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Divergent preferences for enhanced HIV testing options among high-risk populations in northern Tanzania: A short report

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Abstract

To achieve the UNAIDS target of diagnosing 95% of all persons living with HIV, enhanced HIV testing services with greater attractiveness need to be developed and implemented. We conducted a discrete choice experiment (DCE) to quantify preferences for enhanced HIV testing features across two high-risk populations in the Kilimanjaro Region in northern Tanzania. We designed and fielded a survey with 12 choice tasks to systematically recruited female barworkers and male mountain porters. Key enhanced features included: testing availability on every day of the week, an oral test, integration of a general health check or an examination for sexually transmitted infections (STI) with HIV testing, and provider-assisted confidential partner notification in the event of a positive HIV test result. Across 300 barworkers and 440 porters surveyed, mixed logit analyses of 17,760 choices indicated strong preferences for everyday testing availability, health checks, and STI examinations. Most participants were averse to oral testing and confidential partner notification by providers. Substantial preference heterogeneity was observed

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DECLARATION OF INTEREST STATEMENT

No potential competing interest was reported by the authors.

within each risk group. Enhancing HIV testing services to include options for everyday testing, general health checks, and STI examinations may increase the appeal of HIV testing offers to high-risk populations.

Keywords

HIV counseling and testing; discrete choice experiment; preference heterogeneity; sub-Saharan Africa; Tanzania

INTRODUCTION

The United Nations General Assembly and UNAIDS have set for 2025 the ambitious ‘95–95-95’ target: diagnosing 95% of all persons living with HIV (PLWH), initiating antiretroviral therapy for 95% of those diagnosed, and achieving viral suppression for 95% of those treated (UNAIDS, 2021; United Nations General Assembly, 2021). To achieve the ‘first 95’ in Eastern and Southern Africa, more than 1.6 million undiagnosed PLWH need to test for HIV, including more than 200,000 in Tanzania (UNAIDS, 2020). Many of these PLWH will be among difficult-to-reach populations who have already bypassed existing testing opportunities because of stigma, privacy concerns, geographical barriers, inconvenient hours of operation, fear of needles, or gendered perceptions of HIV testing services (Chanda et al., 2017; Fay et al., 2011; Kranzer et al., 2014; Okal et al., 2020; Qiao et al., 2018; Risher et al., 2013; Sileo et al., 2018; Strauss et al., 2015; Treves-Kagan et al., 2017; Tun et al., 2018).

Recognizing these hindrances, Tanzania’s National Multisectoral Strategic Framework for HIV and AIDS, which highlights low rates of HIV testing among high-risk persons, calls for a mix of differentiated models of HIV testing to increase testing uptake and ultimately achieve the first 95 target (Tanzania Commission for AIDS, 2018). Across diverse settings in sub-Saharan Africa, multiple strategies have been employed to increase HIV testing, including home-based testing (Sabapathy et al., 2012), provider-initiated testing (Roura et al., 2013; Topp et al., 2012), and work-place testing (Houdmont et al., 2013), but iteratively implementing, evaluating, and optimizing these interventions can be costly and slow.

Well-designed discrete choice experiments (DCEs), which systematically and efficiently evaluate population preferences, offer an opportunity to engage stakeholders in the design and implementation of new HIV testing options. DCEs have been widely used to characterize end-user preferences in various contexts related to HIV, including prevention (Cameron et al., 2013; Newman et al., 2016; Quaife et al., 2018; Terris-Prestholt et al., 2013), testing (Indravudh et al., 2017; Johnson et al., 2010; Ostermann et al., 2014; Ostermann, Njau, et al., 2015; Phillips et al., 2002; Strauss et al., 2018), service delivery (d’Elbee et al., 2018; Kruk et al., 2016; Zanolini et al., 2018), and treatment (Beusterien et al., 2007; Bregigeon-Ronot et al., 2017; Hauber et al., 2009; Mühlbacher et al., 2013; Ostermann, Mühlbacher, et al., 2020). With the goal of designing optimized HIV testing interventions for high-risk populations, this study used a DCE to characterize preferences for expanded testing hours, less invasive specimen sampling using an oral swab, the

integration of health screening examinations with HIV testing, and assisted confidential partner notification in the event of a positive test result.

METHODS

This manuscript is part of a study that seeks to evaluate the effect of a preference-informed offer of HIV testing on testing rates of high-risk populations ([ClinicalTrials.gov](https://clinicaltrials.gov/ct2/show/study/NCT02714140) Protocol [NCT02714140](https://clinicaltrials.gov/ct2/show/study/NCT02714140)). The study protocol and methods have been previously published (Ostermann et al., 2021; Ostermann, Njau, et al., 2020), and details of the design of the DCE are presented in the Supplemental Material. Methods pertaining to this study are summarized below.

Ethics approvals

The protocol was approved by the Ethics Review Committee at Kilimanjaro Christian Medical University College (Protocols #273 and #901) and the National Institute for Medical Research (NIMR/HQ/R.8a/Vol. IX/1363 and NIMR/HQ/R.8a/Vol. IX/2603) in Tanzania and by the Institutional Review Boards at Duke University (Duke University Health System IRB, Protocol Pro00075996) and the University of South Carolina (Health Sciences South Carolina IRB, facilitated review, Pro00060760) in the United States. Informed consent was obtained from all participants.

Study sample

The study was conducted in Moshi, the administrative and commercial capital of the Kilimanjaro Region in northern Tanzania. Study participants comprised women employed in randomly selected bars, restaurants and guesthouses serving alcohol to patrons (“female barworkers”) and male porters supporting climbers of nearby Mount Kilimanjaro (“male porters”) who were sequentially approached as they exited Mount Kilimanjaro National Park. We previously characterized these groups as populations at high risk of HIV infection (Ostermann, Njau, et al., 2015). Eligible participants were residents of Moshi, able to read, and ages 18 to 49.

Discrete choice experiment

As part of an in-person survey, preferences for enhanced HIV testing characteristics were assessed using a DCE. A DCE, a quantitative survey method grounded in random utility theory (McFadden, 1974; Thurston, 1927) and Lancaster’s theory of consumer demand (Lancaster, 1966), simulates real-world choice situations by asking participants to choose between products or services whose characteristics are systematically varied by means of an experimental design. The analysis of participants’ choices provides estimates of individuals’ relative preferences for each characteristic.

Attributes and levels

The product or service characteristics evaluated in a DCE are commonly referred to as attributes and levels. The selection of attributes and levels for this DCE was guided by a survey of HIV testing facilities in the study area and focus group discussions with members of the target population. Two attributes described testing features commonly available in

the area, including testing venue (health facility; free-standing HIV testing center; home) and pre-test counseling modalities (one-on-one; in a group; with a partner). Four attributes included enhanced features: testing availability every day of the week (vs. weekdays only), an oral swab to obtain the sample for the HIV test (vs. venipuncture or finger prick), the integration of a general health check or an examination for sexually transmitted infections (STI) with an HIV test (vs. HIV testing only), and assisted confidential partner notification in the event of a positive HIV test result (vs. self-disclosure).

Experimental design

The experimental design of a DCE represents the subset of potential choice tasks that is used to estimate preference parameters with the smallest possible error. Ngene software (ChoiceMetrics, Australia, 2018) version 1.12b was used to select an experimental design that minimized the D-error for a mixed logit model with effects-coded, normally distributed priors (Johnson et al., 2007). Statistical priors were obtained from a pilot study with 236 participants. Participants were randomized across 10 sets of choice tasks, with 12 tasks each. The order of choice tasks was randomized across participants. Each choice task included three testing alternatives; the order of alternatives was randomized within each choice task.

DCE administration

In-person surveys were fielded by trained research staff, in Kiswahili, on iOS devices, using Comet survey software (Selway Labs, Englewood, CO, 2017). Participants initially ranked the levels of each attribute (e.g., venipuncture vs. finger prick vs. oral swab). These data were used to populate a participant-specific comprehension task, followed by 12 choice tasks. Using a best-best preference elicitation approach (Ghijben et al., 2014), participants were asked in each task to first select their most preferred option (or “alternative”) from three testing options presented; then, participants were asked to select their more preferred of the two remaining options. A sample choice task illustrating all enhanced HIV testing characteristics included in the DCE is shown in Figure 1.

Statistical analysis

DCE choice data were analyzed using gender-specific mixed logit models with effects-coded correlated, normally distributed random coefficients (Hole, 2007). Coefficient estimates from the mixed logit model represent estimates of participants’ average preferences for each attribute level. The estimated standard deviations of these coefficients describe the variation in preferences across participants (“preference heterogeneity”). Individual participants’ choices were combined with information on the distribution of preferences across participants to derive individual-level preference estimates (“posterior betas”) for each attribute level using a method proposed by Revelt and Train (Revelt & Train, 2000; Train, 2003). Statistical analyses were performed using STATA version 16.1 (StataCorp, College Station, Texas).

RESULTS

Between September 2017 and July 2018, 300 female barworkers and 440 male porters were enrolled into the study. The median age among barworkers was 30 (inter-quartile range,

IQR, 24 to 35) years, the median age among porters was 31 (IQR 26 to 36) years. One third (32%) of female barworkers and 66% of male porters were married. More than half (58%) of female barworkers and 44% of porters had completed primary school education. The majority of female barworkers (95%) and male porters (80%) had previously tested for HIV, but fewer than half (46% of barworkers; 49% of porters) had tested in the past year.

Mixed logit analyses of 17,760 choices (12 first and 12 second choices times 740 participants) indicate strong preferences for everyday testing availability (vs. weekdays only), for health checks, and for STI examinations (vs. HIV testing only). They also indicate a strong aversion to oral swabs (vs. finger prick or venipuncture), and most participants were averse to provider-assisted confidential partner notification (vs. self-disclosure) in the case of a positive HIV test (Figure 2). Results demonstrate substantial heterogeneity in the extent to which individual participants valued enhanced HIV testing features. Small but statistically significant differences in average preferences were noted between risk groups for each enhanced testing feature, except for everyday testing availability, however, the distributions were similar across groups.

DISCUSSION

On average, members of these two high-risk groups strongly preferred HIV testing options that were combined with health examinations and available on weekends; in contrast, most participants demonstrated an aversion to oral testing and provider-assisted confidential partner notification in the event of a positive HIV test. While we observed statistically significant differences in mean preferences between male and female high-risk groups, the overall distributions of preferences were strikingly similar. These findings can inform the design of new HIV testing strategies aimed at achieving the “first 95” target of the 95–95–95 UNAIDS goal.

Across sub-Saharan Africa, modern preference elicitation studies for HIV testing, including DCEs, have focused preference assessments largely around cost, location of and distance to services, privacy, antiretroviral therapy availability, self-testing, and incentives (Beckham et al., 2020; Korte et al., 2019; Ostermann, Brown, et al., 2015; Ostermann et al., 2014; Ostermann, Njau, et al., 2015; Schaffer et al., 2020; Strauss et al., 2018; Uzochukwu et al., 2011). Relatively few studies have examined the attractional value of enhancements to HIV testing services, such as integrating general health examinations and STI testing. Our findings are in keeping with the only other preference study we could identify that examined this attribute. Using a DCE limited to a rural sample of Ugandan men, Schaffer et al. found that the offer of multi-disease testing (i.e., tuberculosis, malaria, hypertension, and diabetes) at the time of HIV testing was significantly associated with increased predicted uptake (Schaffer et al., 2020). This preference for undergoing HIV testing in the context of broader health screening is supported by observational data from a large mobile- and home-testing campaign in Kenya and Uganda, which offered additional services such as hypertension and diabetes screening and malaria testing (Chamie et al., 2016).

In our study, oral testing was less preferred by both high-risk populations — a finding that conforms with our preference research conducted in 2012–2014 in this region (Ostermann

et al., 2014; Ostermann, Njau, et al., 2015), but contrasts with findings from two other studies in sub-Saharan Africa. In a Ugandan DCE conducted among pregnant women and their male partners, oral testing was preferred over finger pricks; but not for the subgroup who had tested previously for HIV (Korte et al., 2019). Similarly, among long distance truck drivers in Kenya, there was overall indifference to oral vs. finger-prick testing, but those who had never tested were more likely to prefer oral testing (Strauss et al., 2018). One potential explanation for the differences across these three countries is differential familiarity with oral testing as an accurate, governmentally-approved, HIV testing option (Unitaid-World Health Organization, 2018). Oral testing, including self-testing (Ekouevi et al., 2020; Hlongwa et al., 2020; Njau et al., 2019), had not been approved for public use by regulatory authorities in Tanzania at the time of this study, and as such may be subject to misperceptions about accuracy (Njau et al., 2014). A comprehensive information campaign may be required for oral testing to be widely accepted as an enhanced HIV testing strategy in Tanzania.

Assisted partner notification services have been recommended by the World Health Organization since 2016 (World Health Organization, 2016), and individual-level randomized trials have demonstrated that, when implemented for HIV-positive testers, this approach increases both HIV testing uptake and identification of HIV infections among sexual partners as compared with passive referrals (Brown et al., 2011; Cherutich et al., 2017; Dalal et al., 2017; Rosenberg et al., 2015). Our data suggest that, for persons who are considering an HIV test, presenting an HIV testing offer that, *a priori*, includes assisted confidential partner notification, on average, is of limited utility. The extent to which the credibility of confidentiality assurances vs. other considerations factor into testing preferences and decisions warrants further exploration.

This study is the first to evaluate preferences for readily-implementable, enhanced testing features targeting high-risk populations in sub-Saharan Africa. The strengths of this study include its size (the largest DCE eliciting HIV testing preferences among specific high-risk populations in sub-Saharan Africa), rigorous sampling and analytic approaches, and a focus on policy-relevant options developed from extensive qualitative work (Njau et al., 2014) and prior DCEs (Ostermann et al., 2014; Ostermann, Njau, et al., 2015). Limitations include potential hypothetical bias, which is implicit in stated preference surveys (Quaife et al., 2018), that these populations were predominantly experienced HIV-testers, and uncertain generalizability of findings to other high-risk populations. Further, because the DCE did not include an opt-out alternative – a decision motivated by high rates of prior HIV testing and concerns about social desirability bias stemming from decades-long efforts to promote HIV testing – the results do not allow for direct inferences about the impact of enhanced features on testing uptake. Finally, this analysis focuses on the distribution of population preferences estimated using standard mixed logit methods and as such highlights general policy implications; reasons for the variation in preferences could not be explored. In a separate latent class analysis of the same data, we describe distinct profiles of preferences that could be used to design testing options for specific sub-populations (Ostermann et al., 2021).

In conclusion, this DCE suggests that both male and female high-risk groups, on average, similarly preferred enhanced HIV testing options that included everyday testing availability and both general and STI health checks. Oral testing was less-preferred compared to more invasive, blood-based sampling methods, and most participants preferred self-disclosure over assisted confidential partner notification. We observed substantial preference heterogeneity for these enhanced HIV testing features among both high-risk groups. However, their strikingly similar distributions across these groups do not support the implementation of differentiating HIV testing models based on group membership. These findings will guide further work evaluating uptake of DCE-informed HIV testing options ([NCT02714140](#)) as part of an overall strategy assessing the utility of DCEs for designing novel HIV testing interventions in sub-Saharan Africa.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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1. We would like you to think of three different testing options, alternative A, B and C.

Alternative A	Alternative B	Alternative C
<p>You will test in a Health center</p> 	<p>You will test at an HIV testing center</p> 	<p>You will be tested in your Home</p> 
<p>Testing is available Every day</p> 	<p>Testing is available Weekdays only</p> 	<p>Testing is available Every day</p> 
<p>Pre-test counseling is done One-on-one</p> 	<p>Pre-test counseling is done in a Group</p> 	<p>You are required to come with your partner for pre-test counseling</p> 
<p>The sample is taken from the Finger</p> 	<p>The sample is taken from the Arm</p> 	<p>The sample is taken from the Mouth</p> 
<p>You will be tested for HIV and other illnesses</p> 	<p>You will be tested for HIV only</p> 	<p>In addition to being tested for HIV you will be examined for STIs</p> 
<p>If you are HIV positive A counselor will contact your partner to test for HIV</p> 	<p>If you are HIV positive it is encouraged that You advise your partner to test for HIV</p> 	<p>If you are HIV positive Your partner will receive the result at the same time</p> 

If today you were given these three options in order to test for HIV, which alternative would you choose, alternative A, B or C?

Figure 1.
Sample DCE choice task.

Notes: Attributes and levels were introduced individually, prior to the administration of the DCE. After the most preferred option was selected, participants were asked to identify the next best option (“best-best” elicitation format). See Supplemental Material for the DCE survey and information provided to the participant about each attribute and level.

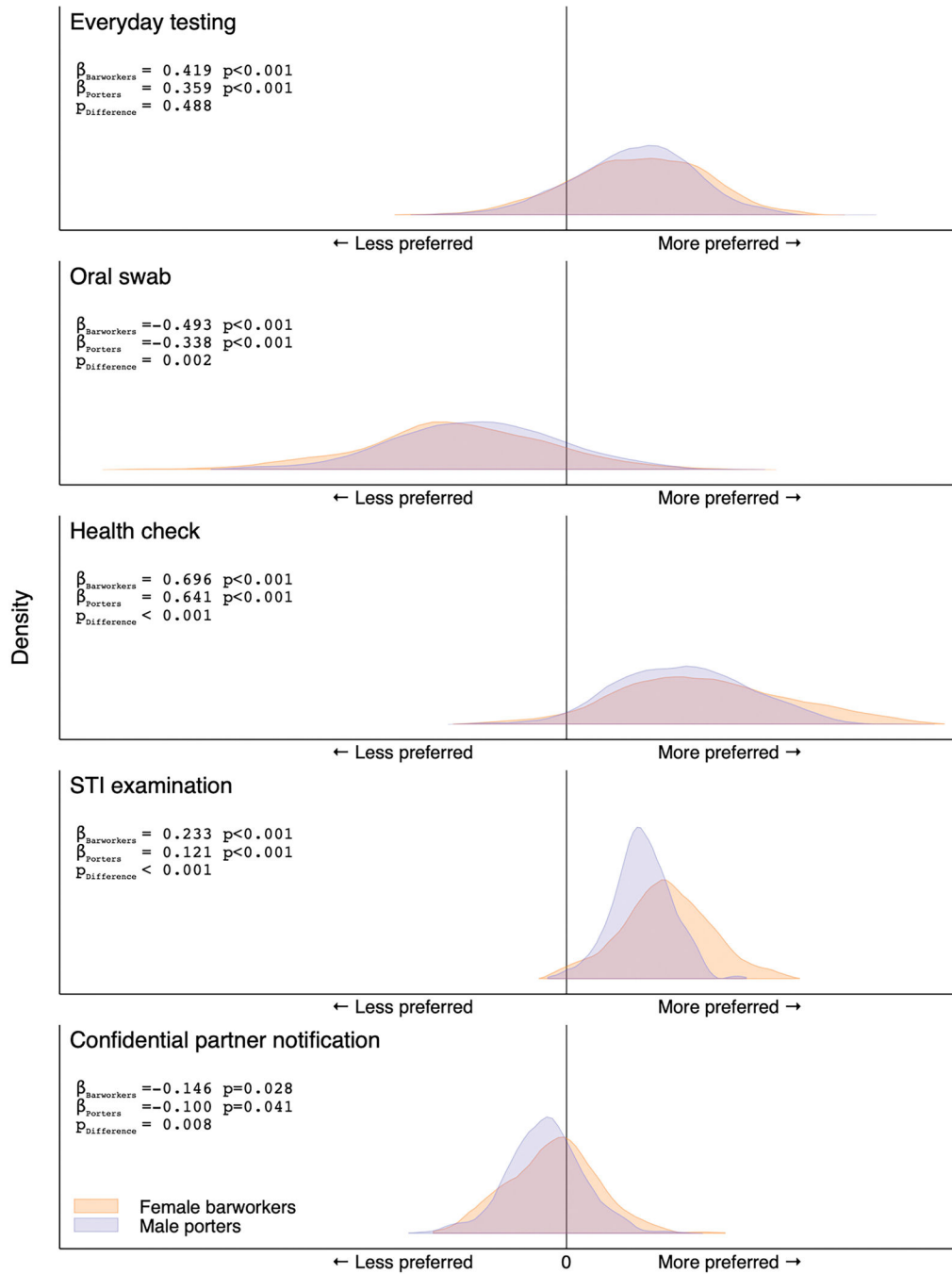


Figure 2. Distribution of preferences for enhanced HIV counseling and testing features among 300 female barworkers and 440 male mountain porters, Tanzania, 2017. Notes: Results of gender-specific mixed logit models with effects-coded correlated random coefficients. Distributions represent kernel densities of individual-level preference estimates for 300 female barworkers (blue) and 440 male mountain porters (orange). The x-axes represent preferences for (to the right of the black line) or against (left of the black line): (a) everyday testing relative to testing on weekdays only, (b) oral swab relative to the estimated

more preferred of either venipuncture or finger prick; (c) a complementary health check or (d) a complementary STI examination relative to HIV testing only; (e) confidential assisted partner notification in the event of a positive test result relative to self-disclosure. Effects-coded (mean) coefficient estimates from gender-specific mixed logit models are indicated by $\beta_{\text{Barworkers}}$ and β_{Porters} . The statistical significance of differences in the distribution of individual-level preference estimates between risk groups, as evaluated by Student's *t*-tests, is indicated by $p_{\text{Difference}}$.