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Development and validation of the mpox stigma scale (MSS) and mpox knowledge scale (MKS)

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Abstract

Background Few validated brief scales are available to measure constructs that may hinder mpox-related prevention and care engagement, such as knowledge and stigma. Both are highly salient barriers to infectious disease care and disease understanding, precursors to evaluating one's risk and need to, for example, accept vaccination. To address this gap, we developed and validated the Mpox Stigma Scale (MSS) and Mpox Knowledge Scale (MKS).

Methods As part of a full-scale clinical trial, we offered an optional mpox survey to participants who self-identified as African American or Black, were 18–29 years old, and lived in Alabama, Georgia, or North Carolina (2023, $N=330$). We calculated psychometric properties through confirmatory factor analyses (CFA) and applied Comparative Fit Index (CFI), Goodness of Fit Index (GFI), and Tucker-Lewis Index (TLI) values equal to or exceeding 0.90 and Root Mean Square Error of Approximation (RMSEA) and Standardized Root Mean Square Residual (SRMR) values less than 0.08 to determine adequate model fit. We computed internal reliability using Cronbach's alpha and calculated Pearson or Spearman correlation coefficients between the MSS and MKS and related variables.

Results For the MSS, CFA results showed that the one-factor model fit the data well ($\chi^2(df=5, N=330)=34.962$, CFI = 0.97, GFI = 0.99, TLI = 0.94, RMSEA = 0.13, SRMR = 0.03). For the MKS, the one-factor model provided a good fit to the data ($\chi^2(df=6, N=330)=8.44$, CFI = 0.99, GFI = 0.99, TLI = 0.95, RMSEA = 0.15, SRMR = 0.02). Cronbach's alphas were MSS = 0.91 and MKS = 0.83, suggesting good to excellent reliability. The MSS was correlated with the MKS ($r=.55$, $p<.001$), stigmatizing attitudes ($r=.24$, $p<.001$), attitudes towards mpox vaccination ($r=-.12$, $p=.030$), and worry about contracting mpox ($r=.44$, $p<.001$). The MKS was correlated with worry about contracting mpox ($r=.30$, $p<.001$) and mpox disclosure ($r=-.16$, $p=.003$).

Conclusions The MSS and MKS are reliable and valid tools for public health practice, treatment and prevention research, and behavioral science. Further validation is warranted across populations and geographic locations.

Trial Registration ClinicalTrials.gov NCT05490329.

Keywords Mpox, Stigma, Monkeypox, Scale validation, Psychometric Properties

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Background

Mpox is an infectious disease that can spread via respiratory droplets, exposure to blood or bodily fluids, or close contact with an infected individual's skin lesions [1]. According to the Centers for Disease Control and Prevention (CDC), from 2022 to 2023, there were 31,689 mpox cases, with nearly a third occurring among African American or Black individuals, leading to 56 mpox-related deaths in the United States (US) [2]. Mpox is preventable by vaccination; [3–6] however, despite the availability of effective vaccines, uptake during the outbreak was suboptimal, potentially due to vaccine hesitancy and stigma related to the infectious nature of the disease, disproportional effects on people of color, and higher prevalence among sexual minority men (SMM) [7–10]. Gaps in mpox vaccination are exacerbated among racial and ethnic minorities, [9, 11, 12] potentially putting Black and Hispanic populations at elevated risk for acquiring mpox, groups that may be hesitant to engage with healthcare systems due to historical mistreatment or general distrust [13]. While addressing barriers to care is a fundamental orientation of public health and medicine, being able to measure the obstacles accurately is a necessary precursor to the promotion of prevention and treatment efforts [14].

Research has indicated that fear of social rejection due to mpox acquisition, stigma, low self-perceived risk, and lack of mpox vaccine knowledge contribute to mpox vaccine hesitancy [8, 10, 15, 16]. Among these factors, stigma is a crucial element in understanding health behaviors, building upon the existing literature on stigma related to HIV and, more recently, COVID-19 [15, 17, 18]. Stigma is defined as an "attribute that is deeply discrediting", resulting in the labeling and perceiving of specific groups as socially undesirable and inferior based on factors such as ethnic background, a chronic disease, or any characteristic deemed different and devalued by the society [19]. Stigma theories suggest that stigmatizing attitudes are rooted in stereotypes, which involve generalized ideas, beliefs, assumptions, perceptions, or biases concerning a specific group of individuals or things [19–21]. Consequently, individuals facing stigma may experience a reduction in social value, loss of status, and discrimination, [19, 22]. leading to adverse health outcomes [23, 24]. In the context of mpox, stigmatizing attitudes and behaviors directed toward individuals with mpox or those at risk (e.g., SMM) can be caused by the perception that mpox is a "gay disease" or that individuals contract mpox due to engaging in certain sexual behaviors [10, 15, 16]. Another factor affecting care engagement is knowledge; a lack of mpox knowledge precludes prevention and treatment [16]. Since stigma and knowledge directly affect acceptance of medical care, being able to assess both constructs consistently is crucial to supporting individuals at elevated risk of acquiring mpox.

To date, few scales have been developed and validated to assess mpox stigma and related components. Curtis et al [10] developed a 4-item scale to measure stigma related to mpox morbidity and a 3-item scale to gauge fear of social rejection due to mpox acquisition (anticipated stigma). Similarly, Zimmerman et al [16] created items that assess aspects of mpox-related stigma beliefs, including perceived severity, perceived responsibility, stereotypes, and perceived norm violation (perceived stigma). While these scales make important contributions, neither presents psychometric results and neither assesses misconceptions about mpox transmission or beliefs, which could act as to increase mpox-related stigma.

To address the need for validated brief scales specific for mpox, we developed and validated the Mpox Stigma Scale (MSS) and Mpox Knowledge Scale (MKS). We investigated the relationships that these scales have with stigmatizing attitudes toward individuals with mpox, positive attitudes towards mpox vaccination, worry about contracting mpox, and disclosure of mpox status. Groups with elevated risk for acquisition must have basic knowledge and resist mpox-related stigma to accept prevention and treatment. These scales can serve as valuable tools for researchers and healthcare providers aiming to improve engagement in care for mpox prevention and treatment via stigma reduction and improved patient knowledge.

Methods

Participants and procedures

As part of the Tough Talks for COVID-19 (TT-C) two-arm randomized controlled trial (NCT05490329, R01MD016834), [25] we offered an optional mpox online survey to participants. The purpose of the TT-C study was to test a digital health intervention's effect on reducing vaccine hesitancy, leading to increased COVID-19 vaccine uptake. The TT-C study is fully detailed in our protocol manuscript, which has been published elsewhere [25]. Inclusion criteria for the primary study were meeting the following criteria (a) self-identifying as African American or Black, (b) aged 18 and 29 years, (c) residing in Alabama, Georgia, and North Carolina, and (d) being able to speak and read English (March-July, 2023, $N=330$). Of note, at the time our survey was developed, monkeypox was the referenced disease name, but in support of the November 28, 2022, recommendation by the World Health Organization (WHO), Health and Human Services (HHS), and the Centers for Disease Control and Prevention (CDC), we use the term mpox throughout this manuscript. Items in our scales were developed as new but were also informed by existing

publications on mpox and prior work in HIV-related stigma measurement [26, 27]. The study was approved by the Institutional Review Boards of the University of North Carolina at Chapel Hill, Florida State University, and the University of Alabama at Birmingham. Informed consent was collected from all study participants before data collection.

Measures

Mpox stigma scale (MSS)

The MSS was developed to assess stigmatizing attitudes toward individuals with mpox. We created a pool of five items that capture different themes such as blame/self-blame, moral judgement, stereotyping, discrimination, and stigma, by examining quantitative and qualitative studies conducted with individuals with and without mpox (e.g., [8, 28–30]). The study team then consulted with expert reviewers to determine which items to include and whether the items were acceptable for measuring mpox-related stigma, resulting in the exclusion of no items. The MSS consists of five items rated on a 4-point Likert-type scale ranging from 1 (strongly disagree) to 4 (strongly agree). See Supplemental Table 1 for the MSS. Sample items include statements such as "People with monkeypox are dirty" and "People with monkeypox should feel ashamed." Composite scores are computed as the mean of these items, with higher scores indicating more stigmatizing attitudes.

Mpox knowledge scale (MKS)

We assessed knowledge about mpox transmission with four questions developed within this study. In the development process of the MKS, we followed the same procedures as those used for the MSS. Specifically, after examining the existing literature on mpox knowledge, we initially generated six items measuring knowledge and beliefs related to mpox, including gender-, sexual orientation-, and transmission-specific misbeliefs, as well as risk perception. After expert reviews, we excluded two items from the scale and finalized a 4-item MKS scale. Items were rated on a 5-point Likert-type scale ranging from 1 (strongly disagree) to 5 (strongly agree), with higher scores indicating higher misconceptions. See Supplemental Table 2 for the MKS. Sample items are "Monkeypox only affects gay men" and "Monkeypox is a sexually transmitted infection."

Validation measures all validation scales and questions were developed by the study team to use for validating the newly developed scales, as no other measures were available at the time the study was designed. See Supplemental table 3 for the validation scales

Our newly developed scales were validated against existing measures and constructs. See Supplement Table 1 for a summary of validation measures presented below.

Stigmatizing attitudes

Stigmatizing attitudes toward people with mpox were assessed using five questions developed for this study. Items were rated with 'Yes' (1) or 'No' (0) responses and included questions such as "Have you ever thought less about someone with monkeypox?" and "Have you ever joked about monkeypox?" These validation questions differed from the MSS, because while the MSS included Likert scale questions, these measures only included response categories of yes or no. These responses to the items were averaged and then summed to produce a total score ranging from 0 to 5, with higher scores indicating more stigmatizing attitudes.

Positive attitudes towards mpox vaccination

Positive attitudes towards vaccination were assessed with four questions developed in the current study. Items were rated with Yes (1) or No (0) responses and included "I have taken the Monkeypox vaccine" and "I would accept the Monkeypox vaccine."

Worry about contracting mpox

We assessed worry about contracting mpox with the single question "In the past two weeks, I've worried a lot about contracting monkeypox" rated on a 4-point Likert-type scale ranging from 1 (strongly disagree) to 4 (strongly agree), with higher scores indicating higher worry.

Mpox disclosure

Mpox disclosure items were developed to measure how comfortable participants would be when discussing their

Table 1 Correlation coefficients

Variables	1	2	3	4	5	6
1. MSS	-					
2. MKS	0.55***	-				
3. Stigmatizing attitudes	0.24***	0.08	-			
4. Positive attitudes towards mpox vaccination	−0.12*	−0.04	0.04	-		
5. Worry about contracting mpox	0.44***	0.30***	0.19***	0.09	-	
6. Mpox disclosure	−0.10	−0.16**	−0.15**	0.07	−0.05	-

*$p<.05$, **$p<.01$, ***$p<.001$

mpox status with others (having mpox symptoms). Participants were given a stem question, "Would you be comfortable discussing mpox with." Items included "primary care providers", "sexual partner(s)", "family members", "close friends", and "co-workers or colleagues" with responses on a 4-point Likert-type scale ranging from 1 (not comfortable) to 4 (very comfortable). Composite scores were computed as the mean of these items, with higher scores reflecting higher levels of comfort with disclosure.

Statistical analyses

We calculated descriptive statistics for the sample and examined the psychometric properties of the MSS and the MKS through confirmatory factor analyses (CFA). Since both the MSS and the MKS were designed as unidimensional scales, we hypothesized one-factor models for each of these scales. The evaluation of CFA model fit involves various model fit indices. In this study, we applied the following criteria to determine adequate model fit: Comparative Fit Index (CFI), Goodness of Fit Index (GFI), and Tucker-Lewis Index (TLI) values equal to or exceeding 0.90; and Root Mean Square Error of Approximation (RMSEA) and Standardized Root Mean Square Residual (SRMR) values less than 0.08 [31–34]. Subsequently, we computed the internal reliability of the scales using Cronbach's alpha. Finally, to examine the validity of both the MSS and MKS, we calculated Pearson or Spearman correlation coefficients between the MSS and MKS and other variables (i.e., stigmatizing attitudes, positive attitudes towards mpox vaccination, worry about contracting mpox, and mpox disclosure). All analyses were conducted using the JASP computer software (Version 0.17.3; JASP Team, 2023) [35].

Table 2 Descriptive statistics ($N=330$)

	N	%
States		
Alabama	61	18.5
Georgia	152	46
North Carolina	117	35.5
Ethnicity		
Hispanic	16	4.8
Non-Hispanic	314	95.2
Gender		
Men	51	15.5
Women	274	83
Transgender men	4	1.2
Transgender women	1	0.3
Insurance		
No insurance	34	10.3
Private	157	47.6
Public	119	36.1
Do not know	16	4.8
Prefer not to answer	4	1.2
Education level		
Less than highschool	16	4.8
High school graduate or GED completed	81	24.5
Some college level/technical/vocational degree	121	36.7
Bachelor's degree	79	23.9
Other advanced degree (Master's, Doctoral degree)	30	9.1
Prefer not to answer	3	0.9
Total household income		
Less than $15,000	65	19.7
$15,000-$19,999	33	10
$20,000-$24,999	20	6.1
$25,000-$34,999	43	13
$35,000-$49,999	54	16.4
$50,000-$74,999	42	12.7
$75,000-$99,999	22	6.7
$100,000 and above	18	5.5
Do not know	22	6.7
Prefer not to answer	11	3.3
	M	**SD**
Age, years	23.64	3.41

Results

Descriptive demographics

Descriptive statistics are in Table 2 ($N=330$). The majority of participants (83%) identified as cisgender women, with a mean age of 23.64±3.41 (ranging from 18 to 29) years. A total of 314 participants (95.2%) were non-Hispanic; nearly half (47.6%) reported having private insurance; 121 (36.7%) held a college degree, and 65 (19.7%) reported a total household income of less than $15,000. Per the inclusion criteria, all (100%) of participants identified as African American or Black.

Psychometric properties of the MSS and the MKS

To test the factorial validity of the MSS and the MKS, two separate CFAs were performed with one-factor models and maximum likelihood estimation. For the MSS, CFA results showed that the one-factor model fit the data well ($\chi^2(df=5, N=330)=34.962$, CFI=0.97, GFI=0.99, TLI=0.94, RMSEA=0.13, SRMR=0.03), with significant standardized factor loadings ranging from 0.77 ("People with monkeypox are dirty") to 0.88 ("People with monkeypox should feel ashamed"). As for the MKS, the one-factor model also provided a good fit to the data ($\chi^2(df=6, N=330)=8.44$, CFI=0.99, GFI=0.99, TLI=0.95, RMSEA=0.15, SRMR=0.02). All standardized factor loadings were significant and ranged from 0.46 ("Monkeypox is a sexually transmitted infection") to 0.97 ("Monkeypox is a men's disease"). All factor loadings for the items of both the MSS and MKS are presented in Table 3.

Table 3 Factor loadings of the MSS and MKS items

Items	Cronbach's alpha	Factor loading
MSS	0.91	
People with mpox should feel ashamed.		0.88
People with mpox are irresponsible.		0.84
Only gay people get mpox.		0.81
If you contract mpox, you are promiscuous.		0.80
People with mpox are dirty.		0.77
MKS	0.83	
Mpox is a men's disease.		0.97
Women do not have to worry about mpox.		0.86
Mpox only affects gay men.		0.83
Mpox is a sexually transmitted infection.		0.46

Reliability of scales

Cronbach's alpha coefficients were calculated to examine the internal consistency of the scales. Cronbach's alpha values were 0.91 for the MSS and 0.83 for the MKS, suggesting that they are good or excellent tools in reliability.

Validity of scales

To examine the validity (i.e., concurrent and/or convergent validity) of the scales, we calculated correlation coefficients. As shown in Table 1, the MSS was statistically significantly correlated with the MKS (r=.55, p<.001), stigmatizing attitudes (r=.24, p<.001), positive attitudes towards mpox vaccination (r=-.12, p=.030, note: negative indicating lower positive attitudes), and worry about contracting mpox (r=.44, p<.001). Additionally, the MKS was statistically significantly correlated with worry about contracting mpox (r=.30, p<.001) and mpox disclosure (r=-.16, p=.003).

Discussion

The purpose of this study was to present the newly developed MSS and MKS with a rigorous examination of their reliability and validity via psychometric property analyses among African American or Black identifying young adults in the southern US. Results provide evidence for the strong reliabilty and validity of both scales indicating readiness for broad scientific use and further testing. The MSS was correlated with the MKS, stigmatizing attitudes, reduced positive attitudes towards mpox vaccination, and worry about contracting mpox, all well aligned and indicative of stigma and social aversion. In addition to being associated with the MSS, the MKS was correlated with worry about mpox acquisition and disclosure, both constructs related to basic knowledge about the mpox viral infection. To our knowledge, this study is the first to validate scales for mpox stigma and mpox knowledge among African American or Black youth, an underserved and priority population for tailored public health prevention efforts.

While validated scales to assess mpox stigma and knowledge are new scientific contributions, stigma and knowledge constructs have been included, measured, and validated within HIV-focused scales and leveraged broadly across HIV prevention and care research and this has informed the framing of this study and processes for ascertaining reliabilty and validity [26, 27]. Of note, brief scales, such as the MSS and MKS, are particularly valuable when conducting assessments with research-averse populations or groups that are uncomfortable disclosing in-depth information on a stigmatized condition, such as mpox. Brief scales are widely used across clinical care and the behavioral sciences, often as screeners prior to the conduct of more detailed or intensive evaluations [36, 37].

The work presented herein expands on prior mpox studies, both scale-development research and related assessments. For example, in a study conducted in Brazel, by Torres et al., found that sexual and gender minorities had high pox knowledge and were willing to accept a pox vaccination [38]. In a 2024, study, researchers adapted the HIV Stigma Scale to assess stigma plus pain from people with mpox in Baltimore, Maryland. Stigma outcomes were high as they related to framing the LGBTQ+community in a negative light, along with high levels or reported pain [39]. As illustrated in the latter study, there is a need for validated brief stigma scales for use in research and clinical care, especially when exploring different dimensions and sources of stigma.

Mpox prevention interventions that address stigma and evaluate knowledge, by using the MSS and MKS, may offer promising opportunities to address time sensitive outbreaks, where containing transmission may require quick and reliable understanding of what populations know and how they feel towards mpox. Moreover, these scales can guide the development of public health responses to other viral infectious diseases which require that affected populations understand how the disease is transmitted and not feel stigmatized when care is needed.

Limitations

Caution should be expressed when extending findings. Data analyzed are cross-sectional and therefore restrict our ability to ascertain changes over time. Our sample was exclusively African American or Black, mostly non-Hispanic, predominantly female, and well-educated, limiting generalizability. We are unaware of other psychometrically validated scales for mpox stigma and knowledge; therefore, convergent and discriminant analyses are limited. The orientation of the parent study, which aimed to improve COVID-19 vaccine uptake, may have influenced responses related to pox. These scales were tested among young adults, and therefore outcomes may vary when applying them to adolescents or adults aged 30 years and older, requiring a further examination of their psychometric properties in older populations. Relatedly, our sample was recruited from southern states, namely Alabama, Georgia, and North Carolina, limiting potential application to other geographic areas. Finally, the newly developed scales are less likely to capture dimensions of stigma (e.g., anticipated, experienced), highlighting a possible need for comprehensive scales.

Conclusions

The Mpox Stigma Scale (MSS) and Mpox Knowledge Scale (MKS) are reliable and valid tools for use in public health practice, treatment and prevention research, and behavioral science. Results of our analyses demonstrate the basic psychometric properties of these two new and meaningful scales to measure stigma and knowledge related to mpox. Further validation is warranted, particularly across populations, such as predominantly male samples, and geographic locations outside the southern US.

Abbreviations

CDC	Centers for Disease Control and Prevention
CFI	Comparative Fit Index
COVID-19	Novel Coronavirus 2019
GFI	Goodness of Fit Index
HIV	Human Immunodeficiency Virus
MSS	Mpox Stigma Scale
MKS	Mpox Knowledge Scale
SMM	Sexual Minority Men
TLI	Tucker-Lewis Index
RMSEA	Root Mean Square Error of Approximation
SRMR	Standardized Root Mean Square Residual
US	United States of America

Supplementary Information

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Supplementary Material 1

Supplementary Material 2

Supplementary Material 3

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Author contributions

HB and LBHW are co-Principal Investigators of the study. HB is the first and lead author. LBHW is the last and senior author on this protocol manuscript. HB and LBHW contributed equally. IY, MCDS and EB are statistical and quantitative experts who conducted analyses reported herein. JBS was the lead data manager. AP is an epidemiology scholar contributing with mpox expertise. All authors contributed to the writing and editing of this manuscript.

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Data availability

The data sets will be shared in compliance with National Institutes of Health data sharing policies and will be made available from the first or senior authors on reasonable request. Dr. Henna Budhwani may be reached at hbudhwani@fsu.edu, and Dr. Lisa B. Hightow-Weidman may be reached at lhightowweidman@fsu.edu.

Declarations

Ethics approval

The study was approved by the Institutional Review Boards of the University of North Carolina at Chapel Hill, Florida State University, and the University of Alabama at Birmingham. Informed consent was collected from all study participants before data collection.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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