

## ORIGINAL RESEARCH ARTICLE

# Adaptation and validation of the abortion provider stigma scale in Ethiopia

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## Abstract

Abortion care providers often face stigma from their communities and colleagues, which may compromise the quality of service they provide. This study aimed to adapt and validate the revised Abortion Provider Stigma Scale (APSS) for use in the Ethiopian context. A cross-sectional psychometric study was conducted among 98 providers in reproductive clinics across Ethiopia. The original 35-item APSS was reviewed by experts, culturally adapted and expanded to 44 items across five domains: disclosure management, internalized states, judgement, social isolation, and discrimination. The scale was then translated into Amharic and pilot tested before administration. Internal consistency was high across most domains (Cronbach's alpha > 0.70), and Confirmatory Factor Analysis supported the five-domain structure, though model fit indices were suboptimal. Nearly half of participants reported stigma, with internalized and disclosure-related stigma being most prevalent. The adapted APSS demonstrated potential for assessing abortion provider stigma and tracking intervention outcomes in Ethiopia. (*Afr J Reprod Health* 2025; 29 [9s]: 82-90).

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**Keywords:** Abortion care providers; stigma; Ethiopia

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## Résumé

Les prestataires de soins liés à l'avortement sont souvent confrontés à la stigmatisation de la part de leurs communautés et collègues, ce qui peut compromettre la qualité des services qu'ils offrent. Cette étude visait à adapter et valider la version révisée de l'échelle de stigmatisation des prestataires d'avortement (Abortion Provider Stigma Scale, APSS) pour une utilisation dans le contexte éthiopien. Une étude psychométrique transversale a été menée auprès de 98 prestataires travaillant dans des cliniques de santé reproductive à travers l'Éthiopie. L'APSS originale, composée de 35 items, a été examinée par des experts, adaptée culturellement et étendue à 44 items répartis en cinq domaines : gestion de la divulgation, états intériorisés, jugement, isolement social et discrimination. L'échelle a ensuite été traduite en amharique et testée en pilote avant son administration. La cohérence interne était élevée dans la plupart des domaines (alpha de Cronbach > 0,70), et l'analyse factorielle confirmatoire a soutenu la structure en cinq domaines, bien que les indices d'ajustement du modèle soient sous-optimaux. Près de la moitié des participants ont rapporté une stigmatisation, les stigmates intériorisés et liés à la divulgation étant les plus fréquents. L'APSS adaptée a démontré son potentiel pour évaluer la stigmatisation des prestataires d'avortement et suivre les résultats des interventions en Éthiopie. (*Afr J Reprod Health* 2025; 29 [9s]: 82-90).

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**Mots-clés:** Prestataires de soins liés à l'avortement; stigmatisation; Éthiopie

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## Introduction

To ensure equal rights for women and girls the Maputo Protocol was adopted by the African Union in 2003. It states that 'parties shall take all appropriate measures to protect the reproductive rights of women by authorizing medical abortion in cases of sexual assault, rape, incest, and where the continued pregnancy endangers the mental and

physical health of the mother or the life of the mother or the fetus'<sup>1</sup>.

It gives Member States that have ratified the Protocol the mandate to harmonize their laws in accordance with the Protocol; to train judges, lawyers, and law enforcement officials to understand the legal framework and allow abortion to the fullest extent of the law; and to facilitate its implementation by training and supporting health

professionals to provide safe abortion services within the full scope of the law. In addition, governments should warrant access to safe and legal abortion services for women and ensure the availability of the procedures free from shame and stigma<sup>2</sup>.

However, despite these legal and policy commitments, Sub-Saharan Africa region still has the highest proportion of unsafe abortions in the world with 77% of abortions in the region being unsafe<sup>3</sup>.

Among the barriers to safe abortion care, abortion stigma stands out as a widespread and culturally embedded challenge that affects both abortion seekers and providers<sup>3-5</sup>. Stigma has multifaceted effects on abortion seekers, resulting in psychological distress, social isolation, self-judgment, reduced access to support, and financial burden<sup>(3,6,7)</sup>. Stigma is also a conspicuous part of abortion providers' lives<sup>4</sup>. It has consequences that range from emotional exhaustion, burnout, isolation to harassment and discrimination<sup>8</sup>.

Stigma against abortion care providers also affects the quality of care they provide. In-depth interviews conducted among obstetricians and gynecologists showed stigma and ideological contention as barriers to the integration of abortion care services<sup>9</sup>.

Studies have shown abortion care providers are given minimal support in the facility and are forced to work in an ill-equipped environment. In some countries the existing legal ground puts providers at risk of litigation. There are also circumstances where abortion providers work under the risk of physical and verbal abuse<sup>10</sup>. To better understand and mitigate the concept of stigma against providers various tools have been developed. One of these is the revised abortion provider stigma scale (APSS) developed by Martin *et al.*<sup>11</sup>. This study aimed to adapt and validate the APSS tool for use in the Ethiopian context. The goal was to then use it for further research on the assessment of stigma against abortion care providers in Ethiopia.

Validating the APSS tool in Ethiopia is crucial to ensure it accurately reflects the country's unique cultural, social, and professional factors that shape abortion provider stigma<sup>4,12</sup>. Adaptation and validation help align the tool's language, concepts, and scenarios with Ethiopian values, beliefs, and healthcare realities, enabling it to comprehensively capture stigma dimensions experienced by

providers. This process also informs targeted interventions, training programs, and policy reforms aimed at reducing stigma and improving reproductive health services. Moreover, a previous study assessing the SABAS tool for medical professionals recommended developing a tailored scale for medical professionals, reinforcing the need for an adapted approach<sup>4</sup>.

## Methods

This was a cross-sectional psychometric study conducted to adapt and validate the revised Abortion Provider Stigma Scale (APSS) in Ethiopia. The study involved two phases: (1) expert review to assess the face and content validity of the APSS in the Ethiopian context, and (2) a quantitative survey to examine the scale's psychometric properties, including internal consistency and construct validity using Confirmatory Factor Analysis (CFA) conducted among health care providers working in reproductive clinics.

The original 35-item APSS developed by Martin *et al.*<sup>11</sup> was reviewed by a team of experts, including OB/GYN specialists, family planning fellows, and reproductive health researchers. This panel assessed the tool's relevance, clarity, and cultural appropriateness. Based on their feedback, nine new items were added, and several existing items were modified to align with the Ethiopian religious, sociocultural and clinical context. The adapted version resulted in a 44-item scale across five domains: disclosure management, internalized states, judgment, social isolation, and discrimination. The tool was translated into Amharic and back translated to ensure accuracy. A pilot test was conducted with five midwives to assess comprehension and clarity.

For the quantitative survey all healthcare providers working in reproductive clinics known as Michu clinics across the country were invited to participate. However, data were collected from 98 health care providers. Michu clinics, located in 12 university hospitals across Ethiopia, offer integrated services that includes postpartum follow-up visit, family planning provision, abortion care and evaluation of sexual assault victims. This multi-service approach was arranged to avoid stigma associated with the use of the clinics. The clinics are staffed by healthcare providers including nurses,

midwives, interns, residents, and obstetrics and gynecology specialists. One of the centers, Saint Paul Hospital Millennium Medical College (SPHMMC), has family planning and reproductive health fellows and sub-specialists in addition to the above-mentioned service providers. Most of the service providers in the clinics are also involved in other activities of the university's obstetrics and gynecology department including the labor ward and emergency room services. This study was carried out among consenting healthcare providers, nurses, midwives, residents, obstetricians, and gynecologists. Other supportive staff in these clinics such as pharmacists, laboratory technicians were not included.

Data collection took place between December 1, 2023, and January 31, 2024. Online surveys (via Google Forms) were used for most participants, while printed questionnaires were used for those working at SPHMMC and Gandhi Hospital in Addis Ababa.

Completed surveys were entered into IBM SPSS Statistics version 26. Descriptive statistics were used to summarize sociodemographic characteristics. Internal consistency of the APSS domains was assessed using Cronbach's alpha. Items with negative or weak item-total correlations were considered for removal.

The total APSS stigma score was computed by summing item scores across all domains. Twelve positively worded items were reverse coded before aggregation. A higher total score indicated lower stigma, while lower scores reflected higher stigma. Stigma levels were also described for each subdomain.

Confirmatory Factor Analysis (CFA) was conducted using IBM SPSS AMOS version 21 to assess the construct validity of the adapted APSS. The hypothesized model consisted of five latent constructs (disclosure management, internalized states, judgment, social isolation, and discrimination), each represented by multiple observed variables (items). Maximum likelihood estimation was employed for parameter estimation. Model fit was evaluated using the chi-square to degrees of freedom ratio ( $\chi^2/df$ ), with values less than 3 indicating acceptable fit; the Comparative Fit Index (CFI) and the Tucker-Lewis Index (TLI), both of which should be greater than or equal to 0.90

to suggest good fit; and the Root Mean Square Error of Approximation (RMSEA), for which values less than or equal to 0.08 are generally considered acceptable.

Standardized factor loadings of  $\geq 0.40$  were considered acceptable. Items with lower loadings or poor model fit were iteratively reviewed and dropped based on both statistical and conceptual considerations. Six items were removed following CFA results, reducing the final tool to 38 items across the five domains.

Ethical approval was secured from the Ethical Review Board of SPHMMC in July 2023 (Ref: PM2 3/960) before the start of the study. Before the collection of the study data, consent was obtained from the study participants. Study participants were not required to mention their names and participation in the study is on a volunteer basis.

## Results

### *Characteristics of study population*

A total of 98 healthcare providers completed the questionnaire. The majority (68.4%) were male, and the mean age was 31 years (range: 20–54 years). Most participants (93.9%) resided in urban areas, and 50% were married. Regarding professional background, 36.7% were OB/GYN residents, 20.4% nurses, and 19.4% midwives. The majority (71.4%) identified as Orthodox Christians. Over two-thirds (69.4%) reported being frontline abortion care providers. (Table 1)

### *Descriptive analysis of scale items*

Responses to the 44 items were measured on a 5-point Likert scale (from "All of the time" to "Never"). Reverse coding was applied to 12 positively framed items. Descriptive analysis of the 44-item tool revealed important patterns in how abortion stigma manifests among providers (Table 2). Nearly half of the respondents (49%) indicated that disclosing their involvement in abortion care would lead others to define them solely by this role, reflected by responses ranging from "sometimes" to "all of the time." Disclosure-related stigma appeared particularly pronounced in the context of family relationships: 35.7% of participants reported

**Table 1:** Socio-demographic characteristics of study participants

Variables	Categories	Number	Percent
Sex	Male	67	68.40%
	Female	30	30.60%
Religion	Orthodox	70	71.40%
	Muslim	11	11.20%
	Protestant	12	12.20%
	Catholic	1	1.00%
Residence	Urban	92	93.90%
	Rural	2	2.00%
	Semi-urban	1	1.00%
Marital	Married	49	50.00%
	Single	43	43.90%
	Divorced	2	2.00%
Occupation	Nurse	20	20.40%
	Midwife	19	19.40%
	Health officer	2	2.00%
	Intern	3	3.10%
	General practitioner	3	3.10%
	OBGYN resident	36	36.70%
	OBGYN senior	14	14.30%

they “always” avoided telling their families about their involvement in abortion care, and 25.5% reported doing so “often.”

Internalized stigma was also notable. One-third of the providers expressed doubts about whether their involvement in abortion care was morally justified, and 58% reported that they were “never proud” of the work they do while 56.1% of participants stating they “never felt ashamed” of their abortion care work. A substantial portion of respondents (35%) felt that abortion care is disproportionately targeted by restrictive legislation compared to other areas of healthcare. In contrast, perceived judgment from others appeared lower; more than half of the providers did not feel judged by their colleagues or support staff because of their involvement in abortion services.

The internal consistency of the APSS subscales was assessed using Cronbach’s alpha coefficients. The results indicated strong reliability across most domains. The disclosure management domain had a Cronbach’s alpha of 0.88, internalized states 0.74, judgment 0.93, and discrimination 0.90. The social

isolation domain demonstrated a lower, yet acceptable, reliability with an alpha of 0.64. Table 2

### **Confirmatory factor analysis (CFA)**

To evaluate the construct validity of the adapted scale, Confirmatory Factor Analysis (CFA) was conducted using Structural Equation Modeling (SEM) in IBM SPSS AMOS version 21. The model specified five latent constructs, each representing one of the APSS domains. Six items with standardized factor loadings below 0.40 were removed based on poor performance and conceptual redundancy (Table 3). These included statements related to fear of disclosure, moral uncertainty, legislative targeting, and difficulty sharing experiences with family or religious groups. Despite item removal, the resulting model showed only limited improvement in model fit. The final fit indices were  $\chi^2/df = 1.946$ , CFI = 0.74, TLI = 0.71, and RMSEA = 0.099 (90% CI: 0.091–0.107), suggesting suboptimal fit relative to conventional benchmarks. Nonetheless, the adapted scale retained structural alignment with the original APSS and demonstrated acceptable internal consistency across most subscales, supporting its potential use in measuring provider stigma in the Ethiopian context.

### **Total and subscale scores**

To calculate the adjusted APSS full scale the answers for each question were summed and lower scores showed higher level of stigma. For this purpose, a total of twelve questions were reverse-coded (Table 2). The mean for the questions on disclosure management was 40.3, for internalized states was 27.4, for judgment was 32.3, for social isolation was 14.3 and for discrimination, it was 30.5. The mean score for the APSS summarized score was 145.1. Those providers who scored less than half of the mean in the APSS scale sum are believed to have felt stigma (Table 4). Based on this 43.9 % of the providers felt stigma. Among the different categories the domain internalized state showed the highest level of stigma (50.5%) followed by social isolation (49.0%) and disclosure (48.0%). The discrimination domain showed the lowest reported stigma levels (21.4%) as shown on Table 4.

**Table 2:** Abortion provider's stigma scale (adapted)

Subscale (factor) and items	All of the time (%)	Often (%)	Sometimes (%)	Rarely (%)	Never (%)	Missing (%)
<b>Disclosure management</b>						
I feel like if I tell people about my involvement in abortion care they will ONLY see me as an abortion worker.	8.2	16.3	24.5	17.3	33.7	-
I worry about telling people I work in abortion care.	15.3	28.6	14.3	20.4	21.4	-
It bothers me if people in my neighborhood know that I work in abortion care.	13.3	20.4	21.4	16.3	28.6	-
I avoid telling people that I provide abortion care.	19.4	31.6	11.2	18.4	19.4	-
I am afraid that if I tell people I work in abortion care I could put myself, or my loved ones, at risk for violence.	6.1	7.1	16.3	14.3	55.1	1.0
I feel that disclosing my abortion work is not worth the potential hassle that could result.	19.4	32.7	26.5	10.2	9.2	2.0
I am afraid of how people will react if they find out about my work in abortion care.	12.2	15.3	23.5	17.3	29.6	2.0
I feel the need to hide my work in abortion care from my friends.	6.1	19.4	22.4	20.4	26.5	5.1
I find it hard to tell people I work in abortion care.	9.2	28.6	20.4	24.5	14.3	3.1
I am afraid if I tell people about my involvement in abortion care they will discriminate against me or my loved ones.	7.1	9.2	15.3	20.4	48	-
I avoid telling my families that I provide abortion care.	35.7	25.5	11.2	12.2	15.3	-
I don't feel comfortable disclosing my involvement in abortion care to religious friends or colleagues.	22.4	21.4	22.4	16.3	17.3	-
I feel that when I disclose my abortion work to strangers, they are supportive of me. *	6.1	10.2	26.5	24.5	31.6	1.0
Cronbach's Alpha- 0.88						
<b>Internalized states</b>						
I am proud that I work in abortion care. *	4.1	9.2	17.3	9.2	58.2	2.0
I feel connected to others who provide abortion care. *	7.1	21.4	23.5	22.4	23.5	2.0
I feel ashamed of my involvement in abortion care.	7.1	8.2	16.3	10.2	56.1	2.0
By providing abortion care, I am making a positive contribution to society. *	14.3	20.4	28.6	26.5	7.1	3.1
I feel guilty about my involvement in abortion care.	10.2	11.2	19.4	15.3	39.8	4.1
I don't feel comfortable going to church or mosque because of my involvement in abortion care.	17.3	35.7	15.3	9.2	20.4	2.0
I feel good about my work in abortion care. *	2.0	16.3	17.3	17.3	44.9	2.0
I feel that my work in abortion care is targeted by restrictive legislation more than other types of health care.	15.3	19.4	21.4	14.3	26.5	3.1
I question whether or not providing abortion care is a good thing to do.	29.6	27.6	9.2	14.3	15.3	4.1
I find it important to share with people that I work that I work in abortion care. *	4.1	9.2	24.5	27.6	30.6	4.1
Cronbach's Alpha- 0.74						
<b>Judgment</b>						
I feel that other health workers look	3.1	6.1	9.2	12.2	66.3	3.1

down on me because of my decision to work in abortion care.						
I feel that non-health workers (support staff) look down on me because of my decision to work in abortion care.	4.1	6.1	7.1	11.2	69.4	2.0
I feel that society (the general public) does not value me as an abortion worker.	9.2	7.1	12.2	14.3	53.1	4.1
When I see or read something about abortion in the papers, television, internet, social media, and other media outlets it makes me feel bad about myself.	9.2	6.1	11.2	6.1	64.3	3.1
I feel other healthcare workers question my professional skills when they learn that I work in abortion care.	8.2	1.0	9.2	8.2	69.4	4.1
I feel that people question my morals when they learn I work in abortion care.	5.1	6.1	13.3	23.5	49.0	3.1
I feel that friends and family who do not work in abortion care don't understand my work.	5.1	15.3	24.5	18.4	32.7	4.1
I worry that my family and friends will think less of me if I talk about the challenging parts of my work in abortion care	7.1	9.2	17.3	12.2	50.0	4.1
Cronbach's Alpha- 0.93						
<b>Social isolation</b>						
I feel that when I disclose my abortion work to family and friends, they are supportive of me. *	3.1	13.3	17.3	25.5	35.7	5.1
I feel I can talk openly with my family about my work in abortion care. *	3.1	9.2	13.3	34.7	35.7	4.1
I feel I can talk openly with my friends outside of work about my work in abortion care. *	3.1	11.2	16.3	25.5	38.8	5.1
I feel I can talk to friends at the workplace and colleagues about a hard day at work. *	26.5	31.6	16.3	15.3	5.1	5.1
I feel I can talk to close friends or family about a hard day at work. *	28.6	23.5	15.3	11.2	14.3	7.1
I feel that I can share about my work in abortion care with religious groups of my religion. *	2.0	7.1	21.4	28.6	36.7	4.1
Cronbach's Alpha- 0.64						
<b>Discrimination</b>						
I have been verbally threatened or insulted as a result of working in abortion care.	1.0	6.1	10.2	10.2	67.3	5.1
I have been physically threatened or attacked as a result of working in abortion care.	-	2.0	6.1	9.2	77.6	5.1
My family has been harassed or discriminated against by others who find out about my work in abortion care.	1.0	4.1	2.0	6.1	80.6	6.1
People treat my family members differently if they know about my work in abortion care.	2.0	2.0	3.1	13.3	73.5	6.1
I have been isolated by colleagues at work because of my involvement in abortion care.	2.0	4.1	3.1	4.1	80.6	6.1
I have been labeled by colleagues at work because of my involvement in abortion care.	-	5.1	3.1	11.2	74.5	6.1
I have been isolated from religious activities because of my involvement in abortion care.	4.1	4.1	6.1	2.0	77.6	6.1
Cronbach's Alpha- 0.90						

**Table 3:** List of items dropped after confirmatory factor analysis

Items dropped	Category
I worry about telling people I work in abortion care.	Disclosure management
I question myself whether or not providing abortion care is a good thing to do.	Internalized state
I find it important to share with people that I work in abortion care.	Internalized state
I feel that my work in abortion care is targeted by restrictive legislation more than other types of health care.	Internalized state
I feel I can talk to close friends or family about a hard day at work.	Social isolation
I feel that I can share about my work in abortion care with religious groups of my religion.	Social isolation

**Table 4:** Level of stigma across the different domains

	Mean score	Range	*Number and % reporting stigma
APSS total score	145.1	68-197	43.0 (43.9 %)
Disclosure	40.3	13-65	47.0 (48.0 %)
Internalized states	27.4	1-43	49.0 (50.5 %)
Judgment	32.3	11-40	32.0 (32.7 %)
Social isolation	14.3	7-28	48.0 (49.0 %)
Discrimination	30.5	8-35	21.0 (21.4 %)

\*Stigma defined as scoring below the domain-specific mean.

## Discussion

The adapted version of the APSS tool revealed 43.9 % of the providers felt stigma with the highest level observed in the internalized state domain and the lowest in the discrimination domain. This finding significantly differs from the findings of a study done among Ethiopian midwives using the SABAS (Stigmatizing Attitudes, Beliefs, and Actions Scale) tool which showed lower level of abortion related stigma<sup>4</sup>. This could be the result of the differing attributes of abortion stigma the two scales measure, with the SABAS tool measuring the stigma towards those who had abortion and the APSS tool assessing the stigma felt by abortion providers.

The experience of direct discrimination or workplace judgment were reported less frequently, with over two-thirds of the providers stating that they have never or rarely been threatened or labeled at the workplace or in the community. However, this may not reflect a true absence of stigma. Instead, it may reflect limited disclosure about their involvement in abortion care- over one-third of respondents reported always avoiding telling their families about their work, and nearly half felt that disclosing their work would result in being reduced to the label of “abortion provider.” Since abortion stigma is often ‘concealable stigma’ which is unknown unless revealed, providers must actively

manage this information and navigate the risks and consequence of potential disclosure<sup>7,13</sup>.

Alternatively, the lower level of discrimination could be due to the integrated model of abortion service delivery through Michu clinics, which are deliberately structured to reduce stigma by combining abortion care with other reproductive health services. Supporting this approach a global study that was conducted as part of the Royal College of Obstetricians and Gynaecologists’ ‘Making Abortion Safe’ Project, identified stigma felt by healthcare professionals and recommended integration of abortion services into public health system as a strategy to normalize abortion care and reduce stigma<sup>14</sup>. On the contrary, a strategy initially devised to increase quality of care by providing specialized care with separate abortion clinics in the United States have resulted in marginalization and exposure of both providers and patients to abortion stigma<sup>7</sup>.

In contrast to discrimination the study has revealed the high level of internalized stigma felt among providers. Nearly 60% of participants reported never feeling proud of their work in abortion care, and about one-third questioned whether providing abortion services was morally justified. At the same time, over half reported never feeling ashamed of their work. This internal conflict may reflect tension between professional duty and

prevailing social or religious norms. This is consistent with the findings of a research that examined abortion stigma through SABAS scale in Ethiopia which reported how some midwives reconciled their religious reservation with a sense of professional duty, and it underscores the importance of addressing stigma not only externally but also within providers' own perceptions of their work<sup>4</sup>.

## Strengths and limitations

This study included data from providers working in different regions of the country, all operating in a setup that actively provides abortion care service. While the study has valuable insights from these setups, it has several limitations that warrant consideration. The relatively small sample size, while adequate for preliminary CFA, limited the ability to achieve stronger model fit and generalizability. The integrated nature of abortion care within broader reproductive health services may have reduced the visibility of stigma, particularly in workplace settings. Additionally, the cultural tendency toward non-disclosure around abortion in Ethiopia may have led to underreporting of stigma experiences. Lastly, since the study was limited to Michu clinics, the findings may not reflect the experiences of providers in rural or non-specialized settings.

## Conclusion

This study attempted to adapt and validate the revised Abortion Provider Stigma Scale (APSS) for the Ethiopian context. The study findings indicate that the APSS, while retaining its original five domains, disclosure management, internalized states, judgment, social isolation, and discrimination, required cultural and linguistic modifications to improve contextual relevance in Ethiopia. These adaptations allowed the tool to more accurately capture the multidimensional nature of abortion stigma in the Ethiopian context. Though the majority of the stigma perception comes from within, the findings show the relatively high prevalence of stigma, urging the need for targeted interventions. These could include provider support groups, training programs that address moral distress and professional identity, and institutional policies that recognize and normalize abortion care as an essential component of reproductive health<sup>8,15</sup>.

Advocacy by the Ministry of Health and professional bodies could also play a critical role in reshaping narratives around abortion care and legitimizing providers' work. The findings from this study can be used as baseline finding for assessing outcomes of interventions.

The findings also suggest that while the adapted APSS is generally reliable, further refinement may be necessary to improve its construct validity in this context.

## Conflicts of interest

The authors declare that they have no potential conflicts of interest that could have influenced the findings reported in this article.

## Authors contribution

Kidist Lemma Gizachew- Conceptualization, Funding acquisition, Development of methodology, Data collection, analysis, Writing. Yared Dagne- Conceptualization, Analysis. Sarah W. Prager- Validation, Writing- reviewing and editing. Lemi Belay Tolu- Validation, Supervision. Mekitie Wondafrash- Development of methodology, data curation, analysis, validation, review and editing of manuscript.

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