HIV/AIDS

The validity of self-reported likelihood of HIV infection among the general population in rural Malawi

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Background: Understanding HIV risk perception is important for designing appropriate strategies for HIV/AIDS prevention, because these interventions often rely on behaviour modification. A key component of HIV risk perception is the individual's own assessment of HIV status, and the extent to which this assessment is correct. However, this issue has received limited attention.
Objectives: To examine the validity of self-reported likelihood of current HIV infection among the general population in rural Malawi.
Methods: As part of a panel household survey, data on behaviour and biomarkers were collected for a population-based sample of approximately 3000 respondents in rural Malawi aged ⩾15 years. Information on self-assessed likelihood of currently having HIV was collected by survey interview. Saliva was obtained from all consenting respondents to assess actual HIV status.
Results: Of 2299 survey respondents who assessed their likelihood of being infected with HIV at the time of the survey, 71% were accurate. Most incorrect assessments (88%) were due to respondents overestimating (rather than underestimating) their likelihood of being infected with HIV. Women were less likely than men to correctly assess their HIV status. The two most important predictors of false-positive responses were marital status and self-reported health.
Conclusions: Self-reports of HIV infection were generally valid. Most invalid self-reports were due to overestimating the risk of having HIV. The implications of this finding are highlighted, as they pertain to the design of HIV prevention interventions and the expansion of HIV counselling, testing and treatment programmes in developing countries.

Understanding risk perception is important for designing appropriate strategies for HIV/AIDS prevention, as they generally rely on behaviour modification.[1] A key component of HIV risk perception is the individual's own assessment of being infected, and the extent to which this assessment is correct. Self-assessed HIV status is particularly relevant when access to HIV testing is limited (as in most developing countries[2i]) and the individual's behaviour is guided more by perceived risk of infection than actual, but unknown, HIV status. In these settings it is thus especially important to examine the extent to which the perceived risk of HIV infection deviates from actual HIV status. However, this issue has been infrequently studied.

Evidence from studies in developed countries among populations at high risk (such as drug users, prostitutes and prisoners) suggests that concurrence between individuals' self-reports of current HIV status and their HIV test results is high for seronegative people (95–99%) but low for seropositive people (40–70%).[3–6] Evidence for developing countries is quite limited. A study of attenders at a voluntary HIV testing centre in Zambia found a 30% rate of incorrect self-reports, with seropositive patients being only slightly more accurate than seronegative patients (72% *v* 60%).[7] In contrast, a case–control study in Tanzania found no significant association between perceived risk of infection and HIV status.[8]

In this paper, we examine the validity of self-reported likelihood of current HIV infection among the general population in rural Malawi by comparing survey responses with the results of oral fluid assays for HIV antibodies. We also investigate the relationship between the validity of self-reports and variables such as the respondents' background characteristics and their perceptions of prevalence. of HIV in their own community.

METHODS

Study population

To examine the validity of self-reported likelihood of HIV infection in rural Malawi, we used data on behaviour and biomarkers collected by the Malawi Diffusion and Ideational Change Project (MDICP) for a population-based sample of approximately 3000 respondents aged ⩾15 years. Since 1998, the MDICP has collected longitudinal data for this sample to examine the role of social networks in changing attitudes and behaviour regarding HIV/AIDS, family size and family planning in rural Malawi. The MDICP is conducted in rural areas of three Malawian districts, one in each of the three regions of the country (north, centre and south). A comparison of the characteristics of the MDICP sample with those of the rural population surveyed in the Malawi Demographic and Health Survey indicated that the MDICP sample is representative of the national rural population (more details on sampling and fieldwork procedures, as well as the survey data, are available from the project's website http://malawi.pop.upenn.edu).

The third wave of the MDICP, carried out in mid-2004, included a testing component for HIV, which consisted of an interviewer-administered questionnaire and collection of a specimen of oral transudate fluid (hereafter saliva) for testing for HIV antibodies. Participation was voluntary. To ensure confidentiality, individual questionnaires and test results were linked only after the completion of fieldwork in all sites.[9]

Abbreviations: MDICP, Malawi Diffusion and Ideational Change Project; STI, sexually transmitted infection

[i] The United Nations Group on HIV/AIDS (UNAIDS) and the World Health Organization countries (WHO) estimate that in low and middle income countries only 10% of people who need voluntary counselling and testing have access to HIV testing services.[2]

A group of trained nurses was responsible for collection of data on biomarkers. According to the HIV testing protocol, the nurses had to first administer a short questionnaire (henceforth referred to as the STI questionnaire) to respondents on health, sexually transmitted infections (STIs), and HIV knowledge and risk perception. The self-reported likelihood of HIV infection was determined from responses to the question ''In your opinion, what is the likelihood (chance) that you are infected with HIV now?''. The possible answers were ''No likelihood'', ''Low likelihood'', ''Medium likelihood'', ''High likelihood'' and ''Don't know''. After completing the STI questionnaire, the nurses provided an extensive explanation of the HIV testing process (as most respondents had never been tested for HIV[ii]), and requested the respondent's consent to be tested. The nurses counselled the respondents who agreed to be tested, and then collected saliva using OraSure oral swabs[iii] (OraSure Technologies, Bethlehem, Pennsylvania, USA). Refusal rates were relatively low (approximately 10%) and within the range of other population-based HIV surveys.[10] At the end of fieldwork, a different group of trained nurses gave HIV test results to the respondents who wished to know their serostatus and provided post-test counselling.

Oral fluid specimens were tested at the laboratory of the University of North Carolina Project in the capital, Lilongwe. HIV antibody status was assessed using ELISA kits for initial screening, with positive results confirmed by a western blot test. The assay sensitivity and specificity exceeded 99% (manufacturer's data).[iv] The survey and biomarker collection protocols were approved by both the institutional review board of the University of Pennsylvania, USA and the research and ethics committee of the College of Medicine, Malawi.

Data analysis

We evaluated the validity of self-reported likelihood of current HIV infection by comparing the respondents' answers in the STI questionnaire with their HIV antibody test results.

We dealt with three issues. Firstly, we evaluated how the prevalence of HIV differs according to perceived likelihood of infection. Secondly, we described the accuracy of the self-reported likelihood of current HIV infection as a diagnostic test. We used the self-reported likelihood of HIV infection as if it was a diagnostic test for HIV status, and compared it with the HIV antibody test result as a gold standard by computing standard epidemiological measures (sensitivity, specificity, and positive and negative predictive values). Thirdly, using multivariate logistic regression analysis, we assessed whether respondents' background characteristics, self-reported health and perceived prevalence of HIV in the community affect the validity of self-reports. Among those who thought they were infected with HIV, we examined the characteristics of those who were more likely to be actually not infected (false positives) than infected (true positives). Among those who thought they were not infected with HIV, we examined the characteristics of those who were more likely to be actually infected (false negatives) than not infected (true negatives). We fit two models to the data, separately for men and women: one model included only the respondent's background characteristics (age, region, marital status and self-reported health) and the other model included respondent's background characteristics as well as his or her perception of prevalence of HIV in the community[v]. As the results were similar in the two cases, we present and discuss only the results of the second model. We calculated ORs and 95% CIs using STATA V.9.

RESULTS

Between April and December 2004, the MDICP nurses interviewed and tested 2823 respondents for HIV. Of these, we included in our analysis 2795 respondents (99%) with definitive serostatus and who provided a non-missing answer to the survey question on self-reported likelihood of HIV infection. Overall, 18% of these respondents reported that they did not know their likelihood of being infected with HIV at the time of the survey, 59% reported that there was no chance they were infected and 23% reported that there was some—low, medium or high—chance (of these, 5% reported that there was a high chance). Women were more likely than men to report some likelihood that they had HIV. The prevalence of HIV in the study population was 6.8%, 5.6% among men and 7.9% among women (table 1).

Table 2 compares the respondents' assessment of their likelihood of HIV infection with the result of their HIV antibody test. Ninety five per cent of respondents who reported no likelihood of HIV infection (96% of men and 94% of women) tested negative for HIV antibody. In contrast, only 8% of respondents who reported some likelihood of HIV infection (7% of males and 9% of females) tested positive for HIV antibody. Respondents who answered ''don't know'' for their self-reported HIV status when interviewed were more likely to test positive for HIV than respondents who had reported some likelihood of having the infection at the time of the survey (11% *v* 8%, respectively). For both sexes combined, the difference in self-reported likelihood of infection between HIV-positive and HIV-negative respondents was significant ($p = 0$), and robust to different dichotomisations of the categorical responses to the self-reported likelihood question (not shown). The remainder of the analysis is based on 2299 respondents who gave a definitive assessment of their likelihood of HIV infection (ie, who did not answer ''don't know'' to the question on self-reported likelihood of infection).

Most MDICP respondents (71%) accurately estimated their likelihood of having HIV at the time of the survey (table 3). Overestimating the chance of being infected with HIV was responsible for most (88%) incorrect assessments. This is because self-reports were more valid for respondents who tested negative for HIV antibodies than respondents who tested positive. Of all respondents whose HIV test was negative, 72% had reported having no likelihood of being currently infected with HIV (specificity). By contrast, of the respondents whose HIV test was positive, 39% had reported having some likelihood of being currently infected with HIV (sensitivity). Men were more accurate than women (77% *v* 65%), mostly because women overestimated their risk more than men. As a

[ii]According to the nationally representative 2000 Malawi Demographic and Health Survey, 93% of the rural population has never been tested for HIV.[11]

[iii]The accuracy of using saliva for detecting HIV antibodies was shown to be comparable to serum-based tests.[12–17] An important motivation for using saliva in population-based surveys is the assumption that a non-invasive method might contribute to reducing selection bias due to non-consent. Studies that used saliva for detecting HIV antibodies have generally achieved higher consent rates, but data are still lacking to make a sound evaluation of the ways in which saliva and serum compete with regard to acceptability.[18]

[iv]Although OraSure has a sensitivity and specificity >99% as reported by the manufacturer, the actual figures for Malawi are unknown. As the test does not detect the very early phase of HIV infection, the actual sensitivity in our setting is probably <99%. Our results should be interpreted taking this issue into account.

[v]We measured perceived HIV prevalence in the community by using the respondent's answer to the question ''If we took a group of 10 people from this area—just normal people who you found working in the fields or in homes—how many of them do you think would now have HIV?'' Answers to this question were on a continuous scale from 1 to 10, but in the multivariate regression analysis we dichotomised them into 0–50% and 50–100% to maximise the sample size for the analysis.

Table 1 Background characteristics and self-reported likelihood of HIV infection for the study population, by sex, 2004 Malawi Diffusion and Ideational Change Project

	Men	Women	Both sexes
	n (%)	n (%)	n (%)
HIV status from antibody testing			
HIV−	1214 (94.4)	1390 (92.1)	2604 (93.2)
HIV+	72 (5.6)	119 (7.9)	191 (6.8)
Region			
South	469 (36.5)	568 (37.6)	1037 (37.1)
Centre	391 (30.4)	424 (28.1)	815 (29.2)
North	426 (33.1)	517 (34.3)	943 (33.7)
Age (years)			
15–19	246 (19.1)	279 (18.5)	525 (18.8)
20–24	227 (17.7)	223 (14.8)	450 (16.1)
25–29	100 (7.8)	200 (13.3)	300 (10.7)
30–34	132 (10.3)	188 (12.5)	320 (11.4)
35–39	116 (9.0)	181 (12.0)	297 (10.6)
40–44	116 (9.0)	147 (9.7)	263 (9.4)
45–49	81 (6.3)	101 (6.7)	182 (6.5)
50–54	116 (9.0)	81 (5.4)	197 (7.0)
⩾55	109 (8.5)	46 (3.0)	155 (5.5)
Missing	43 (3.3)	63 (4.2)	106 (3.8)
Marital status			
Currently married	891 (69.3)	1120 (74.2)	2011 (71.9)
Not married	374 (29.1)	373 (24.7)	747 (26.7)
Missing	21 (1.6)	16 (1.1)	37 (1.3)
Self-reported health			
Excellent	521 (40.5)	483 (32.0)	1004 (35.9)
Very good	242 (18.8)	301 (19.9)	543 (19.4)
Good	357 (27.8)	478 (31.7)	835 (29.9)
Fair	142 (11.0)	211 (14.0)	353 (12.6)
Poor	13 (1.0)	14 (0.9)	27 (1.0)
Missing	11 (0.9)	22 (1.5)	33 (1.2)
Number of people (out of 10) in the community the respondent thinks have HIV			
0	74 (5.8)	86 (5.7)	160 (5.7)
1–5	763 (59.3)	765 (50.7)	1528 (54.7)
6–10	246 (19.1)	336 (22.3)	582 (20.8)
Don't know	194 (15.1)	307 (20.3)	501 (17.9)
Missing	9 (0.7)	15 (1.0)	24 (0.9)
Self-reported likelihood of HIV infection			
High	42 (3.3)	103 (6.8)	145 (5.2)
Medium	55 (4.3)	123 (8.2)	178 (6.4)
Low	119 (9.3)	206 (13.7)	325 (11.6)
None	844 (65.6)	807 (53.5)	1651 (59.1)
Don't know	226 (17.6)	270 (17.9)	496 (17.7)
Total	1286	1509	2795

+, positive, −, negative.

diagnostic test, self-reported likelihood of current HIV infection thus tends to have a lower specificity but higher sensitivity among women (66% and 46%, respectively) than among men (80% and 27%, respectively).

In the logistic regression analysis comparing the probability of false-positive responses with that of true-positive responses (table 4, left panel), for women the only two significant covariates are marital status and self-reported health. Married women were 3.7 times more likely than unmarried women to report some likelihood of HIV infection but to test negative (95% CI 1.39 to 9.58). In other words, among women who believed that they were infected with HIV, married respondents were 3.7 times more likely to be incorrect in their beliefs than unmarried women. Among women who thought that they were infected with HIV, those who also reported a fair or poor health status were only one fifth as likely to be actually infected as those who thought that they had excellent health (OR 0.20; 95% CI 0.06 to 0.62). For men, there was a strong effect of region: men residing in the northern region were 5.4 times more likely than those in the southern region to overstate their likelihood of HIV infection. In addition, there was a small but significant effect of age, and a large effect of marital status: married men were 33.8 times more likely than unmarried men to believe that they were infected with HIV but to test negative for HIV. For both men and women, perceived community prevalence of HIV was not a major predictor of false-positive responses.

In the multivariate logistic regression analysis comparing the probability of false-negative responses relative to that of true-negative responses (table 4, right panel), for both men and women, region and age were significantly associated with the under-reporting of HIV infection: respondents living in the southern region were 2–3 times more likely to understate their likelihood of HIV infection than respondents living in the northern region, and older respondents were 3–5 times more likely to understate it than younger respondents. Men who

Table 2 Self-reported likelihood of current HIV infection by actual HIV status from antibody test and by sex, 2004 Malawi Diffusion and Ideational Change Project

	HIV+, n (%)	HIV−, n (%)	Total
Men			
Some likelihood	14 (6.5)	202 (93.5)	216
High	2 (4.8)	40 (95.2)	42
Medium	4 (7.3)	51 (92.7)	55
Low	8 (6.7)	111 (93.3)	119
No likelihood	38 (4.5)	806 (95.5)	844
Don't know	20 (8.8)	206 (91.2)	226
Total	72	1214	1286
χ^2 test = 7.07 (0.132)			
Women			
Some likelihood	39 (9.0)	393 (91.0)	432
High	11 (10.7)	92 (89.3)	103
Medium	9 (7.3)	114 (92.7)	123
Low	19 (9.2)	187 (90.8)	206
No likelihood	46 (5.7)	761 (94.3)	807
Don't know	34 (12.6)	236 (87.4)	270
Total	119	1390	1509
χ^2 test = 15.21 (0.004)			
Both sexes			
Some likelihood	53 (8.2)	595 (91.8)	648
High	13 (9.0)	132 (91.0)	145
Medium	13 (7.3)	165 (92.7)	178
Low	27 (8.3)	298 (91.7)	325
No likelihood	84 (5.1)	1567 (94.9)	1651
Don't know	54 (10.9)	442 (89.1)	496
Total	191	2604	2795
χ^2 test = 22.91 (0.000)			

HIV+, seropositive from the HIV antibody test; HIV−, seronegative from the HIV antibody test; χ^2 test, Pearson χ^2 test for difference in self-reported likelihood of infection between seropositive and seronegative respondents (p value in parentheses).

Table 3 Accurate self-reports (true negatives and true positives), inaccurate self-reports (false negatives and false positives), proportion of all self-reports that were accurate, proportion of all inaccurate self-reports due to overestimating one's risk of HIV infection, sensitivity, specificity, positive and negative predictive value of self-reported likelihood of current HIV infection, by sex, 2004 Malawi Diffusion and Ideational Change Project*

	Men	Women	Both
Accurate self-reports			
TN	806	761	1567
TP	14	39	53
TN+TP	820	800	1620
Inaccurate self-reports			
FN	38	46	84
FP	202	393	595
FN+FP	240	439	679
Total	1060	1239	2299
Accurate self-reports (%)	77.4	64.6	70.5
Inaccurate self-reports due to overestimating one's risk (%)	84.2	89.5	87.6
Sensitivity (%)	26.9	45.9	38.7
Specificity (%)	80.0	65.9	72.5
Negative predictive value (%)	95.5	94.3	94.9
Positive predictive value (%)	6.5	9.0	8.2

FN, false negative; FP, false positive; TN, true negative; TP, true positive.
*Respondents who answered "don't know" to the question on self-assessed likelihood of HIV infection are excluded.
The proportion of all self-reports that were accurate is calculated as (TP+TN)/(TP+TN+FP+FN). The proportion of inaccurate self-reports due to overestimating one's risk of HIV infection is calculated as FP/(FP+FN). Sensitivity = TP/(TP+FN); specificity = TN/(FP+TN); negative predictive value = TN/(FN+TN); positive predictive value = TP/(TP+FP).

reported good health were also more likely than those who reported excellent health to give a false-negative response (OR 3.46, 95% CI 1.44 to 8.28).

DISCUSSION

Our main finding is that most respondents who gave a definitive assessment of their likelihood of having HIV at the time of the survey were accurate, with men being overall more accurate than women. When they were inaccurate, it was primarily because they thought that they were HIV positive but were, in fact, HIV negative: false positives constitute almost 90% of all inaccurate self-reports.

The proportion of accurate responses among MDICP respondents (approximately 71% for men and women combined) is similar to that found by an earlier study in Zambia. Our result that HIV-positive respondents are significantly less likely than HIV-negative respondents to predict their results correctly also confirms what other studies have found in high-risk populations in developed countries. Our study makes a contribution by finding that prevalence of HIV differed significantly according to individual perceived risk, especially for women. In our sample, overestimating one's own likelihood of infection is the main reason for incorrectly assessing HIV infection status. This finding is consistent with the MDICP survey data, which show that respondents vastly overestimate the transmission probabilities of HIV: >90% of 2001 MDICP respondents believe that HIV transmission is certain or highly likely from a single unprotected act of sexual intercourse with an HIV-infected person. The main factor associated with these false beliefs is marital status and not, as we would have expected, the perceived HIV risk in the surrounding community. Studies have shown that, in this setting, married men and especially married women perceive themselves to have a higher likelihood

Table 4 Multivariate logistic regression analysis of false-positive and false-negative responses, by sex, 2004 Malawi Diffusion and Ideational Change Project

	False positives				False negatives			
	Men		Women		Men		Women	
Variable	OR	95% CI	OR	95%CI	OR	95%CI	OR	95%CI
Region								
South	1.00	(Reference)	1.00	(Reference)	1.00	(Reference)	1.00	(Reference)
Centre	1.90	0.39 to 9.33	1.73	0.67 to 4.47	1.08	0.48 to 2.45	1.14	0.49 to 2.65
North	5.37*	0.78 to 36.93	1.18	0.48 to 2.88	0.39*	0.14 to 1.05	0.42**	0.18 to 1.01
Age (years)								
<25	1.00	(Reference)	1.00	(Reference)	1.00	(Reference)	1.00	(Reference)
25–29	0.04*	0.00 to 1.46	0.89	0.28 to 2.82	2.20	0.41 to 11.85	1.63	0.40 to 6.59
30–34	0.01**	0.00 to 0.50	1.06	0.31 to 3.65	2.81	0.61 to 13.43	5.40***	1.79 to 16.25
35–39	0.01***	0.00 to 0.23	0.78	0.24 to 2.57	4.52**	1.01 to 20.26	3.54**	1.04 to 12.04
40–44	0.00***	0.00 to 0.15	0.85	0.25 to 2.96	4.13*	0.84 to 20.31	6.21***	2.13 to 18.03
45+	0.05*	0.00 to 1.71	2.21	0.53 to 9.12	2.85	0.70 to 11.63	1.45	0.42 to 5.06
Marital status								
Married	33.83**	1.48 to 771.93	3.66***	1.39 to 9.58	1.58	0.38 to 6.56	0.50	0.22 to 1.14
Not married	1.00	(Reference)	1.00	(Reference)	1.00	(Reference)	1.00	(Reference)
Self-reported health								
Excellent	1.00	(Reference)	1.00	(Reference)	1.00	(Reference)	1.00	(Reference)
Very good	1.98	0.26 to 14.89	0.31*	0.10 to 1.03	0.67	0.17 to 2.65	1.34	0.53 to 3.36
Good	1.03	0.18 to 5.91	1.38	0.40 to 4.82	3.46***	1.44 to 8.28	1.26	0.52 to 3.05
Fair/poor	0.78	0.13 to 4.55	0.20***	0.06 to 0.62	2.59	0.80 to 8.44	1.16	0.34 to 4.01
Prevalence in community								
0–50% infected	1.00	(Reference)	1.00	(Reference)	1.00	(Reference)	1.00	(Reference)
50–100% infected	0.55	0.13 to 2.34	0.77	0.35 to 1.72	0.73	0.35 to 1.51	0.88	0.44 to 1.79
n	189		328		674		616	
Likelihood ratio χ^2	20.11		23.86		33.53		22.83	
Probability $>\chi^2$	0.065		0.021		0.001		0.029	

*Significance at the 10% level **significance at the 5% level; ***significance at the 1% level.

of being infected with HIV because they do not trust their spouse's behaviour.[19 20]

We also find that self-assessed HIV status may be subject to response bias. Respondents who had had unsafe sex and thus thought they had a high chance of being infected with HIV may have been self-conscious about their prior behaviours and felt embarrassed to disclose their likely HIV status, or they feared the stigma associated with admitting they might have the infection. Although respondents knew that their true HIV status would be determined regardless of their answers to the survey question (if they consented to the HIV test), they might still have been reluctant to admit their HIV status face-to-face in front of the nurse. As a result, overall prevalence of HIV is highest among respondents who reported that they did not know or were uncertain about their HIV status. Combined with the low proportion of false-negative responses, this finding suggests that respondents (and especially those who were HIV positive) may have given answers affected by social desirability bias.

Although embarrassment or fear of stigma might have led some respondents to answer don't know for their self-reported likelihood of infection, these reasons do not explain why most incorrect self-reports in our study are due to overestimating one's likelihood of infection. It is possible that some respondents overestimated their risk not because they truly thought that they were infected, but because they thought that their admission of vulnerability might entitle them to healthcare they otherwise would not have been able to receive. These conjectures require further research.

Although many respondents did correctly evaluate their likelihood of HIV infection, the rate of incorrect self-reports (and, especially, the overestimation) of HIV status raises concerns about the proper design of HIV intervention programmes in this and similar settings. Without proper information, people may continue to falsely believe that they are already infected and may believe that they no longer have any health to protect, resulting in lower incentives to use condoms, to remain monogamous or to seek medical care even for curable medical conditions such as tuberculosis (with these negative behaviours buffered only by the individuals' conscience and desire to protect others from infection). However, with access to affordable HIV testing, counselling and treatment becoming a reality in many countries, including rural Malawi, the overestimation of one's own HIV risk may actually lead to higher motivation to adopt protective behaviours and seek healthcare.

The public health implications of the (in)accuracy of individuals' risk perception highlight the importance of improving and expanding access to HIV testing, counselling and treatment in developing countries, especially in rural areas.

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Key messages

- Understanding HIV risk perception is important for designing appropriate strategies for HIV/AIDS prevention, because these interventions often rely on behaviour modification. A key component of HIV risk perception is the individual's own assessment of HIV status, and the extent to which this assessment is correct.
- In this study, most respondents who gave a definitive assessment of their likelihood of having HIV at the time of the survey were accurate, with men being overall more accurate than women.
- When they were inaccurate, it was primarily because they thought that they were HIV positive, but were, in fact, HIV negative. Overestimating one's own likelihood of infection is the main reason for incorrectly assessing HIV infection status.
- Self-assessed HIV status may be subject to response bias.
- The public health implications of the (in)accuracy of individuals' risk perception highlight the importance of improving and expanding access to HIV testing, counselling and treatment in developing countries, especially in rural areas.

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