32.22 [18.74, 45.70]	32.80 [18.96, 46.64]
Is HIV transmission possible through sharing food?	SD, BE, BF, BR, CR, CH, Comoros, DC, IC, DC, ET, GB, GH, GU, KY, LE, LI MD, MW, ML, MZ, NM, NG, NI, RW, RS, SN, SL, SW, TA, TO, UG, ZM, ZI,	community dwelling women, men of reproductive age, Students, employees in truck transport sector, seafarers, general population	1,302,877	(8,13,33,38,39,45,53,59,66,67,83)	27.33 [2.67, 51.99]	26.49 [-0.76, 53.73]
Is HIV transmission possible during pregnancy?	UG, NI, ET, MZ, SA, SN, NM, MR, TA, GH, EG,	community dwelling women, MSM, workers, pregnant women, newly married couples without formal education, pediatric caregivers, undergraduate university students, General population, Students, pregnant women, clients presenting for Male medical circumcision, employees in truck transport sector,	115,604	(13,14,16,21,26,37-39,45,47,53,60,65,68,74,75,80,82,83)	57.08 [52.42, 61.74]	57.62 [53.17, 62.07]

		seafarers,				
Is HIV transmission possible during delivery?	UG, NI, MZ, TA, EG,	community dwelling women, newly married couples without formal education, prenatal care in women, Students, General population	107,684	(13,14,30,38,53,74,83)	66.65 [50.99, 82.30]	62.92 [45.98, 79.86]
Is HIV transmission possible during breastfeeding?	UG, NI, GH, MZ, NM, MR, TA, EG,	community dwelling women, newly married couples without formal education, seafarers, employees in truck transport sector, Pregnant women, Students, General population	111,180	(13,14,19,26,30,38,45,47,53,74,75,83)	73.44 [65.49, 81.39]	75.27 [66.98, 83.56]
Is HIV contracted through Sexual intercourse?	SA, ET, UG, MD, GH, NI, GA, MR, NM, SN, SD, MZ,	Students, Adolescents, Pregnant women, workers, MSM, pediatric caregivers, prenatal care in women, FSW, clients presenting for Male medical circumcision, seafarers, employees in truck transport sector,	252,482	(14,16–19,23,26,30,33,37,39,45,47,48,50,60,65,66,68,71,72,75,80,82)	72.20 [64.25, 80.16]	73.36 [65.36, 81.37]
Is HIV contracted through Sharing sharp unsterilized objects?	MZ, SN, MR, NI, GH	Students, Pregnant women, prenatal care in women, seafarers, FSW, Pregnant Women, primary school children	4,268	(16,26,30,39,47,48,60,66)	50.80 [22.19, 79.40]	51.52 [23.90, 79.15]
Is HIV contracted through Transfusion with unscreened blood?	NI, GH, SD, SA, UG, ET	Students, clients presenting for Male medical, FSW, Pregnant Women, workers	2,595	(16,19,23,33,37,48,60,66,72,80)	54.37 [28.12, 80.63]	55.61 [28.01, 83.22]
Is HIV contracted through shaking hands?	NI, MZ, NM, TA, UG	Students, Pregnant women, employees in truck transport sector	2,937	(16,23,26,30,45,53,75)	18.28 [7.67, 28.90]	19.35 [8.69, 30.01]
Can witchcraft and other spiritual factors cause or transmit HIV?	GH, DC, MZ, NM, TA, NI	Students, Outpatients and blood donors, prenatal care in women, general population, employees in truck transport sector, community dwelling women	98,442	(19,25,30,38,45,53,66,83)	36.10 [29.14, 43.07]	34.37 [25.31, 43.43]
Is HIV contracted through Intravenous needle?	NI, MZ, SD, SA, GA, TA, GH, UG, ET	students, Pregnant women, clients presenting for Male medical circumcision, FSW, MSM, workers in China first high way engineering Company	4,522	(23,26,72,75,80,30,33,37,48,50,53,60,65)	64.74 [45.47, 84.01]	67.60 [52.14, 83.06]
Is HIV transmission possible during blood donation?	NI, MZ	Pregnant women, Dental tech students	1,384	(23,26)	73.84 [65.94, 81.73]	
Is HIV transmission possible through sharing of cups/plates?	NI, MZ, GH, UG, SA	Students, Pregnant women, pediatric caregivers, MSM	302,165	(14,23,26,30,66,68,75,82)	20.97 [9.72, 32.22]	19.22 [7.45, 31.00]
Is HIV transmission possible by hugging and kissing?	NI, DC, MZ, SA, TA, GH, UG	Students, Outpatients and blood donors, clients presenting for Male medical circumcision, pediatric caregivers, pregnant women, MSM	6,287	(14,25,26,37,53,66,68,75,82)	26.08 [15.11, 37.05]	25.80 [16.41, 35.18]
Can coughing and sneezing spread HIV?	MZ, GH, SA	MSM, pediatric caregivers, pregnant women	2,239	(30,68,82)	14.94 [6.94, 22.94]	
Is HIV transmission possible through toilets?	NI, MZ	Pregnant women, Students	1,786	(14,26)	43.79 [34.97, 52.60]	
Is HIV transmission possible through tattoos or perforation?	MZ	Pregnant women	1,186	(26)	70 [67.6480, 72.35]	
Is oral candidiasis associated with HIV infection?	SA	General population	2,477	(24)	14.4 [13.0280, 15.77]	
Is herpes zoster associated with HIV infection?	SA	General population	2,477	(24)	17 [15.6280 , 18.37]	

Is TB associated with HIV infection?	SA	General population, home-based carers	2,621	(24,34)	18.00 [16.66, 19.34]	
Is wasting associated with HIV infection?	SA	General population	2,477	(24)	23.8 [22.23 , 25.36]	
Is sores or abscesses associated with HIV infection?	SA	General population	2,477	(24)	23 [21.4320, 24.56]	
Is acute respiratory tract infection associated with HIV infection?	SA	General population	2,477	(24)	26.7 [27.9360 , 31.46]	
Is constant diarrhea associated with HIV infection?	SA	General population	2,477	(24)	17.7 [16.3280, 19.07]	
Do you consider loss of body weight a sign of AIDS?	SA	General population	2,477	(24)	43.7 [39.97, 47.41]	
Is using condom prevent HIV transmission?	BE, BF, BR, CR, CH, Comoros, DC, IC, DC, ET, GB, GH, GU, KY, LE, LI MD, MW, ML, MZ, NM, NG, NI, RW, RS, SN, SL, SW, TA, TO, UG, ZM, ZI, SD, MR,	General population, Students, Outpatients and blood donors, adolescents, seafarers, rural based traditional healers, employees in truck transport sector, STI service attendees, FSW, Pregnant Women, men of reproductive age, pediatric caregivers, workers, religious leaders, MSM, community dwelling women.	1,799,374	(8,13,16,19,23,25,29–31,33,38,39,42,45–48,53,59,60,65–69,75,80–83)	66.82 [62.65, 70.98]	68.05 [63.97, 72.13]
Is having one sexual partner prevent HIV transmission?	BE, BF, BR, CR, CH, Comoros, DC, IC, DC, ET, GB, GH, GU, KY, LE, LI, MD, MW, ML, MZ, NM, NG, NI, RW, RS, SN, SL, SW, TA, TO, UG, ZM, ZI, SD, MR,	General population , Students, Outpatients and blood donors, adolescents, seafarers, rural based traditional healers, employees in truck transport sector, STI service attendees, FSW, Pregnant Women, men of reproductive age, pediatric caregivers, workers, religious leaders, MSM, community dwelling women	1,799,374	(8,13,16,19,23,25,29–31,33,38,39,42,45–48,53,59,60,65–69,75,80–83)	67.61 [64.74, 70.49]	70.16 [67.71, 72.60]
Is abstinence the best way of preventing HIV?	GH, NI, SN, SA, TA, CR.	Students, seafarers, rural based traditional healers, religious leaders	3,794	(19,23,31,39,42,53,59,63, 65,66,81)	64.54 [48.67, 80.41]	
Do you consider showering or washing one's genitals / private parts after sex keeps a person from getting HIV?	GH, MZ, SA.	Pregnant women, pediatric caregivers, MSM.	2,239	(30,68,82)	19.76 [0.20, 39.32]	
Did you practice HIV testing during last pregnancy?	ET	Pregnant women	1,325	(21)	89.30 [87.54, 91.06]	
Is it ok for a person with HIV to teach?	NI, GH, UG	General population, primary school children, community dwelling women	50,037	(13,66,83)	44.80 [10.14, 79.46]	
Is it ok to care for a relative with HIV in household?	UG, NI	community dwelling women, General population	49,917	(13,83)	62.95 [11.11, 114.79]	
Is it ok to buy vegetables from a vendor with HIV?	UG, NI	community dwelling women, General population	49,917	(13,83)	57.11 [25.72, 88.50]	
Do you have feelings of high stigma towards HIV-infected	UG	General population, older adults	2,472	(55)	31.10 [29.34, 32.86]	

patients?						
Condom utilization in the last 12 months?	ET	university students,	1,695	(73,78)	51.63 [25.26, 77.99]	
Is HIV transmit through oral sex?	SA, MZ	Men Who Have Sex with Men, Pregnant women	4,227	(26,30,82)	34.14 [-0.43, 68.71]	

215

216 * Country codes are as follow:

217 Benin=BE, Burkina Faso=BF, Burundi=BR, Cameroon=CR, Democratic Republic of the Congo=DC, Egypt=EG,
 218 Ethiopia=ET, Gabon=GB, Gambia=GA, Ghana=GH, Guinea=GU, Kenya=KY, Lesotho=LE, Liberia=LI,
 219 Madagascar=MD, Malawi =MW, Mali=ML, Morocco=MR, Mozambique=MZ, Namibia=NM, Niger=NG,
 220 Nigeria=NI, Chad=CH, Republic of Sao Tome and Principe=RS, Rwanda=RW, Senegal=SN, Sierra Leone=SL,
 221 South Africa=SA, Sudan=SD, Swaziland=SW, Tanzania=TA, Togo=TO, Uganda=UG, Zambia=ZM,
 222 Zimbabwe=ZI

223 ** Sensitivity analysis was conducted wherever population of proposed high level of knowledge or population
 224 proposed to behave in indifference was participated in a question.

225

226 **Fig (2):** Meta analysis of 1,799,374 Africans' yes response to the question "Is using condom
 227 prevent HIV transmission?"

228

229 Nigeria

230 Eleven included studies in regard to HIV were conducted among Nigerians representing a total
 231 population of 98,279 participants; three studies were conducted in Oyo State ^[14,16,63] and one in each
 232 of Osun State ^[17], Ekiti State ^[18], Enugu State ^[23], Kano State ^[48], Sokoto State ^[81] and Ogun State ^[60].
 233 Two studies were nationally representative and participants were from different States ^[38,83]. The
 234 oldest among the study included were conducted in 2010 while the newest were conducted in 2013
 235 (Table S3). Population under study was found to be mainly students and adolescents (6/11), while one
 236 was toward each of pregnant women, religious leaders, general population, female sex workers and
 237 community dwelling women (Table S3). Majority of studies were conducted among both genders
 238 (7/11), three studies were toward females only while one study included only males. Age of
 239 respondents ranged from 12 to 49 years. Twenty two questions were asked to the participants that are
 240 related to the knowledge and awareness of HIV as general, transmission routes, clinical symptoms,
 241 pathological consequences and prevention attitude, among which 18 questions were analyzed and
 242 synthesized. The question ‘‘ Using condom will reduce HIV transmission?’’ was answered by 57,430
 243 participants; 52,67% [95% CI; 44.42, 60.91] answered yes. The question ‘Is HIV can be transmitted
 244 through mosquito bites?’’ was answered by 95,856 participants; 16.86% [95% CI; 6.77, 26.95]
 245 answered yes. Questions asked, their corresponding study's characteristics, the pooled prevalence and

246 the confidence intervals are depicted in (Table 3). Heterogeneity was high in all questions (I^2 more
247 than 80%).

248

249 **Table (3):** Awareness of HIV-related knowledge among Nigerian population

Questions	Study population/s	Total sample size	References	Pooled prevalence of yes response [95% CI]
Is using condom reduce HIV transmission?	Students, general population, FSW, Pregnant Women, religious leaders, community dwelling women	96,378	(16,23,38,48,60,81,83)	52.67 [44.42, 60.91]
having one sexual partner will reduce HIV transmission?	Students, general population, Pregnant Women, community dwelling women	96,096	(16,23,38,60,83)	57.67 [48.52, 66.81]
Healthy person can be HIV infected ?	general population, community dwelling women	95,255	(38,83)	76.95 [68.43, 85.48]
HIV can be transmitted through mosquito bites	Dental tech students, general population, Pregnant Women, community dwelling women	95,856	(23,38,60,83)	16.86 [6.77, 26.95]
HIV can be transmitted through sharing food	general population, community dwelling women	95,255	(38,83)	16.30 [11.60, 21.01]
Is it OK for a person with HIV to teach	community dwelling women	38,948	(83)	51.60%
Is it OK to care for a relative with HIV in household	community dwelling women	38,948	(83)	63.50%
Is it ok to buy vegetables from a vendor with HIV?	community dwelling women	38,948	(83)	41.10%
Is HIV transmission possible during pregnancy?	Students, general population(NDHS), Pregnant Women, community dwelling women	96,498	(14,16,38,60,83)	45.09 [40.10, 50.08]
Is HIV transmission possible during delivery?	Students, general population, community dwelling women	95,855	(14,38,83)	56.86 [54.43, 59.29]
Is HIV transmission possible during breastfeeding?	Students, general population, community dwelling women	95,855	(14,38,83)	66.72 [62.89, 70.56]
Have you heard about HIV before?	Students, general population, Pregnant Women	56,950	(16,38,60)	94.09 [91.18, 97.00]
Is HIV contracted through Sexual intercourse?	Students, Adolescents, FSW, Pregnant Women,	2,446	(14,16–18,23,48,60)	68.09 [41.80, 94.38]
contracted through Sharing sharp unsterilized objects?	Students, FSW, Pregnant Women	767	(16,48,60)	46.87 [10.49, 83.25]
Is HIV contracted through unscreened blood?	Students, FSW, Pregnant Women	965	(16,23,48,60)	51.17 [4.52, 97.82]
Is HIV contracted through shaking hands?	Students, Dental tech students	438	(16,23)	2.89 [-2.20, 7.98]
Is HIV contracted through witchcraft and other spiritual factors ?	general population(NDHS),community dwelling women	95,255	(38,83)	24.05 [11.21, 36.89]
Is abstinence the best way of preventing HIV?	students, religious leaders	776	(23,63,81)	55.77 [14.32, 97.22]
Is HIV contracted through intravenous needles?	Dental tech students, FSW, Pregnant Women	725	(23,48,60)	61.47 [7.39, 115.56]
Is HIV contracted through sharing of cups/plates?	Students	798	(14,23)	32.50 [-3.52, 68.51]
DO you knows a place to get HIV testing?	general population	56,307	(38)	68.9

250

251 South Africa

252 Nine included studies in regard to HIV were conducted among South Africans representing a total
253 population of 17,320 participants; two studies were conducted in KwaZulu-Natal province [24,37] and
254 one was conducted in each of Gauteng Province [29], Northern Cape province [42], North West province
255 [34], two studies were toward online internet users [27,82], one study was conducted in Eastern Cape,

256 Western Cape, Free State and Gauteng Provinces ^[46] while another study was nationally representative
 257 ^[84] (Table S4). The oldest among the study included was conducted in 2010 while the newest was
 258 conducted after 2010. Population under study was distributed among circumcised males, men who
 259 have sex with men or indicated interest in men, general population and home-based carers (Table S3).
 260 Majority of studies were conducted among both genders (5/9), while four were toward males only
 261 (ref). Age of respondents was from 15 to more than 25 years. Thirty two questions were asked to the
 262 participants that are related to the knowledge and awareness of HIV as general, transmission routes,
 263 clinical symptoms and prevention attitude, among which 16 questions were analyzed and synthesized.
 264 The question ‘Using condom will reduce HIV transmission?’ was answered by 3,979 participants ;
 265 64.46% [95% CI; 31.00, 97.91] answered yes. The question ‘‘Do you perceive risk of contracting
 266 HIV?’’ was answered by 11,472 participants; 42.45% [95% CI; -36.04, 120.05] answered yes.
 267 Questions asked, their corresponding study's characteristics data, the pooled prevalence and the
 268 confidence intervals are depicted in (Table 4). Heterogeneity was high in all questions (I^2 more than
 269 80%).

270

271 **Table (4):** Awareness of HIV-related knowledge among South African population

Question	Study population/s	Total sample size	References	Pooled prevalence of yes response [95% CI]
Using condom will reduce HIV transmission?	General population, home-based carers, rural based traditional healers (THs), STI service attendees, Men Who Have Sex with Men (MSM).	3,979	(29,42,46,82)	64.46 [31.00, 97.91]
Is having one sexual partner reduce HIV transmission?	rural based traditional healers, Men Who Have Sex with Men (MSM).	1,779	(42,82)	83.15 [55.03, 111.27]
A healthy person can be HIV infected ?	MSM	1,593	(82)	94.80% [88.51, 98.23]
Is HIV transmission possible during pregnancy?	General population, MSM	1,987	(37,82)	77.33 [53.32, 101.34]
Is HIV contracted through Sexual intercourse?	General population, MSM	1,987	(37,82)	91.55 [80.48, 102.62]

Is HIV contracted through sharing cups/plates?	(MSM)	1,593	(82)	7 [6.03, 8.27]
Do you perceive risk of contracting HIV?	men who indicated an interest in men, medically and traditionally circumcised males	11,472	(27,84)	42.45 [-36.04, 120.95]
Is ignorance the reason that stigma and discrimination related to HIV testing?	General population	1,146	(29)	46.34 [39.01, 52.51]
Are the social stigma and discrimination barriers to HIV testing?	General population	1,146	(29)	37.43 [35.11, 39.24]
Is your perception of the risk of getting HIV infection low?	General population	1,146	(29)	51.83 [50.07, 53.00]
Is HIV contracted through hugging and kissing	General population, MSM	1,987	(37,82)	4.94 [-0.83, 10.71]
Do you consider loss of body weight a sign of AIDS?	General population, home-based caregivers.	2,477	(24)	34.34[29.25, 41.78]
Is HIV contracted through oral sex?	MSM	1,593	(82)	18 [15.08, 25.26]
Is HIV contracted through coughing and sneezing	MSM	1,593	(82)	8.40 [2.11, 15.85]
Do you consider pulling the penis out before a man climaxes/cums keeps his partner from getting HIV during sex?	MSM	1,593	(82)	4.80 [3.02, 6.25]
Showering or washing one's genitals / private parts after sex keeps a person from getting HIV	MSM	1,593	(82)	1.40 [-0.55, 3.49]
Do you consider Oral candidiasis a sign of AIDS?	General population	2,477	(24)	14.40 [12.45, 18.26]
Do you consider Herpes zoster a sign of AIDS?	General population	2,477	(24)	17 [16.08, 18.27]
Do you consider TB a sign of AIDS?	General population, home-based carers	2,621	(24,34)	18 [16.25, 19.95]
Do you consider Wasting a sign of AIDS?	General population	2,477	(24)	23.80 [20.15, 14.50]
Do you consider Sores/abscesses a sign of AIDS?	General population	2,477	(24)	23 [21.45, 25.96]
Do you consider acute respiratory tract infection a sign of AIDS?	General population	2,477	(24)	29.70 [25.13, 32.76]
Do you consider constant diarrhea abscesses a sign of AIDS?	General population	2,477	(24)	17.70 [14.29, 20.19]

272

273

274 Adolescents

275 The study participants' age were equal or less than 25 years in thirteen HIV-related included studies,
 276 representing a total population of 5,908 participants; five studies were conducted in Nigeria [14,16–18,63],
 277 three in Ghana [19,31,66], two in Mozambique [26,30], and one in each of Cameroon [59], Madagascar [71]
 278 and Uganda [72]. Majority of studies were toward students and adolescents (11/13) while two studies
 279 were conducted among pregnant women. Majority of studies were conducted among both genders
 280 (11/13), while two were toward females only (pregnant women) (Table S5). Age of respondents was
 281 from 12 to 25 years. Twenty two questions were asked to the participants that are related to the
 282 knowledge and awareness of HIV as general, transmission routes, clinical symptoms and prevention
 283 attitude, among which 21 questions were analyzed and synthesized. The question ‘‘Do you think HIV
 284 is contracted through Sexual intercourse?’’ was answered by 4,122 participants; 67.81% [95% CI;
 285 50.66, 84.96] answered yes. The question ‘‘Do you think sharing cups/plates can transmit HIV?’’ was

286 answered by 2,254 participants; 33.51% [95% CI; 9.43, 57.59] answered yes. Questions asked, their
 287 corresponding studies' characteristics, the pooled prevalence and the confidence intervals are depicted
 288 in (Table 5). Heterogeneity was high in all questions (I^2 more than 80%).

289

290 **Table (5):** Awareness of HIV-related knowledge among adolescents in Africa

Question	Country/ies	Study population	Total sample size	First author's last name	Pooled prevalence of yes response [95% CI]
Using condom will reduce HIV transmission?	Nigeria, Ghana, Mozambique, Cameroon	Students, prenatal care in women, adolescents, general population	2,214	(16,19,30,31,59)	75.55 [41.92, 109.19]
having one sexual partner will reduce HIV transmission?	Nigeria, Mozambique, Cameroon, Ghana	Students, prenatal care in women	1,172	(16,30,59,66)	48.45 [2.11, 94.79]
Healthy person can be HIV infected ?	Ghana, Mozambique, Cameroon, Uganda	Students, prenatal care in women	1,317	(19,30,59,72)	60.75 [23.58, 97.92]
Is transmission possible through mosquito bites?	Mozambique, Cameroon, Ghana	Pregnant women, students	1,770	(26,59,66)	43.54 [19.80, 67.29]
HIV transmission possible during pregnancy?	Nigeria, Mozambique	Students, Pregnant women	2,026	(14,16,26)	58.40 [29.92, 86.89]
Is transmission possible through sharing food?	Cameroon, Ghana	students	584	(59,66)	27.01 [-11.11, 65.13]
Is transmission possible through Delivery?	Nigeria, Mozambique	Students, pregnant women	948	(14,30)	55.76 [52.34, 59.17]
Is transmission possible through Breastfeeding?	Nigeria, Ghana, Mozambique, Mozambique	Students, pregnant women	2,394	(14,19,26,30)	74.45 [57.01, 91.90]
You have heard about HIV before?	Nigeria, Uganda	Students	485	(16,72)	93.35 [89.55, 97.15]
It is possible to cure HIV?	Nigeria, Mozambique, Cameroon, Uganda	Students, prenatal care in women	1,297	(16,30,59,72)	46.99 [13.62, 80.35]
HIV is contracted through Sexual intercourse?	Nigeria, Ghana, Mozambique, Madagascar, Uganda	Students, Adolescents, Pregnant women	4,122	(14,16-19,26,30,66,71,72)	67.81 [50.66, 84.96]
HIV is contracted through transfusion with unscreened blood?	Nigeria, Ghana, Uganda	Students	865	(16,19,66,72)	30.89 [-3.39, 65.17]
HIV is contracted through Sharing sharp unsterilized objects?	Nigeria, Mozambique, Ghana	Students, Pregnant women	1,894	(16,26,30,66)	54.27 [29.66, 78.88]
HIV is contracted through shaking hands?	Nigeria, Mozambique	Students, Pregnant women	1,774	(16,26,30)	19.53 [-0.03, 39.08]
Witchcraft and other spiritual factors can cause or transmit HIV/AIDS?	Ghana, Mozambique	Students, pregnant women	728	(19,30,66)	42.64 [15.55, 69.73]
Abstinence is the best way of preventing HIV/AIDS	Ghana, Cameroon, Nigerian city, Nigeria	Students, adolescents, general population	2,166	(19,31,59,63,66)	56.15 [26.66, 85.63]
HIV is contracted through intravenous needle sticks?	Mozambique, Mozambique, Uganda	Pregnant women, school students	1,779	(26,30,72)	51.63 [25.26, 77.99]
HIV is contracted through sharing cups/plates?	Nigeria, Mozambique, Ghana	Students, Pregnant women	2,254	(14,26,30,66)	33.51 [9.43, 57.59]
HIV is contracted through hugging and kissing?	Nigeria, Mozambique, Ghana	Students, Pregnant women	1,906	(14,26,66)	25.83 [-4.73, 56.38]
HIV is contracted through oral sex?	Mozambique	Pregnant women	1,534	(26,30)	42.22 [-9.13, 93.57]
HIV is contracted through sharing toilets?	Nigeria, Mozambique	Students, Pregnant women	1,786	(14,26)	43.79 [34.97, 52.60]

HIV is contracted through tattoos or perforations?	Mozambique	Pregnant women	1,186	(26)	74% [71.6480 , 76.35]
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291

292 **Awareness related to demographic characteristics**

293 Media (as general) was the main source of information of participants reported in several
294 studies [17,47,74]. However, other studies among students reported that school is the main source
295 of information not media [22,75]. Health professionals was the least mentioned source of
296 information in the study of Saleh and colleagues [74].

297 Chaquise and colleagues in their recently published study (2018) determined women's age as not
298 significantly associated with HIV and HBV knowledge. Moreover, they determined that to have heard
299 about HIV/AIDS, Syphilis, Gonorrhoea, Hepatitis B or Hepatitis C, was associated with better
300 knowledge about HIV transmission modes [26].

301 Two studies indicated a statistically significant difference in the HIV/AIDS knowledge scores
302 and the marital/ relationship status [38,65]. Nevertheless, another study indicated that no relation
303 exists. This last study also reported that stigma toward HIV was significantly associated with
304 knowledge scores of HIV as well as education level, female (sex) while place of residence
305 (rural versus urban) is not [55].

306 One study concluded that Comprehensive knowledge of HIV is significantly associated with
307 more media items and fewer children at home [30].

308 Regarding religion, Christians compared to Muslims have been found to significantly have
309 better knowledge of HIV/AIDS. Nevertheless, another study found that Muslim students scored
310 higher on HIV/AIDS knowledge than Christian students [65,81].

311 Several studies indicated that the level of education and age have a significant association with
312 the knowledge of HIV transmission [21,39,48]. Additionally, one study [81] agreed that only
313 education level is associated, while another agreed that only age is associated [77]. Nevertheless,
314 Faye and colleagues only concluded that marital status is associated to the knowledge of HIV
315 transmission [39].

316 Seyoum and colleagues concluded that female participants who heard about HIV was
317 significantly higher than that of the male participants. Moreover, there was a significant
318 difference between males and females who suggested unsafe sexual intercourse as mode of
319 transmission of HIV [77]. However, Yaya and colleagues found that the majority of participants

320 (females) (N=32,123, 82.5%) believe on contracting the virus via supernatural means as a mode
 321 of transmission [83].

322 Hepatitis B Virus (HBV)

323 Fourteen included studies assessed the awareness of 9,446 Africans in regard to HBV, three studies
 324 were conducted in each of Nigeria [61,62,64], Cameroon [20,40,58] and Ghana [12,15,28], two in Ethiopia [32,52],
 325 one in each of Kenya, Mozambique and Madagascar [26,57,71]. The oldest among the study included
 326 was conducted in 2010 while the newest was conducted in 2016 (Table 1). Population under study was
 327 found to be mainly students and adolescents and pregnant women (10/14), one study was targeting
 328 each of non medical staff of health facilities, general population, barbers and traders (Table 1).
 329 Majority of studies were conducted among both genders (8/14), five studies were toward females only
 330 (pregnant women) while one study included only males (barbers). Age of respondents ranged from 10
 331 to 75 years. Fifteen questions were asked to the participants that are related to the knowledge and
 332 awareness of HBV as general, transmission routes, clinical symptoms, pathological consequences and
 333 prevention attitude, among which 13 questions were analyzed and synthesized. The question ‘‘Do you
 334 know HBV?’’ was answered by 4,066 participants in Ghana, Mozambique, Ethiopia, Nigeria and
 335 Madagascar; 53.84% [95% CI; 27.68, 79.99] answered yes. The question ‘‘Does sexual contact is a
 336 possible route of HBV transmission?’’ was answered by 7,490 participants in Ghana, Mozambique,
 337 Ethiopia, Cameroon and Nigeria; 42.58% [95% CI; 20.45, 64.71] answered yes. Questions asked, their
 338 corresponding articles’ data, the pooled prevalence and the confidence intervals are depicted in (Table
 339 6). Heterogeneity was high in all questions (I^2 more than 80%).

340

341 **Table (6):** Awareness of HBV-related knowledge among Africans

Question	Country/ies	Study population/s	Total sample size	References	Pooled prevalence of yes response [95% CI]
Do you know HBV?	Ghana, Mozambique, Ethiopia, Kenya, Nigeria, Madagascar	Barbers, Pregnant women, students, general population	4,570	(12,15,26,28,52,57,62,71)	53.84 [27.68, 79.99]
HBV can damage liver?	Ghana, Ethiopia, Cameroon, Nigeria	students, pregnant women, general population	2,735	(28,32,40,52,62)	61.43 [31.34, 91.52]
Does Blood transfusion is a possible route of HBV transmission?	Ghana, Mozambique, Ethiopia, Cameroon, Nigeria	Barbers, Pregnant women, Students, traders, general population, Administration staff of a hospital	7,490	(15,26,32,40,52,58,61,62,64)	56.16 [28.62, 83.69]
Does reusing needles is a possible route of HBV transmission? (5)	Ghana, Mozambique, Ethiopia, Cameroon, Nigeria	Barbers, Pregnant women, Students, general population, Administration staff of a hospital	7,155	(15,26,32,40,52,58,62,64)	52.72 [26.96, 78.48]

Does sharing blades is a possible route of HBV transmission?	Ghana, Mozambique, Ethiopia, Cameroon, Nigeria	Barbers, Pregnant women, medicine and health science students, traders, Administration staff of a hospital	5,437	(15,26,32,40,61,64)	39.75 [4.40, 75.10]
Does tattooing is a possible route of HBV transmission?	Ghana, Mozambique, Nigeria	Barbers, Pregnant women, traders, general population	3,341	(15,26,61,62)	28.20 [5.03, 51.36]
Does sexual contact is a possible route of HBV transmission?	Ghana, Mozambique, Ethiopia, Cameroon, Nigeria	Barbers, Pregnant women, Students, traders, general population, Administration staff of a hospital	7,490	(15,26,32,40,52,58,61,62,64)	42.58 [20.45, 64.71]
Does mosquito bites is a possible route of HBV transmission?	Mozambique, Nigeria	Pregnant women, general population	2,806	(26,62)	28.49 [-3.85, 60.83]
Does mother to child is a possible route of HBV transmission?	Mozambique, Ethiopia, Nigeria	pregnant women, Students, general population	3,745	(26,28,32,52,62)	57.55 [35.98, 79.12]
Hepatitis B can be transmitted through feco-oral route	Ethiopia, Cameroon	medical students	519	(32,58)	48.65 [6.51, 90.79]
Does toothbrush sharing is a possible route of HBV transmission?	Nigeria	General population	1,620	(62)	49 [46.6480 , 51.35]
HBV can be asymptomatic?	Ethiopia, Cameroon	pregnant women, medicine and health science students	793	(20,28,32,40)	58.12 [23.38, 92.85]
HBV can be prevented by avoiding casual sex or multi sexual partnership?	Ethiopia	medicine and health science students	408	(32)	87 [83.8641 , 90.13]
Do you know HBV vaccination?	Ethiopia, Cameroon	pregnant women, Students	1,226	(28,32,40,52,58)	72.36 [50.69, 94.03]

342

343 **Awareness related to demographic characteristics**

344 Abdulai and colleagues in their study among pregnant women determined that level of education and
 345 occupation are significantly associated to hepatitis B awareness [12]. Frambo and colleagues among the
 346 same population concluded that education is significantly associated to the level of awareness as well
 347 [40]. Furthermore, Ngaira and colleagues assessed the awareness as well as vaccination status among
 348 the same population (pregnant women) and indicated a significant difference between vaccine uptake
 349 and education [57].

350 Noubiap and colleagues assessed HBV vaccine uptake but among medical students, and indicated that
 351 duration of study but not age and vaccination status are significantly correlated. Nevertheless
 352 Okonkwo and colleagues in their study among traders concluded that knowledge of the nature of HBV
 353 virus varied significantly according to age [58,61].

354

355 **Hepatitis C Virus (HCV)**

356 Six included studies assessed the awareness of 2,306 Africans in regard to HCV, two studies were
 357 conducted in Egypt [74,79] and one in each of Ghana [15], Mozambique [26], Ethiopia [32] and Madagascar
 358 [71]. The oldest among the study included was conducted after 2010 while the newest was conducted in
 359 2015 (Table 1). Population under study was distributed among students and adolescents, general
 360 population, HCV positive patients, pregnant women and barbers (Table 1). Four studies were
 361 conducted among both genders, one toward females only and one toward males only (Table 1). Age of
 362 respondents range from 18 to 80 years. Seventeen questions were asked to the participants that are
 363 related to the knowledge and awareness of HCV as general, transmission routes, clinical symptoms,
 364 pathological consequences and prevention attitude, among which 10 questions were analyzed and
 365 synthesized. The question ‘‘Does sexual contact is a possible route of HCV transmission?’’ was
 366 answered by 1,997 Africans in Ghana, Mozambique, Ethiopia and Egypt; 30.61% [95% CI; 2.04,
 367 59.17] answered yes. The question ‘‘Hepatitis C infection can be prevented by vaccination?’’ was
 368 answered by 611 participants in Ethiopia and Egypt; 42.05 [95% CI; 8.73, 75.37] answered yes.
 369 Questions asked, their corresponding articles’ data, the pooled prevalence and the confidence intervals
 370 are depicted in (Table 7). Heterogeneity was high in all questions (I^2 more than 80%).

371

372 **Table (7):** Awareness of HCV-related knowledge among Africans

Question	Country/ies	Study population/s	Total sample size	References	Pooled prevalence of yes response [95% CI]
Have you ever heard about viral hepatitis C?	Ghana, Mozambique, Egypt	Barbers, Pregnant women, university students, HCV patients	1,831	(15,26,71)	20.21 [5.42, 35.00]
Do you know what cause HCV infection?	Egypt	General population	67	(74)	87 [68.2002 , 87.79]
Is HCV can be cured?	Egypt	General population	67	(74)	39 [27.4362 , 50.56]
Hepatitis C can cause liver cancer?	Ethiopia, Egypt	medicine and health science students, HCV patients	611	(32,79)	89.50 [87.15, 91.85]
Does Blood transfusion is a possible route of HCV transmission?	Ghana	Barbers	200	(15,79)	86.40 [81.70, 91.10]
Does reusing needles is a possible route of HCV transmission?	Ghana, Mozambique, Ethiopia, Egypt	Barbers, Pregnant women, medicine and health science students, HCV patients	1,997	(15,26,32,79)	68.82 [16.96, 120.69]
Does sharing blades is a possible route of HCV transmission?	Ghana, Mozambique, Egypt	Barbers, Pregnant women, HCV patients	1,589	(15,26,79)	54.72 [-9.47, 118.91]
Does tatooining is a possible route of HCV transmission?	Ghana, Mozambique	Barbers, Pregnant women	1,386	(15,26)	21.60 [19.44, 23.76]
Does sexual contact is a possible route of HCV transmission?	Ghana, Mozambique, Ethiopia, Egypt	Barbers, Pregnant women, medicine and health science students, HCV patients	1,997	(15,26,32,79)	30.61 [2.04, 59.17]
Can mother transmit HCV to infants?	Mozambique, Ethiopia	Pregnant women, medicine and health science students	1,594	(26,32)	52.89 [-9.64, 115.41]
Does mosquito bite is a possible route of HCV transmission?	Mozambique	Pregnant women	1,186	(26)	10.3 [8.7320 , 11.86]
Hepatitis C can be transmitted through feco-oral route?	Ethiopia	medicine and health science students	408	(32)	70.3 [65.9881 , 74.61]
Does sharing toothbrush is a possible route of HCV transmission?	Mozambique, Egypt	Pregnant women, HCV patients	1,389	(32,79)	52.46 [-7.32, 112.24]

Do you know any of HCV disease symptoms?	Egypt	Residents	67	(74)	55 [43.2402 , 66.75]
infection can be asymptomatic?	Ethiopia	medicine and health science students	408	(32)	55 [50.2961 , 59.70]
Hepatitis C infection can be prevented by vaccination?	Ethiopia, Egypt	medicine and health science students, HCV patients	611	(32,79)	42.05 [8.73, 75.37]
Hepatitis C can be prevented by avoiding multi sexual partnership?	Ethiopia	medicine and health science students	408	(32)	87 [83.8641 , 90.13]

373

374 **Awareness related to demographic characteristics**

375 Adoba and colleagues conducted their study among barbers - individuals of a sharp shaving objects'
 376 based occupation, nevertheless, the radio was the major source of information on HCV infection (25.0
 377 %) [15].

378 Demssis and colleagues in 2018 conducted a study among medicine and health science students in
 379 Ethiopia and determined that student's residence and department were significantly associated with
 380 good level of knowledge toward transmission and prevention of hepatitis B and C infection [32].

381 **Human Papillomavirus (HPV)**

382 Nine included studies assessed the awareness of 5,157 Africans in regard to HPV, four studies were
 383 conducted in Nigeria [35,36,41] and one in each of Madagascar, Morocco, Mali, South Africa and
 384 Senegal [43,49,51,54,70,71]. The oldest among the study included was conducted in 2010 while the newest
 385 was conducted in 2016 (Table 1). Population under study was found to be mainly adolescents and
 386 students (6/9), while two studies was targeting general population and one was targeting HIV positive
 387 and negative females (Table 1). Majority of studies were conducted among both genders (6/9), while
 388 three studies were toward females only. Age of respondents range from 15 to older than 67 years.
 389 Fifteen questions were asked to the participants that are related to the knowledge and awareness of
 390 HPV as general, transmission routes, clinical symptoms, pathological consequences and prevention
 391 attitude, among which 13 questions were analyzed and synthesized. The question "Do you know
 392 HPV?" was answered by 5,076 participants in Nigeria, Senegal, Morocco and Madagascar; 25.18%
 393 [95% CI; 13.31, 37.06] answered yes. The question "Are you aware of a vaccine for the prevention of
 394 HPV?" was answered by 2,548 participants in Nigeria and Morocco; 26.15% [95% CI; 13.36, 38.93]
 395 answered yes. Furthermore; the question "Do you know that HPV is a sexually transmitted infection"
 396 was answered by 1,409 participants in Nigeria, South Africa and Mali; 38.16% [95% CI; 15.10, 61.22]
 397 answered yes. Questions asked, their corresponding articles' data, the pooled prevalence and the

398 confidence intervals are depicted in (Table 8). Heterogeneity was high in all questions (I^2 more than
399 80%).

400

401 **Table (8):** Awareness of HPV-related knowledge among Africans

Question	Country/ies	Study population/s	Total sample size	References	Pooled prevalence of yes response [95% CI]
Do you know HPV?	Nigeria; Senegal , Morocco , Madagascar	university staff and general population, mothers of female adolescents, students, Adolescents and young adults, parents	5,076	(35,36,41,49,51,54,71)	25.18 [13.31, 37.06]
Do you know that HPV can cause cervical cancer	Nigeria, Mali	University students ,university staff and general population ,mothers of female adolescents ,adults and adolescents	1,379	(35,36,41,70)	43.86 [19.39, 68.33]
HPV usually does not need treatment	South Africa	HIV positive and negative females	30	(43)	97 [90.9241 , 103.075]
Cervical cancer is caused by persistent HPV infection	Nigeria	students	368	(49)	19.6 [15.6801 , 23.51]
A person could have HPV without knowing it?	South Africa	HIV positive and negative females, university students	310	(41,43)	79.92 [61.34, 98.51]
Vaccine may expose adolescents to risky sexual behaviors	Nigeria	mothers of female adolescents, university students	570	(36,41)	34.65 [-20.82, 90.11]
having many sexual partners increases the risk of HPV?	South Africa, Nigeria	HIV positive and negative females, students	678	(41,43,49)	65.64 [40.15, 91.13]
Do you know that HPV is a sexually transmitted infection	South Africa, Nigeria	University students ,university staff and general population , mothers of female adolescents ,HIV positive and negative females, adults and adolescents	1,409	(35,36,41,43,70)	38.16 [15.10, 61.22]
Are you aware of a vaccine for the prevention of HPV?	Morocco, Nigeria	University students ,HIV positive and negative females, mothers of female adolescents, students, parents	2,548	(35,36,41,49,54)	26.15 [13.36, 38.93]
Does not know where or how to access the vaccines	Nigeria	mothers of female adolescents, university students	570	(36,41)	53.00 [48.98, 57.02]
The vaccine is too costly	Nigeria, South Africa	mothers of female adolescents ,HIV positive and negative females ,university students	600	(36,41,43)	38.57 [13.65, 63.49]
Are you willing to receive the HPV vaccine?	Senegal, Mali, Nigeria	students , Adolescents and young adults	2,985	(41,49,51,70)	58.54 [9.67, 107.41]

402

403 **Awareness related to demographic characteristics**

404 Funmilayo and colleagues in their study of medical students awareness and vaccination acceptance

405 determined that the obstacles - as concluded by authors to receiving HPV vaccination among the

406 female respondents included inadequate information (60.9%), high cost of vaccine (56.2%), poor
 407 access to vaccine (55.6%), worry about efficacy (38.5%), worry about safety (36.1%) and religious
 408 barriers (17.7%). A statistically significant association was found between level of awareness and
 409 vaccine acceptance and the level or class of students [41]. Supporting this finding; Makwe and
 410 colleagues indicated the same association between the two variables as well [49].

411 Massey and colleagues in Senegal reported that respondents who indicated living most of their lives in
 412 a rural area demonstrated a greater percentage of ever having heard of HPV, and that fathers'
 413 education level is significantly associated with the willingness of HPV vaccination. Mouallif and
 414 colleagues in Morocco concluded that mothers who agreed with the statement ‘Whatever happens to
 415 my health is God’s will’, believed that the vaccine was expensive and believed that they had
 416 insufficient information about the vaccine were significantly less likely to accept the vaccine [51,54].

417 Sexually Transmitted Infections (STIs)

418 Seven included studies assessed the awareness of 2,986 Africans in regard to STIs as general, three
 419 studies were conducted in Nigeria [17,18,44] and one in each of Madagascar, Morocco, Mali, Uganda
 420 [47,56,70,71]. The oldest among the study included was conducted after 2010 while the newest was
 421 conducted in 2014. Population under study was found to be mainly adolescents and students (5/7),
 422 while one study was targeting seafarers and another targeting women in reproductive age (Table 1).
 423 Majority of studies were conducted among both genders (5/7), one was toward males only while
 424 another was targeting females only (Table 1). Age of respondents range from 14 to older than 45
 425 years. Thirty five questions were asked to the participants that are related to the knowledge and
 426 awareness of STIs general knowledge, transmission routes, clinical symptoms, pathological
 427 consequences and prevention attitude, among which 14 questions were analyzed and synthesized. The
 428 question ‘‘Is Genital ulcer a symptom of having STIs?’’ was answered by 2,322 participants in
 429 Morocco and Uganda; 23.55% [95% CI; 3.83 , 43.27] answered yes. The question ‘‘Do you know
 430 gonorrhoea?’’ was answered by 1,123 participants in Nigeria and Madagascar; 22.84% [95% CI; 5.13 ,
 431 40.56] answered yes. questions asked, their corresponding articles’ data, the pooled prevalence and the
 432 confidence intervals are depicted in (Table 9). Heterogeneity was high in all questions (I^2 more than
 433 80%).

434
 435 **Table (9):** Awareness of STIs-related knowledge among Africans

Question	Country/ies	Study population/s	Total sample size	References	Pooled prevalence of yes response [95% CI]
Have you heard about STDs?	Nigeria	Adolescents, Students	881	(17,18)	94.52 [89.62, 99.42]

Do you know gonorrhoea?	Nigeria, Madagascar	Adolescents, Students, university students	1,123	(17,18,71)	22.84 [5.13 , 40.56]
Do you know syphilis?	Nigeria, Madagascar	Students, university students	782	(18,71)	5.67 [4.33, 7.01]
Do you know Herpes simplex?	Nigeria, Madagascar	Students, university students	782	(18,71)	4.70 [1.17 , 8.23]
Do you know chlamydia?	Madagascar	university students	242	(71)	1.70 [0.1320 , 3.268]
Can Gonorrhoea cause infertility?	Nigeria	students	30	(44)	60 [42.5563 , 77.4437]
Is unprotected sex a mode of transmission of STIs?	Nigeria	students	540	(18)	87 [84.2561 , 89.7439]
Is Needles and syringes a mode of transmission?	Nigeria	students	540	(18)	82.6 [79.4641, 85.7359]
Is Blood and blood products a mode of transmission?	Nigeria	students	540	(18)	73.10 [69.3761, 76.823]
Is Mother to child a mode of transmission of STIs?	Nigeria	students	540	(18)	70.9 [67.1761, 74.623]
Is Coughing/sneezing a mode of transmission of STIs?	Nigeria	students	540	(18)	22 [18.6681, 25.3319]
Is Sharing plates a mode of transmission of STIs?	Nigeria	students	540	(18)	12.2 [9.4561, 14.243]
Can Gonorrhoea transmits to neonates?	Nigeria	students	30	(44)	21.8 [6.5123 , 37.08]
Is weight loss a symptom of having STIs?	Nigeria, Uganda	Students, women of reproductive age	875	(18,56)	41.44 [-28.24 , 111.11]
Is Painful micturition a symptom of having STIs?	Nigeria	students	540	(18)	68.9 [65.1761, 72.62]
Is Genital ulcer a symptom of having STIs?	Nigeria, Uganda, Morocco	Students, women of reproductive age, seafarers	2,322	(18,47,56)	23.55 [3.83 , 43.27]
Is Genital swelling a symptom of having STIs?	Nigeria	students	540	(18)	38.4 [44.1841, 52.4159]
Is Genital discharge a symptom of having STIs?	Nigeria, Uganda, Morocco	Students, women of reproductive age, seafarers	2,322	(18,47,56)	34.98 [-0.99, 70.95]
Is Micturition burns a symptom of STIs in females?	Morocco	seafarers	1,447	(47)	6.2 [5.0240, 7.37]
Is Micturition burns a symptom of STIs in males?	Morocco	seafarers	1,447	(47)	30.2 [27.7480, 32.45]
Is Tumefaction of the groin a symptom of STIs in females?	Morocco	seafarers	1,447	(47)	1.2 [0.8080, 1.56]
Is Tumefaction of the groin a symptom of STIs in males?	Morocco	seafarers	1,447	(47)	35 [32.6480, 37.35]
Is Genital itching a symptom of STIs in females?	Morocco, Uganda	seafarers, women of reproductive age	1,782	(47,56)	34.09 [-16.28 , 84.75]
Is Genital rash a symptom of STIs?	Uganda	women of reproductive age	335	(56)	14.5 [10.7761, 18.223]
Is painful sex a symptom of STIs?	Uganda	women of reproductive age	335	(56)	0.3 [-1.4640, 2.06]
Can Gonorrhoea be Asymptomatic ?	Nigeria	students	30	(44)	20.04 [5.5763, 34.58]
Is abstinence a possible way to prevent STDs?	Nigeria, Uganda	Adolescents, women of reproductive age	676	(17,56)	23.20 [-19.23 , 85.63]
Is condom use a possible way to prevent STDs?	Nigeria, Uganda	Adolescents, women of reproductive age	676	(17,56)	36.96 [13.44, 60.48]
Being faithful by having one sexual partner is a way to prevent STIs?	Uganda	women of reproductive age	335	(56)	26.3 [21.5961 , 31.00]
Do you use condoms?	Nigeria	students	30	(44)	72.5 [56.6243, 88.37]
Do you reuse condoms?	Nigeria	students	30	(44)	10.1 [-0.6798 , 20.87]

436

437 **Awareness related to demographic characteristics**

438 Akokuwebe and colleagues reported that Media (as general) was the main source of information 57%
439 followed by friends 30%, and association between source of information about STDs is significantly
440 related to age. Moreover, Laraqui and colleagues concluded that during the year prior to the study,
441 73.2% of participants (seafarers) were informed about the prevention of STI/HIV/AIDS through
442 different ways, mainly the media (73% via TV and 45.6% via radio). Amu and colleagues provided
443 more specific information in regard to source of knowledge as they determined that there are three
444 major sources of information; the radio and television 343 (68.7%); teachers 340 (68.1%); and
445 newspapers 224 (44.9%). Nevertheless, Nawagi and colleagues in their study in Uganda determined
446 that only (23.9%) of the participants have information about STIs from the media [17,47,56].

447 Joda and his colleagues in Nigeria conducted a study to assess the level of knowledge of STIs among
448 students from different schools and concluded that there is no statistically significant differences in the
449 responses obtained from various schools. Moreover, Reuter and colleagues conducted a study to
450 assess the difference of STIs related knowledge between university students of Madagascar and USA,
451 and concluded that there is no statistically significant differences as well [44,71].

452 In spite of the study populations' differences, five studies reported a significant association
453 between knowledge of STIs and the level of education [30,38,68,81,82]. Considering age as a factor
454 affecting the level of awareness; several studies reported it to be significantly true [38,50,65,81],
455 while other studies reported it is not [26,59]. Moreover, living in an urban area was found to be
456 significantly associated with awareness level in several studies [38,68,83].

457

458 **Discussion**

459 The current study was the first of its kind - to our knowledge, as not general assessment of knowledge
460 is studied, but the specific awareness determinants, the presented outcomes are believed to be the best
461 inputs for organizing effective preventive measures as well as planning and conducting awareness
462 raising campaigns.

463 The current study highlights the specific levels of STIs-related knowledge, practices and prevention
464 attitudes among different African populations. The pooled prevalence estimates showed that even

465 though more than 90% of the population had heard about STIs (94.52%) in general and HIV (92.24%)
466 in particular, (79.79%) had never heard about HCV. These results are consistent with earlier studies in
467 Eastern Europe, Victoria, Lao People's Democratic Republic and Iran [85–88]. Moreover, 25.18% of the
468 population knows HPV. However, a study conducted among adolescents and adult women in one of
469 the developed countries (USA) reported that only 18% had heard about the virus [89]. Nevertheless, the
470 confounders among participants are to be considered when comparing the studies.

471 In the contrary of the expectation of HIV associated signs and symptoms awareness in such epidemic
472 countries, this review revealed that almost only 14.4%, 17% and 17.7% of South Africans know that
473 oral candidiasis, herpes zoster and constant diarrhea could be associated with HIV infection,
474 respectively. Furthermore, less than 20% of the same population consider TB to be associated with
475 AIDS [90].

476 The current findings of knowledge related to vertical HIV transmission during pregnancy 57%,
477 delivery 66% or breastfeeding 73% corroborate with the studies of Stockholm et al (Stockholm 14)
478 and Maimaiti et al (Maimaiti 15) although they slightly concluded higher proportions [91,92].
479 Furthermore, these findings are in line with the results reported in UAE and Greece. Nevertheless, in
480 India Pratibha Gupta and colleagues reported prevalence as low as 8.85% and 23.85% regarding the
481 transmission during delivery and breastfeeding, respectively [93–95].

482 The findings clearly demonstrate that HIV preventative measures of South Africans are higher than
483 that of Nigerians. For instance; using condom (64.46% versus 52.67%) and having one sexual partner
484 (83.15% versus 57.67%) are known to reduce HIV transmission by South African and Nigerian
485 populations, respectively. Bangladeshi women were reported to have knowledge similar to South
486 Africans. However, other studies conducted in Vietnam, Italy and USA reported higher proportions
487 [96–99].

488 It has been reported that increased HIV knowledge resulted in a reduction of risky sexual behaviors
489 among adolescents [100]. Notably, current findings revealed that adolescents in Africa were - for some
490 extent aware of the facts associated with epidemics, transmission and prevention of HIV infection.
491 Approximately 60.75% think that a healthy person can be HIV infected, similar finding was reported
492 among Russians as well. Nevertheless, higher proportions were found to be reported in Iran and USA
493 [101–103]. More than 50% were found to be of good knowledge level about HIV transmission through
494 Sexual intercourse (67.81%, Sharing sharp unsterilized objects (54.27%) and using intravenous
495 needles (53.32%). This knowledge is higher when compared to Southern Brazilian adolescent's.

496 However, adolescents from India, US, Lao People's Democratic Republic and Iraq were reported to
497 possess higher knowledge scores [86,97,104–106].

498 Despite the finding that most of adolescents in Africa are aware of the correct ways of HIV
499 transmission, they still express extensive misconceptions; nearly the half believe that HIV could be
500 contracted through mosquitoes (43.54%), through toilet seats(43.79%), sharing cups/plates (33.51%)
501 and through hugging or kissing (25.83%). Studies carried out among nursing students in Greece and
502 among men who have sex with men in Finland illustrate similar findings as well. However, higher
503 proportions (76%) for kissing and (100%) for sharing dishes, hot springs, kissing and mosquito bites
504 were reported in Taiwan and Japan, respectively [95,107–109].

505 HIV-related stigma and discrimination persist as major obstacles to an effective HIV response in all
506 parts of the world. Almost 37.4% of South Africans consider stigma is a barrier to HIV testing.
507 Generally speaking, Africans' attitudes towards HIV/AIDS patients were in need for enforcement. For
508 example, 62.95% would care for a relative with HIV in household, 57.11% would buy vegetables
509 from an HIV infected vendor, and only 44.80% would allow a person with HIV to teach. Similar
510 results were found to be reported in Sri Lanka. However, Janahi and colleagues in their findings
511 reported that more than half of the adult participants (n=1,630) in Bahrain would avoid sitting near,
512 hugging or even shaking HIV infected people hands [110–112].

513 The findings presented in this study regarding HBV illustrate that the knowledge of Africans is
514 moderate, i.e. 61.43% know about the consequence of liver damage. Moreover, reusing needles
515 52.72%, sexual contact 42.58% and toothbrush sharing 49% were considered to be possible routs of
516 HBV transmission. Furthermore, 72.36% correctly believe in the existence of vaccination. A prior
517 study conducted among Asian Americans in USA reported similar or slightly higher knowledge [113].

518 Regarding HCV, about 68.82% of Africans have correct knowledge about its transmission through
519 reusing needles. However, nearly the half (42.05%) incorrectly believe in the existence of vaccination.
520 Taiwanese dental students also believe that there is an effective vaccine for HCV but in a proportion
521 as low as 15% [107].

522 The pooled prevalence of the African knowledge regarding the association between HPV and cervical
523 cancer was found to be mostly 43.86%, this is consistent with a study conducted in USA. Moreover,
524 nearly 26.15% of South Africans were aware of a vaccine for HPV prevention, lower prevalence
525 (10.8%, N=1,177) was reported in Berlin, Germany recently (2018). However, the fact that the later

526 study was conducted among students and young adults is needed to considered when comparing the
527 results. [114,115].

528 Implementation of educational awareness programs in schools will have its impacts in the near future.
529 Moreover, knowledge raising campaigns at the continent level or nationally, in urban and rural regions
530 targeting infected or non infected individuals using traditional sittings or integrating new online tools
531 is needed to be applied, for raising awareness, increasing willingness for testing, decreasing STIs
532 transmission and decreasing stigma and discriminations.

533 **Strengths and Limitations**

534 The strengths of this review are that we systematically identified and included awareness estimates
535 from 2010, Moreover, we have conducted meta-analysis to derive pooled prevalence estimates of all
536 questions related. Furthermore, we carried out a quality assessment of the included studies based on
537 criteria specifically developed to determine the quality of included studies.

538 Nevertheless, several limitations are to be considered when interpreting study results; grey literature
539 evidence was not assessed. Moreover, African journals that are not indexed in the screened databases
540 was not considered for inclusion as well, although all included studies are of good quality, several
541 good studies might have be missed. Furthermore, another parameter that should be considered is that
542 the limited number of participants in some questions can be observed for which the outcome might
543 not be suitable to be generalized to the continent/country/population level. Lastly, the heterogeneity
544 was high among the majority of questions analyzed.

545 **Conclusion**

546 The current study indicates that awareness is needed to be enforced. The differences observed among
547 populations are highlighting the possibility for containment and control by directing light toward
548 specific populations or countries as well as addressing specific awareness knowledge to ensure that
549 the general as well as the related specific preventive awareness knowledge is improved.

550 **Authors' contribution**

551 Designed the experiments: BMM and AMS. Performed the experiments: All authors. Analyzed the
552 data: BMM. Wrote the paper: BMM, AMS and OWM. All authors read and approved the final
553 article.

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556 **Conflict of interests**

557 Authors declare they have no competing interests; financial or others.

558

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926

927 **Table (S1): PRISMA checklist.**

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	1
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	2
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	2
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	3
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	3
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	3
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	3
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	4
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	4
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	4
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	4

Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	4
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I ²) for each meta-analysis.	5
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	4
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	5
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	5
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	6
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	9
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	11
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	11
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	8
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	11
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	28
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	30
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	30
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	30

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929 **Table (S2):** Assessment of quality of included studies.

Study	Was the study obj clear?	Study sample clearly defined	Study pop specified and defined?	Participation rate above 70%?	Sitting and methods rigorous?	Analysis rigorous?	Total score
Abdulai <i>et al</i> (12)	1	1	1	0	1	1	5
Abimanyi-Ochom <i>et al</i> (13)	1	1	0	0	1	1	4
Aderemi <i>et al</i> (14)	1	1	1	0	1	1	5
Adoba <i>et al</i> (15)	1	1	1	0	0	1	4
Ajide and Balogun (16)	1	1	1	0	0	1	4
Akokuwebe <i>et al</i> (17)	1	1	1	0	0	1	4
Amu and Adegun (18)	1	1	1	1	0	1	5

Appiah-Agyekum <i>et al</i> (19)	1	0	1	0	1	1	4
Aroke <i>et al</i> (20)	1	1	1	0	0	1	4
Asefa and Beyene (21)	1	1	0	1	1	1	5
Audet <i>et al</i> (22)	1	1	1	0	0	1	4
Azodo <i>et al</i> (23)	1	1	1	1	0	1	5
Becker <i>et al</i> (24)	1	1	0	0	1	0	3
Carlos <i>et al</i> (25)	1	1	1	0	0	1	4
Chan and Tsai (8)	1	1	0	1	0	1	4
Chaquisse <i>et al</i> (26)	1	1	0	1	1	1	5
Chard <i>et al</i> (27)	1	1	1	1	0	1	5
Cheng <i>et al</i> (28)	1	1	1	0	0	1	4
Chimoyi <i>et al</i> (29)	1	0	1	0	0	1	3
Ciampa <i>et al</i> (30)	1	1	0	1	1	1	5
Darteh <i>et al</i> (31)	1	1	0	1	0	1	4
Demsiss <i>et al</i> (32)	-	-	-	-	-	-	-
Elbadawi <i>et al</i> (33)	1	1	1	1	0	1	5
Engelbrecht <i>et al</i> (34)	1	1	1	0	0	1	4
Eni <i>et al</i> (35)	1	1	0	0	1	1	4
Ezenwa <i>et al</i> (36)	1	1	1	1	0	1	5
Faleye <i>et al</i> (37)	1	1	1	1	0	1	5
Faust <i>et al</i> (38)	1	1	0	0	0	1	3
Faye <i>et al</i> (39)	1	1	1	1	1	1	6
Frambo <i>et al</i> (40)	1	1	0	1	0	1	4
Funmilayo <i>et al</i> (41)	1	1	0	0	0	1	3
George <i>et al</i> (42)	1	1	0	1	0	0	3
Griffith <i>et al</i> (43)	1	1	0	1	0	0	3
Joda <i>et al</i> (44)	1	1	0	1	0	0	3
Kiderlen <i>et al</i> (45)	1	1	1	0	0	1	4
Kufa <i>et al</i> (46)	1	1	0	1	0	1	4
Laraqui <i>et al</i> (47)	1	1	1	1	0	1	5
Lawan <i>et al</i> (48)	1	1	0	0	1	1	4
Makwe <i>et al</i> (49)	1	1	1	1	0	1	5
Mason <i>et al</i> (50)	1	1	1	0	0	1	4
Massey <i>et al</i> (51)	1	1	1	1	0	1	5
Mesfin <i>et al</i> (52)	1	1	1	0	0	1	4
Mkumbo <i>et al</i> (53)	1	1	1	1	0	1	5
Mouallif <i>et al</i> (54)	1	1	1	0	0	1	4
Nabukenya <i>et al</i> (55)	1	1	0	1	0	1	4
Nawagi <i>etal</i> (56)	1	1	1	0	0	1	4
Ngaira <i>et al</i> (57)	1	1	1	0	1	0	4
Noubiap <i>et al</i> (58)	1	1	1	0	1	0	4
Nubed <i>et al</i> (59)	1	1	0	1	0	1	4
Ojieabu <i>et al</i> (60)	1	1	1	1	0	1	5

Okonkwo <i>et al</i> (61)	1	1	0	1	0	0	3
Okonkwo <i>et al</i> (62)	1	1	1	1	1	1	6
Oladepo <i>and</i> Fayemi (63)	1	1	1	0	1	0	4
Omotowo <i>et al</i> (64)	1	1	1	1	1	1	6
Oppong and Oti-Boadi (65)	1	1	1	0	0	0	3
Owusu (66)	1	0	1	0	0	1	3
Oyekale (67)	1	1	0	0	1	1	4
Paintsil <i>et al</i> (68)	1	1	1	0	0	1	4
Pathmanathan <i>et al</i> (69)	1	1	0	0	0	1	3
Poole <i>et al</i> (70)	1	1	1	0	1	1	5
Reuter <i>et al</i> (71)	1	0	1	0	1	1	4
Rukundo <i>et al</i> (72)	1	1	0	0	1	1	4
Sahile <i>et al</i> (73)	1	1	1	1	0	1	5
Saleh <i>et al</i> (74)	1	1	0	0	1	1	4
Sandqvist <i>et al</i> (75)	1	1	1	0	1	0	4
Schwitters <i>et al</i> (76)	1	1	1	0	1	1	5
Seyoum and Legesse (77)	1	1	1	0	1	1	5
Shiferaw <i>et al</i> (78)	1	1	1	0	0	1	4
Sultan <i>et al</i> (79)	1	1	1	0	0	1	4
Tarekegne <i>et al</i> (80)	1	1	1	1	1	1	6
Umar and Oche (81)	1	1	1	1	0	1	5
Wagenaar <i>et al</i> (82)	1	0	1	0	0	1	3
Yaya <i>et al</i> (83)	1	1	0	1	1	1	5
Zungu <i>et al</i> (84)	1	1	1	0	1	1	5

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933 **Table (S3):** Characteristics of HIV-related included studies conducted among Nigerians.

Study	Year of publication	Year/s of conduction	City/Region	study population/s	sample size	Gender	Participants' Age
Aderemi <i>et al</i> (14)	2013	After 2010	Oyo State	Students	600	Both	12-19
Ajide and Balogun (16)	2018	After 2010	Ibadan/Oyo State	Students	240	Both	16±1
Akokuwebe <i>et al</i> (17)	2016	After 2010	Ikeji-Arakeji/Osun State	Adolescents	341	Both	16+-2
Amu and Adegun (18)	2015	After 2010	Ekiti State	Students	540	Both	Oct-14
Azodo <i>et al</i> (23)	2014	2010	Enugu State	Dental tech students	198	Both	20- ≥27
Faust <i>et al</i> (38)	2017	2013	Nigeria	general population	56 307	Both	15-49
Lawan <i>et al</i> (48)	2012	2011	KanoState	FSW	124	Females	26±2
Ojieabu <i>et al</i> (60)	2011	2011	Sagamu/Ogun State	Pregnant Women	403	Females	20- ≥40
Oladepo and Fayemi (63)	2011	2010	Ibadan/Oyo State	Secondary students	420	Both	10-19
Umar and Oche (81)	2012	2010	Sokoto State	religious leaders	158	Male	≥30

Yaya <i>et al</i> (83)	2018	2013	Nigeria	community dwelling women	38 948	Females	15-49
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936 **Table (S4):** Characteristics of HIV-related included studies conducted among South Africans.

Study	Year of publication	Year/s of conduction	City/Region	study population/s	sample size	Gender	Participants' Age
Becker <i>et al</i> (24)	2015	2009-2010	Durban/KwaZulu-Natal	General population	2,477	Both	N.A
Chard <i>et al</i> (27)	2017	After 2010	South Africa	men who indicated an interest in men	386	Male	mean 33
Chimoyi <i>et al</i> (29)	2015	2013	Johannesburg/Gauteng	General population	1,146	Both	N.A
Engelbrecht <i>et al</i> (34)	2017	2012	Moretele Sub-district/Bojanala District/North West province	home-based carers	144	Both	median 35
Faleyee <i>et al</i> (37)	2014	2012-2013	Durban/KwaZulu-Natal/South africa	Male medical circumcision clients	394	Male	mean 28±9
George <i>et al</i> (42)	2013	2010	Northern Cape province	rural based traditional healers	186	Both	N.A
Kufa <i>et al</i> (46)	2018	After 2010	Eastern Cape,Western Cape,Free State,Gauteng State	STI service attendees	1,054	Both	23-32
Wagenaar <i>et al</i> (82)	2012	2010	South Africa	Men Who Have Sex with Men	1,593	Male	≥18
Zungu <i>et al</i> (84)	2016	2012	South Africa	medically and traditionally circumcised males	11,086	Male	≥15

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939 **Table (S5):** Characteristics of HIV-related included studies conducted among adolescent
940 Africans.

	Year of publication	Year/s of conduction	City/Region/Country	Study population/s	Sample size	Gender	Participants' Age
Aderemi <i>et al</i> (14)	2013	After 2010	Oyo State/Nigeria	Students	600	Both	12-19
Ajide and Balogun (16)	2018	After 2010	Ibadan/Nigeria	Students	240	Both	16±1
Akokuwebe <i>et al</i> (17)	2016	After 2010	Ikeji-Arakeji/Osun/Nigeria	Adolescents	341	Both	16+2
Amu and Adegun (18)	2015	After 2010	Ado Ekiti/Nigeria	Students	540	Both	10-14
Appiah-Agyekum <i>et al</i> (19)	2013	After 2010	Accra/Ghana	Students	260	Female	16- ≥19
Chaquisse <i>et al</i> (26)	2018	2013-2014	Nampula/Mozambique	Pregnant women	1,186	Female	median 22
Chiampapa <i>et al</i> (30)	2012	2011	Zambezia/Mozambique	prenatal care in women	348	Female	median 24
Darteh <i>et al</i> (31)	2016	2011	Kwesimintsim Zongo/Ghana	adolescents, general population	902	Both	mean 14
Nubed <i>et al</i> (59)	2016	2014	Fako/South West Region/Cameroon	senior secondary school students	464	Both	13-25
Oladejo and Fayemi (63)	2011	2010	Ibadan South-West Local Government Area/Oyo/Nigeria	secondary students	420	Both	10-19

						h	
Dwusu <i>et al</i> (66)	2015	After 2010	Cape Coast Metropolis/Ghana	primary school children	120	B o t h	9-13
Reuter <i>et al</i> (71)	2018	2013	Antsiranana/Madagascar	university students	242	B o t h	23±3
Rukundo <i>et al</i> (72)	2016	2014	Kampala and Buikwe districts/Uganda	school students	245	B o t h	10-19

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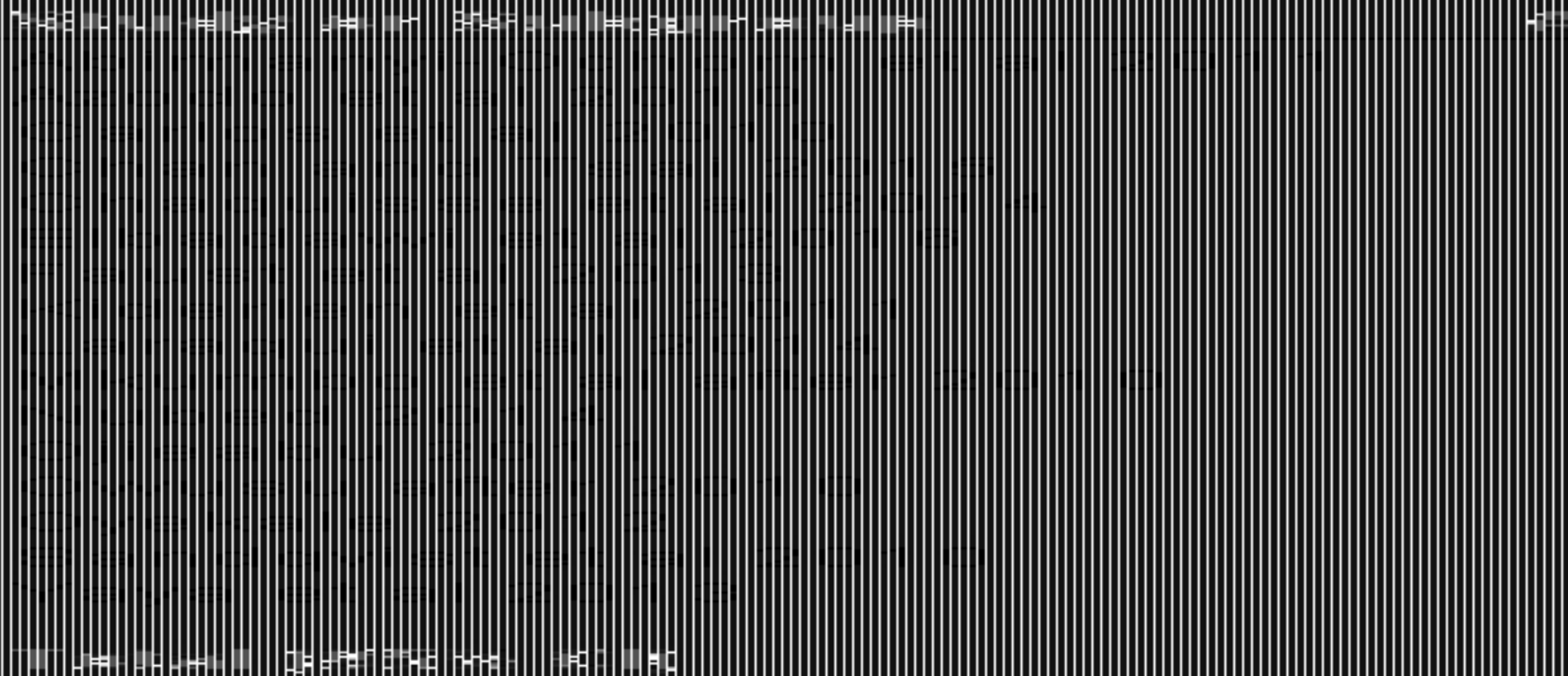


Fig (2)

Included

Eligibility

Screening

Identification

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Fig (1)