


BMJ Open Prevalence estimates of trafficking in persons using statistical definitions: a cross-sectional high-risk community survey in Cape Town, South Africa

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ABSTRACT

Objectives Current research on trafficking in persons (TIP) relies heavily on legal and prosecutorial definitions. A public health approach has called for population-level assessment; however, identification of TIP victims lacks a standardised operational definition. This study applied the Prevalence Reduction Innovation Forum (PRIF) statistical definitions, developed by the US Department of State, to a community survey in Cape Town, South Africa.

Designs A high-risk sampling strategy was used. TIP screening questions from two instruments were matched with PRIF domain indicators to generate prevalence estimates. Sensitivity, specificity and receiver operating characteristics analyses were conducted to assess the performance of the two screeners.

Setting Cross-sectional survey conducted in Cape Town, South Africa, from January to October 2021.

Participants South Africans and immigrants from other nations residing in Cape Town and its surrounding areas, aged 18 or older, who met the study inclusion criteria for a set of experiences that were identified as TIP risk factors.

Primary and secondary outcome measures Primary outcome measures were PRIF lifetime and past 12-month TIP positivity. Secondary outcome measures included individual and summary measures from the two screeners.

Results Our PRIF algorithm yielded a TIP lifetime prevalence rate of 17.0% and past 12-month rate of 2.9%. Summary measures from each TIP screener showed an excellent range of predictive utility. The summary screener measures yielded statistically significant differences among some demographic and background categories. Several screener items were shown less predictive of the PRIF statistical definition criteria than others.

Conclusions Prevalence estimates of probable TIP were higher than those reported elsewhere. Our TIP screeners yielded an excellent range of predictive utility for the statistical definitions, promising the potential for wider applications in global and regional TIP research and policymaking. A more systematic sampling strategy is needed even if statistical definitions become widely used.

INTRODUCTION

Because of the clandestine nature of victimisation, the definition of trafficking in persons (TIP) has most frequently used its legal and

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ This study provides a methodological framework to estimate the prevalence of trafficking in persons (TIP) victimisation derived from statistical rules.
- ⇒ Use of well-established TIP indicators could allow comparisons across multiple studies.
- ⇒ The receiver operating characteristics analysis enables the level of predictive utility of two chosen screeners against the statistical definitions.
- ⇒ Our application of statistical definitions is limited due to selective questions available in the two screeners used.
- ⇒ Due to a limited sampling strategy, our results are not generalisable to the population of Cape Town, South Africa.

prosecutorial definitions, mostly based on the United Nations' *Protocol to Prevent, Suppress and Punish Trafficking in Persons Especially Women and Children in 2000*¹ and the US *Trafficking Victims Protection Act of 2000*.² The Republic of South Africa enacted the *Prevention and Combating of Trafficking in Persons Act 7 of 2013* (PACOTIP),³ which includes abuse of power, abduction and kidnapping, in addition to the usual force, fraud and coercion emphasised in the international and US legal definitions.

Negative health consequences of trafficking and exploitation experiences have been extensively documented, ranging from infectious diseases, toxin-exposure poisoning, musculoskeletal diseases, violence, substance abuse and physical and reproductive injuries,^{4 5} as well as neuropsychiatric sequelae, including post-traumatic stress disorder and depression and ultimately leading to premature mortality.⁶⁻⁸ With the increasing knowledge of the nature and scope of TIP, a public health approach has called for a population-level assessment and identification of TIP survivors.^{9 10} However, identification of TIP victims has lacked a clear population-based



definition that is reproducible.¹¹ Varied estimations have been circulated so much that researchers often question the veracity of the claims made by a few sources of information that have come to fuel the global movement against modern slavery.^{12 13} More than two decades after the historical advances in legal definitions, the human trafficking field still does not have a set of agreed-upon rules to operationalise TIP definitions for research or clinical purposes.

There have been several attempts at standardising the operational definitions of human trafficking for field research. The International Labour Organization (ILO) established a set of operational indicators of trafficking victimisation using the Delphi method.¹⁴ In a different vein, a more recent introduction of ICD-10-CM (International Classification of Diseases, Tenth Revision, Clinical Modification) codes for classifying labour and sex trafficking among children and adults¹⁵ now allows differentiating victims of human trafficking from other victims of interpersonal abuse. The rapid expansion of electronic health records in high-income countries may further advance clinical care by enabling medical providers to document encounters and identify patients with a history of human trafficking. Systematic coding would also enable researchers to establish longitudinal tracking of human trafficking victims while prospectively assessing short-term and long-term consequences.¹⁶ However, these codes are currently severely underused.¹⁷

In an effort to accelerate the development of a uniform set of TIP measures, the US Department of State partnered with TIP experts in several institutions to launch the Prevalence Reduction Innovation Forum (PRIF). This partnership required the use of a common set of statistical definitions to test different prevalence estimation strategies across three continents.¹⁸ The PRIF statistical definitions are modelled after the 2009 ILO statistical guideline,¹⁴ in which certain configurations of strong or medium indicators are required to establish the threshold for TIP victimisation.¹⁹ This document includes seven domains or categories likely affected by TIP life spheres: recruitment, employment practice and penalties, personal life and properties, degrading conditions, freedom of movement, debt or dependency and violence and threats of violence. Each domain includes 4–8 ‘indicators’. A unique aspect of this document is providing statistical rules that are akin to the to the *Diagnostic and Statistical Manual of Mental Disorders* approach.²⁰ With many good human trafficking screening tools identified, some of which are rigorously evaluated,^{21 22} it is now feasible to apply select screeners to estimate the prevalence rates of TIP in a community using such statistical definitions.

We applied the first edition of the PRIF statistical definitions to responses from two well-regarded screeners as part of a community survey in Cape Town, South Africa. Cape Town was chosen in part because existing documents suggest that Cape Town is one of major hubs for regional human trafficking in Southern Africa as well as

a major port entry for international trafficking.^{23–25} While regional estimates within South Africa are unavailable, the Global Slavery Index (GSI)²⁶ estimated South Africa’s prevalence as 2.8 per 1000 (0.28%) based on the country’s vulnerability score and surveys from select countries in earlier years (including South Africa).²⁷ However, validity of the GSI methodology has been under considerable scrutiny.²⁸

The aims of the current study are to: (1) estimate lifetime and past 12-month prevalence rates from the local-population survey sample based on the PRIF statistical definitions; (2) examine predictive utility of two TIP screeners; and, (3) select common victimisation indices that predict probable TIP cases.

METHODS

Study setting and participants

The RESET (WesteRn capE Stop ExploITation) study, an original study conducted by the authors, aimed to deliver community research methodologies and tools for ongoing TIP monitoring and research in South Africa. The population catchment area was the City of Cape Town. Given the unfortunate legacy of land dispossession in South Africa, considerations for local movement of vulnerable populations²⁹ were made to extend recruitment to Cape Town’s surrounding areas.

Study design

The design was a cross-sectional structured survey, conducted in 2021. Due to the rapid spread of the COVID-19 pandemic at the RESET study initiation phase in the spring and summer of 2020, the scope of the RESET study was adjusted in compliance with the South African government policies and directives, while maintaining research staff’s safety and protection.

Sampling size and sampling procedure

Within the Cape Town catchment area, we sought a broad range of community sample members who are at an increased risk for TIP currently or in the past. The RESET study sample inclusion criteria consisted of adults aged 18 or older who indicated at least one exploitation or risk experiences that are well-documented red flags³⁰ or comorbid factors associated with human trafficking³¹ (online supplemental table 1).

While we used a high-risk sampling framework, our sampling procedure attempted to use a hybrid approach recommended for hard-to-reach populations in the human trafficking field,³² in part to adjust to the COVID-19 pandemic. Using the principle of the time and location sampling method,³³ we drew a list of community organisations as entry points that are typically associated with human trafficking and exploitation and expanded the list as we proceeded with the field work. In some areas where local knowledge indicated a concentration of high-risk residents (eg, ‘informal settlements’, concentrated ‘backyard dwellers’), the field staff attempted

to recruit residents for every third dwelling unit to the extent permitted. This hybrid method, however, did not lend easily to the estimate of the population base count to arrive at a generalisable prevalence estimate.³⁴ The sample members for the RESET study totaled 665. The analytical sample size for the current study is 652, after removing those respondents (n=13) oversampled for a substudy of transgender characteristics.

Data collection tools and procedures

We used modified versions of two TIP screening tools, the Trafficking Victim Identification Tool (TVIT), short version,³⁵ and the Adult Human Trafficking Screening Tool (AHTST).³⁶ The two screeners are among a dozen documented human trafficking screeners applicable to adult populations.²¹ The TVIT, a validated screening tool, is reliable in predicting the identification of sex and labour trafficking among US born and foreign-born victims.³⁷ Our version included 18 main TIP screening questions including ‘abduction or kidnapping’, which was added based on TIP information in South Africa and PACOTIP.³ The AHTST is not yet validated but was created for use in social service settings to assess human trafficking victimisation and risk among adults in the USA. AHTST consists of eight closed-ended, minimally invasive screening questions. Open-ended questions were added to some of the screener questions that would allow clarifications of potentially ambiguous experiences. Other modules included demographics, risk and comorbid factors, COVID-19 self-assessment and post-interview assessment. Trained research assistants provided participant-specific referrals at the conclusion of each survey.

Combined survey modules first drafted in English were translated to Afrikaans and isiXhosa by native speakers and back translated into English by different native speakers. The default mode of administration was an electronic tablet using KoboToolbox, designed to be administered in person by the survey taker; however, due in part to the COVID-19 pandemic restrictions, telephonic surveys and paper-and-pencil administration were augmented. All survey participants received a grocery voucher worth R50 (equivalent to US\$3.40) for their time.

Variables and measurement

A total of 26 TIP screening questions from two screeners were input to match with domains and indicators from the PRIF statistical definitions. The procedure involved three human trafficking experts (RKP, AKB and ELK) who examined the PRIF domains, indicators and statistical definitions on one hand and TIP survey questions from the two screeners on the other. Our own modified versions, m-TVIT and m-AHTST, eliminated four questions: two questions from the TVIT screener and two questions from the AHTST screener. The decision was based on our consensus that those four TIP questions cannot be matched to any of the indicators in the PRIF definitions. Thus, 22 TIP-qualifying questions matched

to a total of 15 PRIF statistical definition indicators across 4 domains (details in online supplemental tables 2,3).

We created two summary additive variables from the m-TVIT and m-AHTST and also added a synthetic combined score to compare with the two summary measures from the two screeners. Furthermore, we examined demographic variables (age categories, sex, education, country of origin, relationship status) and other information such as participant current housing situation and recruitment location.

Statistical analyses

Most data analyses were performed in SAS V.9.4 (Statistical Analytic Software; SAS Institute; Cary, North Carolina, USA). The primary outcome measures were PRIF statistical definition criteria for lifetime and past 12 months for period estimates (called flow). They were derived using a series of algorithms linking TIP screening questions to PRIF indicators to PRIF statistical definition criteria. The PRIF positives were judged meeting TIP ‘probable cases’ for the specified duration. Individual and summary measures derived from the m-TVIT and m-AHTST screeners were used as ‘predictors’ of PRIF definition positives.

We examined the performance of TIP screeners using the receiver operating characteristics (ROC) analysis.²² ROC combines sensitivity (positive predictive probability) and specificity (negative predictive probability), against the PRIF statistical definition criteria as ‘gold standards’. The values of the area under the curve (AUC) indicate how well each screener summary measure performed against the PRIF statistical definitions and usually indicates the model’s relative predictive value.³⁸ Additional indices were examined to identify the best cut-off points of the screeners that maximise the AUC values. Finally, we examined most commonly endorsed TIP screener questions among those who are judged probable TIP cases according to the limited PRIF statistical definitions. Considering the multicollinearity of screener items, the ‘best’ set of screening items were chosen using a Lasso regularisation estimation technique in combination with traditional logistic regressions.^{39 40}

Missing cases were relatively small for individual TIP screening questions (ranges 0–3.5% across 24 TIP screening questions) and demographics included in the subsequent data analyses. No participants were missing 40% or more of all TIP screening questions, which was our decision point for case removal. Thus, all 652 participants were included in the subsequent data analyses. Specific missing or ‘refused’ cases of individual TIP screening questions, as well as two summary measures, were coded as zero (negative for specific question), thus the resulting PRIF prevalence estimates are conservative, in that the estimates may be biased toward lower estimates. Missing cases in demographic variables were removed in a pairwise analysis.

Participant and public involvement

Participants and the public were not systematically involved in all phases of the current study. However, Cape Town-based survivor advocates and two TIP experts in South Africa were extensively involved in the review and translations of the survey questions. South Africa civil society organisations were instrumental for recruitment assistance and providing safety measures.

Consent procedure

A written consent form describing the aims, benefits and potential risks of participation in the study, and information about their right to withdraw, was read to each participant. Institutional Review Board approvals were exempted from each of the US collaborating institutions.

RESULTS

Participant characteristics

Recruitment sites were spread beyond the city proper and surrounding suburbs although numbers at each site outside of the city were small (usually one or two). A large number ($n=226$ or 34.6%) were recruited in the Hout Bay area through various venues (eg, treatment facilities, homeless shelters and informal settlement as well as residential housing) (see online supplemental figure 1).

In this sample, 37.7% were men, 60% were women and 2.3% identified themselves as 'non-binary' or 'other' (table 1). The sample members included both young (18.6% aged 18–25) and middle aged or older people (24% aged 45 or older). A majority (68.4%) identified themselves as 'Coloured' (South Africa's reference to mixed race), followed by 'Black African' (25.4%). Those who identified themselves as 'White' consisted of 4.0% of the sample members. Most participants (89.2%) were South Africans, followed by those born in Zimbabwe (9.7%). The language used for the survey was mainly English (86.4%), followed by Afrikaans (6.0%) and isiXhosa (5.3%). Relationship statuses at the time of survey were diverse. A total of 37.9% reported to be single; 50.1% reported to be in a serious relationship, married, engaged or living as though married; and 6.0% were divorced. The number of people living in their 'household' also varied widely: 48.1% reported household size of 1–4; 41.2% reported 5–10; and 10.7% reported 11 or more, which often included residents in a facility (eg, homeless shelter).

Summary TIP screener measures

The summary measure from m-TVIT ranged from 0 to 15 (although theoretical maximum=16); and the summary measure from m-AHTST ranged from 0 to 6 (theoretical maximum=6). While m-TVIT's median was between 3 and 4, 70.3% did not endorse any of the m-AHTST screener questions. Several statistically significant differences were found for the means of the m-TVIT summary measure by demographic or other background categories including:

Table 1 Socio-demographic and background characteristics ($n=652$)

N=652 (%)	
Gender*	
Male	245 (37.7)
Female	390 (60.0)
Other	15 (2.3)
Age	
18–25	115 (18.6)
26–34	209 (33.8)
35–44	143 (23.1)
45 or older	151 (24.4)
Race (ethnicity)†	
White	26 (4.0)
Coloured	444 (68.4)
Black African	165 (25.4)
Other	14 (2.2)
Highest level of education	
Less than high school	102 (16.0)
Some high school	301 (46.5)
Completed high school	148 (23.0)
Some university or more education	96 (14.5)
Country of origin‡	
South Africa	562 (89.2)
Zimbabwe	61 (9.7)
Other	7 (1.1)
Language used for survey§	
English	559 (86.4)
Afrikaans	39 (6.0)
isiXhosa	34 (5.3)
Other	15 (2.3)
Relationship status	
Single	251 (38.6)
In a relationship/living as though married	169 (26.1)
Married or engaged	155 (24.0)
Divorced	39 (6.0)
Other	37 (5.7)
Number of people living in household¶	
1–4	307 (48.1)
5–10	263 (41.2)
11 or more	68 (10.7)
Area where recruited for survey**	
Hout Bay	226 (34.7)
City of Cape Town	403 (61.9)
Outside City of Cape Town	22 (3.4)
<p>Owing to missing data, column numbers may not add to $n=652$. Percentage totals exclude missing cases.</p> <p>*'Other' includes 'non-binary' ($n=4$) and unspecified others ($n=11$).</p> <p>†'Coloured' refers to a mixed race; 'Other' included 'Asian/Indian' ($n=5$) and unspecified 'others' ($n=9$).</p> <p>‡'Other' countries include: Malawi and Namibia (both $n=2$), and Burundi, Congo and Mozambique (all $n=1$).</p> <p>§'Other' includes 'Shona' ($n=1$) and unspecified 'others' ($n=14$).</p> <p>¶The numbers reported include participant-estimated numbers of 'household' if the participant was residing in a residential facility.</p> <p>**Hout Bay is a seaside suburb of Cape Town which includes informal settlements.</p>	

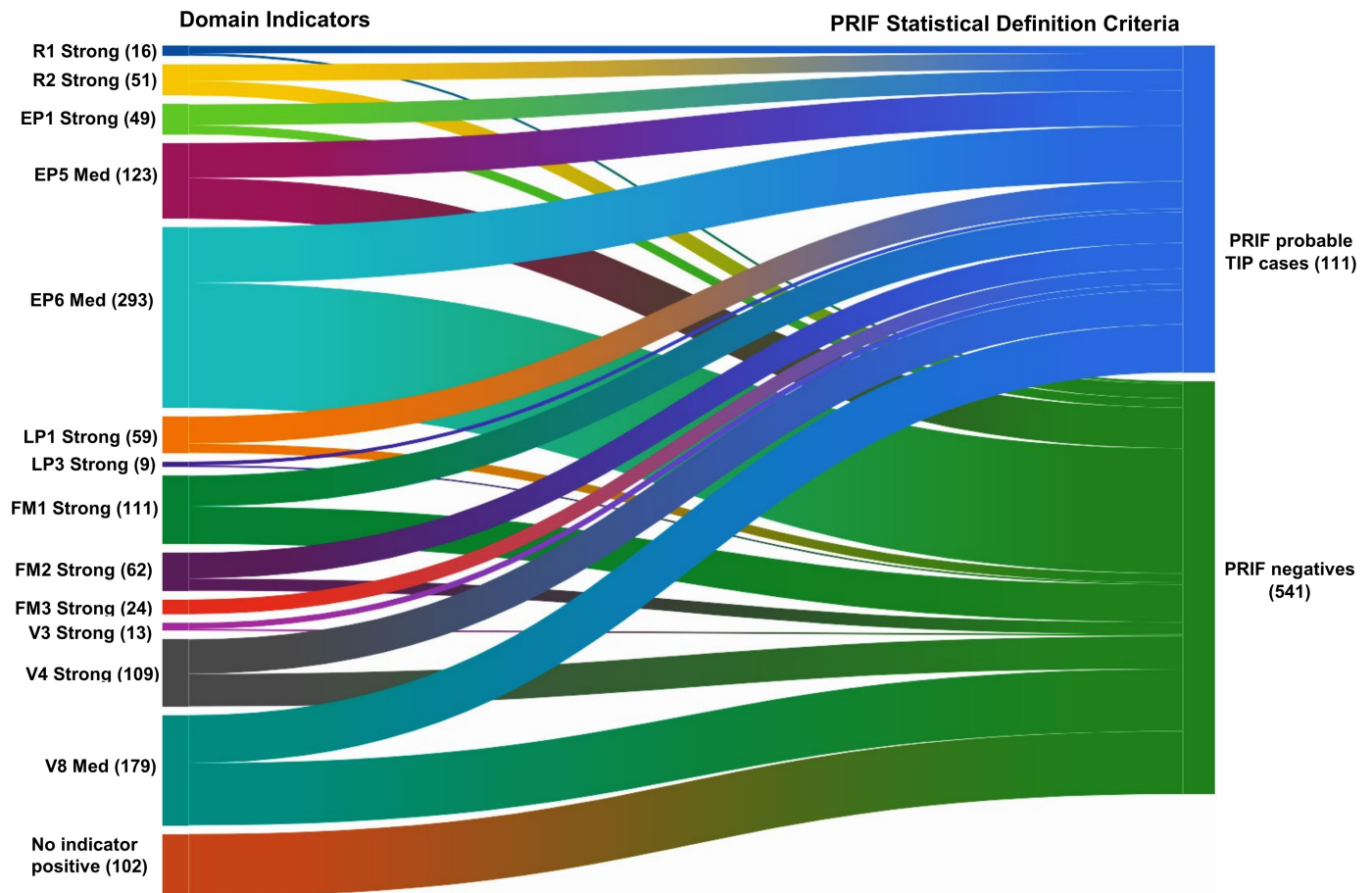


Figure 1 A flow representation of PRIF indicator positives (inputs) to PRIF statistical definition criteria (outputs), lifetime (sample $n=652$). The number in each indicator is the number of positives (see online supplemental table 3 for indicator descriptions). The total indicator positives exceeded the number of unique individuals (530) due to multiple indicator positives. The flow figure does not show exact proportions of PRIF positives and negatives (positive=111, negative=541). Indicators assessed but not positive endorsement were omitted here (EP7 medium and FM4 medium in online supplemental table 3). PRIF, Prevalence Reduction Innovation Forum; TIP, trafficking in persons.

gender categories (females lowest, males middle and non-binary/other the highest, $F=21.90$, $p<0.0001$); age categories ($F=2.81$, $p=0.039$); race (black Africans lowest, coloured in the middle and the rest was the highest, $F=12.22$, $p<0.0001$); country of origin ($F=3.90$, $p=0.021$); language ($F=9.16$, $p<0.0001$); and household size ($F=9.63$, $p<0.001$). A few statistically significant differences were found for the m-AHTST summary measure including: race ($F=10.75$, $p<0.0001$); household size ($F=15.32$, $p<0.0001$), and recruitment locations (Hout Bay or not, $F=9.44$, $p=0.002$). Reflecting different local characteristics, the recruitment locations variable was in turn significantly associated with age, race, education, country of origin, language, relationship status and household size (Fisher's exact test, all $p<0.0001$).

Prevalence estimates

A flow diagram of PRIF indicators across four domains (inputs) to PRIF criteria positives and negatives (outputs) (figure 1) illustrates the relative contribution of each of the 13 indicators for lifetime experiences (2 indicators omitted due to zero positive rate). Generally, indicators designated as 'medium' were experienced

more frequently but a smaller proportion of them were classified as PRIF positives. On the other hand, the 'strong' indicators were experienced less frequently but a higher proportion of them were classified as PRIF positives. At the bottom, the flow of 'no indicator positive' shows 15.6% of the sample members did not answer

Table 2 Lifetime and past 12 months prevalence of probable trafficking-in-person cases who met the partial Prevalence Reduction Innovation Forum statistical definitions* ($n=652$)†

Time duration	n (%)	SE (%)	95% CI
Lifetime prevalence	111 (17.0)	1.47	14.1% to 20.0%
Past 12 months	19 (2.9)	0.66	1.62% to 4.21%

*See online supplemental table 3 for domains and indicators used in the estimates.

†The oversampled non-binary participants ($n=13$) used for a substudy were removed from the analytical sample. Those missing or 'refused to answer' in specific screener questions were coded as negative in the corresponding indicators, granted that no participant met the criteria of 40% or more of screener questions missing.

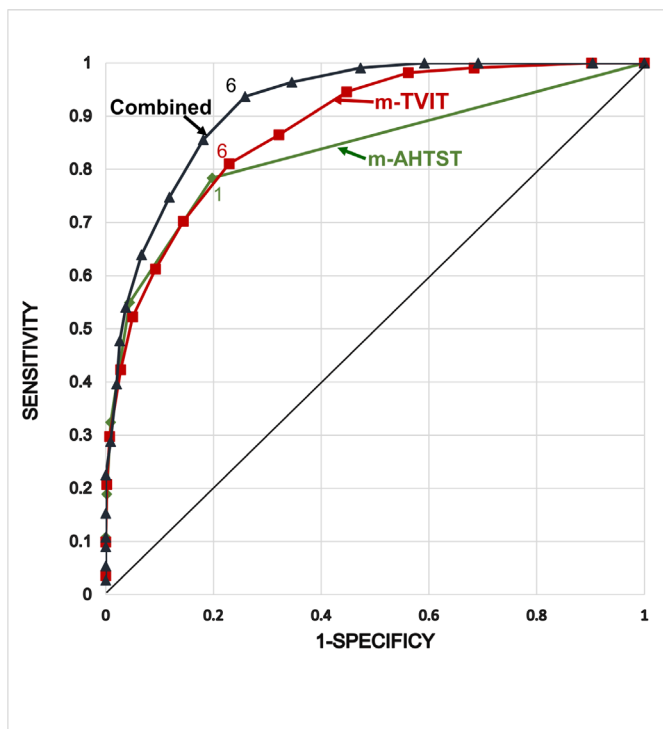


Figure 2 Receiver operating characteristic curves assessing the performance of the m-TVIT screener, m-AHTST screener and the synthetic combined score (n=652). The closer to the left top corner, the better performance. The diagonal line indicates no discrimination. Green line: m-AHTST; red line: m-TVIT; black line: synthetic combined score. The numbers indicate best cut-offs. m-AHTST, modified Adult Human Trafficking Screening Tool; m-TVIT, modified Trafficking Victim Identification Tool.

affirmative to any of the TIP screening questions that matched to PRIF indicators. Resulting estimates of the probable TIP cases meeting the limited PRIF statistical definitions yielded the lifetime prevalence of 17.0%

(95% CI 14.1% to 20.0%) and past 12-month prevalence of 2.9% (95% CI 1.62% to 4.21%) in this high-risk sample (table 2).

Performance of TIP screeners

In assessing the performance of the two modified screener measures, we drew the ROC curves that plot coordinates of successive sensitivity and (1-specificity) (figure 2). The closer the ROC curve reaches the upper left corner, the better the AUC, which assesses the predictive value of each screener. The best cut-off point maximises the values of sensitivity and specificity of the ROC curve.

The statistical assessment of ROC shows all three curves were much better than random draw ($p < 0.0001$ for all) (table 3). The AUC values were 0.880 for m-TVIT, 0.835 for m-AHTST and 0.921 for the synthetic combined summary measure; indicating the performance of these screeners were an excellent to outstanding range. The contrast testing using m-AHTST or m-TVIT as the reference shows that we cannot statistically distinguish the performance of m-AHTST versus that of m-TVIT; however, the synthetic combination is superior to either of them. The best cut-off score was 6 for m-TVIT, 1 for m-AHTST and 6 for the combined score, based on the Youden's J indices (varies from 0 to 1 with a higher index value indicating a better cut-off).

To assess clinical implications of common screening questions, positive endorsement rates of all screener questions are rank-ordered separately for m-TVIT and m-AHTST among those participants who met the probable PRIF criteria (table 4). Among the PRIF positives for lifetime criteria, all 16 items were endorsed, but endorsement rates were higher than those of the whole sample. The endorsement rates from m-TVIT items ranged the highest 70.3%, to the lowest 0.9%; and 12 items received endorsement of more than 50% of them. For the m-AHTST, endorsement rates were generally lower

Table 3 Performance of the modified Trafficking Victim Identification Tool (m-TVIT), short version and the modified Adult Human Trafficking Screening Tool (m-AHTST), as applied to the partial PRIF statistical definitions: Lifetime prevalence (n=652)

	m-TVIT	m-AHTST	m-TVIT and m-AHTST combined
ROC p value against ROC=0.5*	$p < 0.0001$	$p < 0.0001$	$p < 0.0001$
AUC†	0.880	0.835	0.921
P value using m-AHTST as reference	$p = 0.1287$	Reference	$p = 0.0002$
P value using m-TVIT as reference	Reference	$p = 0.1287$	$p < 0.0001$
Best cut-off‡	6	1	6
Youden's J§	0.5816	0.5860	0.6782

*ROC analysis for each and combined screeners are shown in figure 2. ROC=0.5 signifies no discrimination.

†The area under the curve for each ROC varies from 0.5 (random) to 1.0 (perfect classifier). 0.9–1.0 is considered outstanding; 0.8–0.9 is considered excellent.

‡The best cut-off is the number of screener questions involved in achieving the maximum sensitivity (true positive rate) and specificity (true negative rate) against the partial PRIF criteria within each screener or combined.

§Youden's J index is the height from the random AUC line (ROC=0.5) to the coordinates of the best cut-off or, sensitivity+specificity=1. Varies from 0 to 1.0.

AUC, area under the curve; PRIF, Prevalence Reduction Innovation Forum; ROC, receiver operating characteristics.

Table 4 Rank-ordered endorsements and selection of ‘best’ screening questions among the modified Trafficking Victim Identification Tool (m-TVIT) and the modified Adult Human Trafficking Screening Tool (m-AHTST)*

A. Numbers and percentages endorsed m-TVIT items for lifetime experiences				
Item number	Short description	PRIF positive number (%)*	AOR†	95% CI‡
T4	Worked w/o payment expected	88 (79.3)	1.89	0.78 to 4.63
T3	Worked pay not expected	87 (78.4)	1.54	0.64 to 3.71
T9	Not allowed to take break at work	84 (75.7)	Removed	
T7	Work made you feel scared/unsafe	71 (64.0)	1.64	0.82 to 3.29
T5	Payment withheld	66 (59.5)	1.14	0.59 to 2.20
T10	Injured/getting sick at work	65 (58.6)	Removed	
T8	At work threatened to hurt you	63 (56.8)	1.46	0.74 to 2.87
T6	Work different from promised	59 (53.2)	Removed	
T12	Tricked/pressured to do things	57 (51.4)	2.61	1.38 to 4.95
T11	Felt could not leave work	58 (52.3)	1.22	0.62 to 2.40
T15	Kept/took your ID	58 (52.3)	3.67	2.02 to 6.67
T13	Pressured for physical/sexual	56 (50.5)	10.21	5.21 to 20.00
T16	Work pay taken to pay for things	55 (49.6)	8.14	4.22 to 15.69
T14	Sex for things of value	53 (47.8)	Removed	
T2	Abducted or kidnapped	22 (19.8)	4.17	1.67 to 10.45
T1	Pressured to do things to pay debt	1 (0.90)	Removed	
B. Numbers and percentages endorsed m-AHTST items for lifetime experiences				
Item number	Short description	PRIF positive number (%)*	AOR*†	95% CI‡
A4	Restricted family contact	44 (39.6)	11.29	5.16 to 24.71
A5	Lived at work/boss chose	42 (37.8)	8.21	3.91 to 17.28
A2	Forced to do things to pay debt	38 (34.2)	5.92	2.86 to 12.25
A1	Lied/tricked into a job	37 (33.3)	Removed	
A3	Work restricted contacts/activities	32 (28.8)	5.11	1.45 to 18.00
A6	Threatened if not making money	29 (26.1)	4.14	1.83 to 9.37

*Lifetime PRIF positives n=111.

†AOR, controlling for all other screener items remained. 95% CI of AOR. The coefficients were estimated from the whole sample (n=652) using logistic regression initially to select insignificant screening items, then to further identify those items with a Lasso regularisation technique with a logit function. The Schwarz Bayesian criterion (a.k.a. Bayesian information criteria) was used primarily to select variables in the regularisation model, while the Akaike information criteria was also inspected for comparison. The final model parameter estimates were derived from the logistic regression using the H-L GoF test. For the final model of m-TVIT items (upper section): H-L GoF $\chi^2=4.875$, df=6, $Pr>\chi^2=0.560$; for the final model of m-AHTST items (lower section): H-L GoF $\chi^2=0.428$, df=1, $Pr>\chi^2=0.513$.

‡Item numbers and descriptions correspond to those in online supplemental table 1. Items are rank-ordered here according to the numbers (%) meeting the PRIF criteria for lifetime exploitation experiences.

§

AOR, adjusted OR; GoF, goodness-of-fit; H-L, Hosmer-Lemeshow; PRIF, Prevalence Reduction Innovation Forum.

than those of m-TVIT: the highest being 39.6%; however, lowest was 26.1%.

Further multivariate analysis using logistic regression and Lasso regularisation yielded five variables from m-TVIT that were less predictive of the lifetime PRIF criteria than the remaining 11 screener items. The removed five item are: ‘not allowed to take break at work’, ‘injured or getting sick at work’, ‘work different from what was promised’, ‘had sex for things of value’ and ‘pressured to do things to pay debt’. ORs of the remaining items show a varying degree of association, from 1.14

to 10.21 (more than 10 times as likely to be PRIF positive), when all other screener items were simultaneously controlled for. From the m-AHTST screener items, ‘lied or tricked into a job’, was only item among the six to be judged less predictive of the lifetime PRIF criteria than other five screener items. ORs of five remaining screener items ranged from 4.14 to 11.29.



DISCUSSION

Using the PRIF statistical definitions, we produced estimates of probable TIP positive cases, among 652 high-risk individuals aged 18 or older residing in Cape Town and the surrounding areas in South Africa. The PRIF statistical definitions yielded the lifetime prevalence rate of 17.0% and past 12-month rate of 2.9%. The rates are higher than an earlier national estimate by the GSI. Interpretation of the prevalence rates requires extreme caution, given that we used high-risk sampling, which resulted in disproportionately vulnerable participants with large numbers from informal settlements in the Hout Bay area.

The detailed flow analysis of endorsement patterns in this sample generally confirmed the designation of 'strong' and 'medium' PRIF indicators, although the selected indicators were limited in this study. The summary measures from TIP screeners showed excellent predictive utility with the AUC of the combined score exceeding 0.9. However, there was no clear statistical evidence that showed whether m-TVIT is better than m-AHTST based on these performance indices. Each summary measure was associated with several demographic and other background measures, but both measures were significantly different depending on race category and household size.

Reducing the number of screener questions saves time and burden for respondents. Moreover, in a clinical setting such as in an emergency department, it is critical to obtain the essential information to provide safety and downstream specialty care for potential human trafficking victims. While the majority of those meeting the PRIF lifetime criteria endorsed most of m-TVIT and m-AHTST questions, the proportion of reporting these experiences were higher among PRIF positives than the whole sample. The trend was even clearer for the past 12-month experiences (data not shown). Overall, we did not observe a distinctive subtype of questions (domain or indicator type) that suggests clear differentiation of exploitation experiences in this sample.

Notably, it is important to ask a rarely-experienced screener item such as 'abduction and kidnapping', which is highlighted in South Africa's PACOTIP legislation, as it proved to be a predictive indicator of probable TIP. Our variables selection showed that participants who affirmed such a victimisation were 50% more likely (OR=1.49) to be a probable TIP case when other exploitation experiences were simultaneously taken into account, even though only 20% of probable TIP cases had reported experiencing it. On the other hand, in our analysis, the question asking if participants had 'sex for things of value' was statistically less predictive of the PRIF definition criteria than others, although 48% of the sample PRIF positives experienced it. While it is an important TIP indicator for minors, in the context of an adult population living in economically disadvantaged Southern African countries, the experience of having sex for other things of value may not be perceived as trafficking-like victimisation by even those who experience it.^{41 42} Moreover, statistical analysis of collinear variables is often sensitive to the choice

of fit indices, estimation model and so on. Thus, additional cultural and economic contexts of the population TIP vulnerabilities should be carefully examined prior to implementing a standardised set of assessment tools.

Limitations of the study

The current study encountered several challenges and limitations. First, data collection occurred during the nation's second and third waves of the COVID-19 pandemic surges. Not only did the safety and protection of the research staff have to be the priority of fieldwork, but also many of our community contacts were temporarily or permanently unavailable during fieldwork.

Second, our hybrid sampling strategy was compromised by a lack of contact with venues drawn initially. In addition, because of the unique nature and heightened trafficking risk expected of residents in the Hout Bay informal settlement area, close to 35% were recruited in the area. Meaningful weights could not be constructed because population mobility is extremely high and not well reflected even in the most recent census of 2020, thus limiting the generalisability of the findings.

Third, invaluable assistance from the US government and the governmental body of South Africa specialising in TIP counter measures did not result in improving the research team's ability to collect survey data using a more systematic sampling method. This might reflect the nascent stage of TIP community research in South Africa. In fact, we observed that community residents were either unaware of human trafficking or not connecting the term 'human trafficking' to a severe form of human exploitation that can happen to them or that may have happened to them.

Fourth, only a limited number of the PRIF statistical definition indicators could be used in the current study. Ideally, TIP questions should be derived first from the PRIF indicators, not the other way around. That being said, such a screener first needs to be validated prior to commencing a large-scale community research. Furthermore, the PRIF statistical definitions have not been validated either. More work is needed to cross-validate the statistical definitions and TIP screener questions simultaneously.

CONCLUSION

The current study provides a direction to apply standardised assessment and epidemiological statistical definitions of TIP. Our estimates indicate community prevalence rates of TIP are much higher than those reported than an earlier estimate for South Africa. In our assessment, we found 17% of a high-risk sample in the Cape Town area met the PRIF statistical definition criteria; and 2.9% met the same criteria in the past 12 months. The human trafficking screeners used in this study yielded an excellent range of predictive utility, building the confidence of practical values for validated screening tools.

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REFERENCES

- 1 United Nations. *Protocol to prevent, suppress and punish trafficking in persons especially women and children, supplementing the United Nations convention against transnational organized crime*. Geneva: United Nations, 2000.
- 2 Victims of trafficking and violence protection act of 2000. Public law 106-385 2000.
- 3 Republic of South Africa. Prevention and combating of trafficking in persons act 7 of 2013 2013.
- 4 Ronda-Pérez E, Moen BE. Labour trafficking: challenges and opportunities from an occupational health perspective. *PLoS Med* 2017;14:e1002440.
- 5 Macias-Konstantopoulos W. Human trafficking: the role of medicine in interrupting the cycle of abuse and violence. *Ann Intern Med* 2016;165:582–8.
- 6 Oram S, Stöckl H, Busza J, *et al*. Prevalence and risk of violence and the physical, mental, and sexual health problems associated with human trafficking: systematic review. *PLoS Med* 2012;9:e1001224.
- 7 Hopper EK, Gonzalez LD. A comparison of psychological symptoms in survivors of sex and labor trafficking. *Behav Med* 2018;44:177–88.
- 8 Zimmerman C, Kiss L. Human trafficking and exploitation: a global health concern. *PLoS Med* 2017;14:e1002437.
- 9 Rothman EF, Stoklosa H, Baldwin SB, *et al*. Public health research priorities to address us human trafficking. *Am J Public Health* 2017;107:1045–7.
- 10 Chisolm-Straker M, Stoklosa H, eds. *Human trafficking is a public health issue: a paradigm expansion in the United States*. Cham, Switzerland: Springer International Publishing, 2018.
- 11 Okech D, Choi YJ, Elkins J, *et al*. Seventeen years of human trafficking research in social work: a review of the literature. *J Evid Inf Soc Work* 2018;15:103–22.
- 12 Weitzer R. New directions in research on human trafficking. *Ann Am Acad Pol Soc Sci* 2014;653:6–24.
- 13 Zhang SX. Measuring labor trafficking: a research note. *Crime Law Soc Change* 2012;58:469–82.
- 14 International Labor Organization. *Operational indicators of trafficking in human being – results from a Delphi survey implemented by the ILO and the European Commission*. Geneva, Switzerland: International Labor Organization, 2009. https://www.ilo.org/global/topics/forced-labour/publications/WCMS_105023/lang-en/index.htm
- 15 American Hospital Association. ICD-10-CM coding for human trafficking, 2018. Available: <https://www.aha.org/factsheet/2018-factsheet-icd-10-coding-human-trafficking> [Accessed 09 Oct 2018].
- 16 International Centre for Missing & Exploited Children and HEAL Trafficking. Documenting ICD codes and other sensitive information in electronic health records, 2021. Available: <https://cdn.icmec.org/wp-content/uploads/2021/02/Final-ICD-code-documentation-recommendations-Feb-2021.pdf> [Accessed 26 Mar 2021].
- 17 Dell N, Koegler E, Holzer JK, *et al*. ICD-10-CM codes infrequently used to document human trafficking in 2019 nationwide emergency department sample (under review).
- 18 Zhang SX. Progress and challenges in human trafficking research: two decades after the Palermo protocol. *J Hum Traffick* 2022;8:4–12.
- 19 Schroeder E, Aletraris L, Okech D, United States Department of State Office to Monitor and Combat Trafficking in Persons. *Human trafficking statistical definitions: prevalence reduction innovation forum*. University of Georgia African Programming and Research Initiative to End Slavery & The US Department of State Office to Monitor and Combat Trafficking in Persons, 2020. <https://www.aha.org/system/files/media/file/2020/08/PRIF-Statistical-Definitions-Documents-8-3.pdf>
- 20 American Psychiatric Association. *Diagnostic and statistical manual of mental disorders*. 5th edn. Washington, DC: American Psychiatric Association, 2013.
- 21 Macy RJ, Klein LB, Shuck CA, *et al*. A scoping review of human trafficking screening and response. *Trauma Violence Abuse* 2021;0:152483802110572–18.
- 22 Kaltiso S-AO, Greenbaum VJ, Moran TP, *et al*. Feasibility of a screening tool for sex trafficking in an adult emergency department. *Acad Emerg Med* 2021;28:1399–408.



- 23 US Department of State. *2021 trafficking in persons report*. Washington, DC: US Department of State, 2021.
- 24 Yesufu S. *Human trafficking: a South African perspective*. e-BANGI: Jurnal Sains Sosial dan Kemanusiaan, 2020; 17. 103–20. <http://journalarticle.ukm.my/16302/1/41247-131836-1-SM.pdf>
- 25 The Guardian. Bid for freedom: rescuing trafficking fishermen as they DOCK in Cape town, 2016. Available: <https://www.theguardian.com/global-development/2016/aug/11/rescuing-trafficked-fishermen-cape-town-south-africa-slave-like-conditions> [Accessed 28 Jul 2020].
- 26 Walk Free Foundation. The global slavery index, 2018. The Minderoo Foundation Pty, LTD. Available: <https://www.globalslaveryindex.org/resources/downloads/> [Accessed 12 Oct 2018].
- 27 International Labour Office (ILO) & Walk Free. *Methodology of the global estimates of modern slavery: forced labour and forced marriage*. Geneva, Switzerland: ILO, 2017. https://www.ilo.org/global/topics/forced-labour/publications/WCMS_586127/lang-en/index.htm
- 28 Gallagher AT. What's wrong with the Global Slavery Index? *Anti-Traffick Rev* 2017;8:90–112.
- 29 Gibson L, Rush D. Novel coronavirus in Cape town informal settlements: feasibility of using informal dwelling outlines to identify high risk areas for COVID-19 transmission from a social distancing perspective. *JMIR Public Health Surveill* 2020;6:e18844.
- 30 International Labour Office. ILO indicators of forced labour, ILO special action programme to combat forced labour, 2012. Available: https://www.ilo.org/global/topics/forced-labour/publications/WCMS_203832/lang-en/index.htm [Accessed 02 Jan 2022].
- 31 National Center on Safe Supportive Learning Environments (NCSSLE). *Human trafficking in America's schools: what schools can do to prevent, respond, and help students to recover from human trafficking*. 2nd edn. U.S. Department of Education, 2021. <https://www2.ed.gov/documents/human-trafficking/human-trafficking-americas-schools.pdf>
- 32 Bermudez LG, Okech D, Prakash M, eds. *Methods of prevalence estimation in modern slavery: an introductory overview*. Global Fund to End Modern Slavery & Norad, 2021. https://www.gfems.org/wp-content/uploads/2021/10/Revised_GFEMS_MethodologiesBooklet.pdf
- 33 Leon L, Jauffret-Roustide M, Le Strat Y. Design-based inference in time-location sampling. *Biostatistics* 2015;16:565–79.
- 34 Barrick K, Pfeffer R. Advances in measurement: a scoping review of prior human trafficking prevalence studies and recommendations for future research. *J Hum Traffick* 2021.
- 35 VERA Institute for Justice. Trafficking victim identification tool (TVIT). short version, 2014. Available: <https://www.vera.org/downloads/publications/human-trafficking-identification-tool-and-user-guidelines.pdf> [Accessed 17 Dec 2021].
- 36 US Department of Health and Human Services. Adult human trafficking screening tool (AHTST) and guide. Administration of Children & Family, Office on Trafficking Persons, and National Human Trafficking Training and Technical Assistance Center, 2018. Available: https://www.acf.hhs.gov/sites/default/files/documents/otip/adult_human_trafficking_screening_tool_and_guide.pdf [Accessed 17 Dec, 2021].
- 37 et al Simich L, Goyen L, Powerll A. Improving human trafficking victim identification - validation and dissemination of a screening tool, 2014. VERA Institute for Justice, Final report. Available: <https://www.ojp.gov/pdffiles1/nij/grants/246712.pdf> [Accessed 09 June 2021].
- 38 Hosmer DW, Lemeshow S, Sturdivant RX. *Applied logistic regression*. 3rd edn. Hoboken, NJ: John Wiley & Sons, 2013.
- 39 Efron B, Hastie T, Johnstone I, et al. Least angle regression. *Ann. Statist* 2004;32:407–51.
- 40 Wang Y. A survey of methods in variable selection and penalized regression, 2020. SAS Global Forum Paper SAS4387-2020. Available: <https://www.sas.com/content/dam/SAS/support/en/sas-global-forum-proceedings/2020/4287-2020.pdf> [Accessed 18 Jan 2022].
- 41 Elmes J, Skovdal M, Nhongo K, et al. A reconfiguration of the sex trade: how social and structural changes in eastern Zimbabwe left women involved in sex work and transactional sex more vulnerable. *PLoS One* 2017;12:e0171916.
- 42 Blumberg RL, Malaba J, Meyers L. Women Cross-border traders in southern Africa. contributions, constrains and opportunities in Malawi and Botswana, 2016. AECOM International Development & Bayan Global, prepared for the United States Agency for International Development. Available: https://banyanglobal.com/wp-content/uploads/2017/05/ICBT-Gender-Assessment-Report_Final_4-30-2016_DEC.pdf [Accessed 29 Jan 22].