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Advancing methodology in the study of HIV status disclosure: the importance of considering disclosure target and intent

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Abstract:

Disclosure of HIV status has been the focus of three decades of research, which have revealed its complex relations to many behaviors involved in HIV prevention and treatment, and exposed its central role in managing the HIV epidemic. The causes and consequences of disclosure acts have recently been the subject of several theoretical models. Although it is acknowledged that individual disclosure events are part of a broader process of disclosing one's HIV status to an increasing number of people, this process has received less theoretical attention. In quantitative studies of disclosure, researchers have often implicitly assumed that disclosure is a single unidimensional process appropriately measured via the total number of one's disclosure acts. However, there is also evidence that disclosure may have different causes and consequences depending on the types of actors involved (e.g. family members, friends) and on the presence or absence of the discloser's intention, suggesting that the unidimensionality assumption may not hold. We quantitatively examined the dimensionality of voluntary and involuntary disclosure to different categories of actors, using data collected via structured interviews in the spring of 2010 from 158 people living with HIV in Kilimanjaro, Tanzania. For voluntary disclosure, nonparametric item response analyses identified two multi-category clusters, family and community, and two single-category dimensions, partner and children. Involuntary disclosure consisted of several single- or two-category dimensions. Correlation analyses between the resulting disclosure dimensions and stigma and social support revealed distinct relationships for each disclosure dimension. Our results suggest that treating disclosure as a unidimensional construct is a simplification of disclosure processes that may lead to incorrect conclusions about disclosure correlates. We therefore recommend examining disclosure acts jointly to identify sample-specific dimensions before examining causes and consequences of disclosure. We propose a

methodology for investigating disclosure processes, and recommend its adoption in future disclosure studies.

Keywords: PLWH; Tanzania; HIV disclosure; HIV-related stigma; social support; item response theory; measurement

Introduction

HIV-status disclosure can have a considerable impact on the psychological well-being of people living with HIV (PLWH) and on the prevention of HIV transmission, via behaviors such as HIV-testing, negotiating safe sex, involvement in medical care, breast feeding (Chaudoir et al., 2011; Klitzman et al., 2004; Nachega et al., 2012; Stutterheim, Bos et al., 2011; Wohl et al., 2011). Many studies have examined the causes and consequences of disclosure in PLWH (e.g., Chandra et al., 2003; Chaudoir & Fisher, 2010; Pachankis, 2007; Sandelowski et al., 2004). Some studies suggest that disclosing one's HIV status can have beneficial effects such as increased social support, decreased experienced stigma, improved treatment adherence, greater well-being, and healthier behaviors (Peretti-Watel et al., 2006; Skogmar et al., 2006; Smith et al., 2008). Other studies point out that disclosure may also result in stigmatization (Stutterheim, Bos et al., 2011; Valle & Levy, 2009) manifest as, for example, avoidance, rejection, exclusion, blaming, physical distance, and awkward social interaction (Shamos et al., 2009; Stutterheim et al., 2009, 2012). High levels of perceived, anticipated, or internalized stigma, in turn, have been found to yield lower levels of disclosure (Stutterheim, Shiripinda et al., 2011; Tsai et al., 2013; Wolitski et al., 2009). Recent reviews of HIV disclosure research describe a complex and often inconsistent picture of the relationships between disclosure acts, antecedents and outcomes (Chaudoir & Fisher, 2010; Chaudoir et al., 2011; Smith et al., 2008). Clarifying these relationships is essential for

the development of successful interventions to reduce stigma, enhance social support, maintain mental and physical health, promote healthy behaviors, and thereby improve the general well-being of PLWH, and lower the risk of HIV transmission (Chaudoir et al., 2011).

One strategy to accelerate progress in this research area is to refocus on fundamental aspects of how we operationalize, measure, and analyze disclosure quantitatively. There has been renewed interest recently in advancing conceptual and measurement clarity. Several reviewers highlighted the need for improved measurement (e.g. Obermeyer et al., 2011; Smith et al., 2008), and several authors proposed models to guide research on disclosure (Bairan et al., 2007; Bird & Voisin, 2011; Chaudoir & Fisher, 2010; Chaudoir et al., 2011; Mayfield Arnold et al., 2008; Serovich et al., 2008) and stigma (Bos et al., 2013; Earnshaw & Chaudoir, 2009; Mahajan et al., 2008). However, although most research has focused on the broader process of increasing one's disclosure levels from none or few confidants to the entire social network, the existing theoretical models interpreted all empirical evidence in terms of causes and consequences of single disclosure events. This interpretation may not be fully warranted, as individual events may well have different effects on relevant outcomes compared to overall assessments of one's degree of disclosure regarding one's identity (Chaudoir & Fisher, 2010). To further improve conceptual clarity, it is therefore necessary to distinguish between these two conceptualizations of disclosure, i.e. event versus process, and, in addition, to direct theoretical and methodological efforts towards the disclosure process.

Disclosure is often implicitly conceptualized as a single gradual process of sharing information about one's HIV status to an increasing number of people, but evidence is accumulating that this is not a uniform process (Obermeyer et al., 2011). Thus, examining the possible dimensions of disclosure may lead to its better conceptualization and measurement. Within the existing literature, two factors stand out as potential sources of multi-dimensionality: the types of actors involved as disclosure targets, and the discloser's

intention. While their influence is commonly overlooked, several studies suggest that considering these factors may be relevant for understanding the dynamics of HIV-status disclosure.

Quantitative studies examining predictors or consequences of disclosure often include several disclosure targets in their assessment tool and ask people to select to whom they have disclosed from a list of actor categories (e.g. Emlet, 2006; Skogmar et al., 2006). However, a common analytical choice is to add up positive answers to obtain a total score representing the extent of disclosure (e.g., Armistead et al., 1999; Emlet, 2006; Wohl et al., 2011), or merge them into a dichotomous variable assessing whether the person disclosed to no one versus to at least one person (Nachega et al., 2012; Wohl et al., 2011). This method does not allow for an examination of dimensionality, as computing a total score or a dichotomous variable implicitly assumes that disclosure acts involving various actors are interchangeable indicators of a single disclosure process. This assumption might not hold, as several studies, both qualitative and quantitative, indicate that each act of disclosure to a particular type of actor may have different causes and consequences. For example, disclosure to a partner may be intended to prevent HIV transmission and to gain social support in the context of a steady relationship, disclosing to a family member may aim for emotional or financial support, while disclosing to a broader audience may be motivated by a wish to change the perception of PLWH by the community at large (Greeff et al., 2008; Sowell et al., 2003; Stutterheim, Shiripinda et al., 2011; Vu et al., 2012). Hence, other authors chose to analyze disclosure acts to different actor categories separately (Armistead et al., 1999; Tsai et al., 2013). However, this choice assumes that disclosure acts are independent of each other, which goes against existing evidence that suggests single disclosure events are likely to influence the likelihood of subsequent disclosure (Chaudoir & Fisher, 2010; Chaudoir et al., 2011). Between unidimensionality and independence lays a third analytical choice (so far

unexplored): to conceptualize HIV disclosure as a multi-dimensional phenomenon consisting of several clusters of related disclosure events involving different types of actors. Adopting any of these three choices based on theoretical arguments alone may lead to erroneous conclusions if the approach selected does not match the dynamics of HIV disclosure in the target population. Fortunately, this decision can also be informed by a psychometric analysis of participants' reports regarding disclosure to a range of actor categories. By performing such analysis, researchers would be able to adapt the conceptualization of HIV disclosure to the population under study, and thus build a more valid basis for examining the causes and consequences of disclosure taking into account the type of actors. No empirical investigations of HIV disclosure have adopted this approach to date.

Similarly to the role of disclosure target, the influence of the discloser's intention on HIV-status disclosure has been scarcely explored. Assessment tools rarely inquire as to whether disclosure acts were voluntary or involuntary, but simply ask about their occurrence thereby implicitly assuming that intention has a negligible impact. Yet, the causes and consequences of disclosure acts may vary substantially depending on whether they occur as an intentional and planned activity or without one's intent. In the first case, the discloser maintains control over the decision to disclose and/or aspects of the event itself such as the content and timing (Chandra et al., 2003; Chaudoir et al., 2011; Sandelowski et al., 2004), and the event may be beneficial particularly if motivated by approach-focused goals (Chaudoir & Fisher, 2010). In the second case, for example when others infer one's HIV status from visible physical symptoms or seeing a person enter an HIV clinic, or when the information is disclosed without one's consent by another person, disclosure may be have particularly harmful consequences such as increased stigma (Obermeyer et al., 2011; Sandelowski et al., 2004). Although several qualitative studies have made the distinction between voluntary disclosure versus disclosure without consent (Chandra et al., 2003),

managed versus mismanaged (Sandelowski et al., 2004), or voluntary versus involuntary disclosure (Varga et al., 2006), we have not found any quantitative studies that have examined them as separate dimensions. In light of these qualitative findings, assessing voluntary and involuntary HIV disclosure separately may open new possibilities for investigating HIV disclosure processes in terms of both dimensionality and relationships with relevant concepts.

In sum, disclosure is a central topic in HIV-related research, and many studies have revealed its relation to numerous concepts relevant for PLWH, such as perceived stigma, social support, psychological well-being, treatment adherence, and safe sexual practices. In line with the recent focus on refining conceptualization and measurement of disclosure, the present study aimed to, firstly, examine empirically the structure of disclosure as a process with a focus on two potential influences (the types of disclosure targets, and the discloser's intention), and, secondly, compare this new approach to disclosure analyses to the commonly used cumulative score in the exploration of the relationship between disclosure and two well-known correlates, stigma and social support (Stutterheim, Bos et al., 2011). This comparison allowed us to verify the existence of distinct HIV disclosure processes in our target population and thus the importance of considering disclosure target and intent in investigating disclosure.

Methods

Participants and procedure

We used data from a study conducted in the spring of 2010 at two rural anti-retroviral therapy (ART) clinics in the Kilimanjaro region, Tanzania. Five trained research assistants recruited eligible participants (over 18 years, on ART for at least six months, regular clients of the clinic, not on medication for tuberculosis) among PLWH attending their usual care appointments consecutively. The interviewers performed face-to-face interviews in

Kiswahili, and used a pre-tested, structured questionnaire with fixed response options, Interviews lasted for approximately 30 minutes. We gave every participant a small stipend of 5000 Tanzanian Shilling to cover the costs of a lunch. The Tanzania National Institute for Medical Research (NIMR/HQ/R.8a/Vol.IX/812) granted ethical approval prior to the study start.

Measures

Disclosure. We developed a comprehensive list of 21 actor categories to which PLWH might have disclosed their HIV status based on interviews with PLWH, previous literature (Deribe et al., 2008; Serovich & Mosack, 2003) and pre-testing the questionnaire among the target group. The order of the items aimed to reflect the social dynamics in the target group and thus facilitate interview responses, starting with people in one's family environment and ending with actor categories in one's broader social network. Interviewers assessed voluntary and involuntary disclosure separately via two questions: 'To whom have you disclosed your HIV status besides the ART clinic staff?', and 'Who else do you think knows or suspects that you have HIV, besides the ART clinic staff and those to whom you disclosed?' While voluntary disclosure is directly amenable to self-report as a result of one's intentional actions, involuntary disclosure can only indirectly be reported by the PLWH themselves, via their perceptions regarding other's behaviors. We therefore formulated the second question in terms of 'knowing or suspecting' HIV status since involuntary disclosure may not always generate an open discussion that leads to certainty of one's HIV status being disclosed and may be experienced only as an uncertain result of a particular event (e.g. being seen entering an ART clinic). The interviewers read all categories systematically to participants and scored their responses regarding all 21 actors on a response form as (1) 'disclosure reported' or (0) 'no disclosure reported' irrespective of reason. To ensure we did not omit any relevant actor

categories, interviewers also asked participants whether they disclosed their HIV status (voluntarily or involuntarily) to any other actor not on the list, and whether they had disclosed to nobody (besides the ART clinic staff). No participant added actors to the list, and all those who reported disclosure to none of the 21 actors also indicated they disclosed to nobody. These additional responses indicate that the actor list was comprehensive and responses were accurate.

We also checked the accuracy between voluntary and involuntary disclosure for the same actor category. For most actor categories, no participants mentioned both voluntary and involuntary disclosure, indicating that participants perceived the two types of disclosure as mutually exclusive. The only actor categories for which voluntary and involuntary disclosure were mentioned simultaneously by a few participants were the larger community (N=2), any neighbor (N=1), and any other relative (N=2). As these categories may include multiple unrelated people, voluntary and involuntary disclosure may have involved different people.

Stigma. We measured *perceived stigma* and *self-stigma* using items from the Perceived Stigma Scale (Berger et al., 2001) and the Internalized AIDS-Related Stigma Scale (Kalichman et al., 2009). Response scales for both subscales ranged from (1) 'strongly disagree' to (5) 'strongly agree'. Five items measured *perceived stigma* (e.g., 'People seem afraid of me because I have HIV'; Cronbach's $\alpha = .76$) and six items assessed *self-stigma* (e.g., 'I feel guilty that I am HIV positive'; Cronbach's $\alpha = .79$). We computed sum scores following psychometric analyses that confirmed the bidimensional structure of the item set (not reported here for reasons of brevity).

Social support. We developed twelve items based on the Medical Outcomes Study (MOS) Social Support Survey (Sherbourne & Stewart, 1991), prior qualitative work (e.g., Watt et al., 2009) and clinical experience and pre-testing with the target group. We asked participants to indicate on five-point response scales (from 'never' to 'always') how often

there is someone available to them to approach various topics related to their condition and antiretroviral medicines (ARVs). While activities such as giving advice, listening to one's worries and ensuring transport to the doctor where among the MOS items relevant to our group, other activities were also considered important for living with HIV in this socio-cultural context. The final scale included five items on emotional/informational support (on sharing concerns, understanding problems, giving advice, information and coping advice about HIV and ARVs), three items assessing adherence support (on reminding about taking medication, having medication accessible and attending clinic appointments), and four items measuring instrumental support (on helping with obtaining new medication, transport to the clinic, financial assistance and food supplies). We computed sum scores for three subscales based on psychometric analyses (not reported). All subscales showed good internal consistency (Cronbach's α =.80, .85, and .76 respectively).

Two bilingual researchers back-translated the stigma and social support items in Kiswahili and pre-tested the questionnaires among the target group to verify that they interpreted the items as intended. To facilitate response given the prevalence of low literacy, the 5-point response scales were presented via diagrams showing five incrementally larger circles that accompanied the verbal labels; participants were required to point to the circle that best reflected their response. They had the opportunity to practice this task before the interview and ask for clarifications.

Background variables. We assessed socio-demographic variables (e.g., gender, age, educational attainment, and marital status) and treatment-related factors (e.g., side effects over the past four weeks, time since HIV diagnosis, and current regimen) within the same interview.

Data analyses

We performed the data analysis in IBM SPSS Statistics 21 (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.) and R (*mokken* package; R Core Team, 2013; van der Ark, 2007, 2012). We screened the data for input accuracy and computed descriptive statistics for all variables. Next, we conducted a 3-step psychometric examination of voluntary and involuntary disclosure: 1) examination of item endorsement frequencies and item selection; 2) structural validity analysis via non-parametric item response theory (NIRT) with identification of possible subscales; and 3) comparative analysis of construct validity (i.e. examination of relationships with stigma and social support). We detail these steps below.

To identify disclosure items eligible for further analyses, we first examined endorsement frequencies, i.e. how many participants reported voluntary or involuntary disclosure to the actor categories investigated. This step was necessary because items with very low endorsements do not show sufficient variation to differentiate among participants in further analyses. As no recommendations were found regarding exact thresholds of item endorsement frequency for performing NIRT, we selected items with minimum five endorsements (we obtained similar NIRT results with a cut-off of 8 endorsements, i.e. 5% of the sample, indicating that the method is robust to this selection procedure). For items with one to four endorsements, we examined item content and endorsement frequencies of item pairs (bivariate contingency tables) to identify meaningful ways of merging them with other related items into broader categories. We merged low-frequency items with items with compatible content, and excluded low-frequency items with no meaningful relationships with other items. We also examined content and endorsement frequencies of item pairs among items with five endorsements or more, to identify any pairs of items that participants might have interpreted interchangeably and thus exclude any redundant categories. This preparatory step allowed us to select the actor categories appropriate for further analyses.

We examined structural validity via NIRT, i.e. Mokken Scale Analysis (MSA; Hemker et al., 1995; Meijer & Baneke, 2004; Molenaar & Sijtsma, 1984; Schuur, 2003; Sijtsma & Molenaar, 1987; Sijtsma, 1998). We believe that MSA is a better methodology for analyzing disclosure compared to the more commonly used methods. Unlike factor analysis, MSA assumes that items have different endorsement frequencies (item intensities) and thus takes into account the fact that PLWH might be more likely to disclose their HIV status to particular types of actors (e.g. family). Moreover, unlike the more restrictive parametric IRT models, MSA does not assume that a precise quantification of the differences among respondents is necessary and considers ordinal differences sufficient, which is arguably applicable to disclosure (see Schuur, 2003 for a technical discussion of MSA). According to MSA, a set of items forms a scale if they can be ordered on a single latent dimension representing a construct, i.e. if they meet 3 conditions: (1) endorsing more intense items should be related to an increased probability of endorsing less intense items, while endorsing less intense items should be unrelated to responses to more intense items (unidimensionality); (2) inter-item associations should be explained only by the construct (local independence); and (3) the probability of endorsing an item should not decrease as scores on the latent dimension increase (latent monotonicity). If an item set meets these three conditions, it fits the monotone homogeneity model, which means that it orders respondents accurately according to their scores on the latent dimension. If it also meets a fourth condition, invariant item ordering (i.e. items display the same order of intensity irrespective of the scores on the latent dimension), the scale fits a more restrictive MSA model (i.e. the double monotonicity model); this means that all respondents perceive the item intensities similarly, and thus their latent scores can be compared across subgroups or datasets (Schuur, 2003; Sijtsma & Hemker, 1998).

We investigated these properties by examining coefficients of homogeneity (H; ranging from 0 to 1, from no association to perfect association considering item distributions), and via an Automated Item Selection Procedure (*aisp*) algorithm available in R *mokken* package, which clusters items into unidimensional scales based on previously defined thresholds of homogeneity. We examined the performance of the item sets at increasing thresholds of homogeneity as recommended by Hemker et al. (1995). We selected subscales based on recommended ranges for weak (.3-.4), medium (.4-.5), and good homogeneity (over .5). We examined graphically item response functions (i.e. probabilities of item endorsement depending on scores on the latent dimension) for resulting subscales, as well as numerical output, to identify if they also meet the conditions of latent monotonicity and invariant item ordering.

This second step of our psychometric analysis had three aims. First, it identified whether the data are better described in terms of a single disclosure process or several distinct disclosure processes each including one or more (a *cluster of*) actors. Second, it indicated which actors can be combined (*clustered*) in cumulative scores representing 'the degree of disclosure' within the disclosure processes identified. Third, it examined whether items can be ordered within a cluster according to their intensity. In other words, it identified actors to which participants are likely to have disclosed their HIV status even if they have not disclosed to others in that cluster, and actors that are likely to be the target of disclosure only after participants already disclosed to other actors within that cluster. While this analysis step was largely exploratory, we expected voluntary disclosure items to be comparatively more interrelated than involuntary disclosure items, because the latter are by definition governed more by chance than one's deliberate efforts to share this information.

As we identified multiple voluntary and involuntary disclosure processes, the third step of our psychometric analysis examined their construct validity in comparison to the

commonly used cumulative score. Thus, we first compared the relationship with other meaningful variables such as stigma and social support variables via correlational analyses (using Kendall's τ, since it is reported to result in better estimates of population parameters than Spearman's ρ with nonparametric data, Field, 2005; Howell, 2010). Given the exploratory nature of this analysis, we considered unnecessary to correct for multiple comparisons, however we acknowledge the need to investigate these relationships in new samples via hypothesis testing.

Results

Participant characteristics

From the 158 participants enrolled in the study, 48 were male and most (87.3%) were of Chagga ethnicity (the native Kilimanjaro population). The mean age was 44 years. Participants received their HIV diagnosis on average about four years prior to this study and had been on treatment for 2.9 years. Only 26 participants (16.5%) had detectable viral load (Table 1).

INSERT TABLE 1 ABOUT HERE

Exploring the frequency of endorsing disclosure items

Endorsement frequencies varied between actor categories and between voluntary and involuntary disclosure (Table 2). For example, while many participants disclosed their HIV status to family members (e.g. siblings, spouse, mother, children), very few disclosed this information to workmates, a boss or a traditional healer, and no participants reported disclosure to a house owner. Nine participants reported not having disclosed their HIV status to anyone besides the clinic staff.

INSERT TABLE 2 ABOUT HERE

Participants reported involuntary disclosure more frequently towards neighbors, support group members, and their community in general. By contrast, very few participants who did not voluntarily disclose to their parents or siblings knew or suspected these actors know their HIV status, and none reported involuntary disclosure to spouse. Forty participants did not think anybody else knew or suspected they had HIV apart from the people to whom they had intentionally disclosed.

We excluded categories with no endorsement (see Table 2). We combined categories with 1 to 4 endorsements with other conceptually related categories or excluded them from analyses if distinct from all other categories. Thus, we grouped boss and workmates into work colleagues for both types of disclosure, we merged partner and spouse for voluntary disclosure, we merged mother and father into a parent category for involuntary disclosure, and we excluded traditional healer and house boy/girl for both types of disclosure, and any acquaintance and partner for involuntary disclosure.

Exploring psychometric properties of disclosure items

The selected items did not form homogenous voluntary and involuntary disclosure scales, as indicated by the homogeneity values and standard errors: H (SE) =.24 (.05) and .06 (.02) respectively. This implies that the selected items did not form unidimensional scales. We further examined the dimensionality of the two sets of disclosure items via the *aisp* method.

The analysis of the voluntary disclosure items led to a dimensionality solution including two stand-alone items (spouse/partner and children) and two unidimensional item-sets focusing on close family and larger community (Table 3). The two subscales presented good

homogeneity and also met the latent monotonicity and invariant item ordering criteria; although some items displayed minor violations of these criteria, these were not statistically significant (Graphs may be obtained from the authors). These results indicate that in this population there might be four distinct voluntary disclosure processes involving different categories of actors. Moreover, within the two multi-actor groups, there was a specific sample-invariant order in which people tended to disclose their status to different actor categories. For example in relation to the close family, more people tended to disclose to a sister, and less to a brother, a mother and least of all to a father.

INSERT TABLE 3 ABOUT HERE

For involuntary disclosure, the *aisp* analysis indicated six stand-alone items (sister, close friends, neighbors, work colleagues, village leader, and community) and three pairs of related items, i.e. parents and brother, other relatives and close friends, pastor and support group (Table 3). We examined these items and item-pairs separately in further analyses. These results suggest that, unlike voluntary disclosure, reporting concerns of involuntary disclosure to each stand-alone item may be due to specific causes unrelated to other items. Only three pairs of items are present, suggesting that disclosing involuntarily to these categories of actors might be part of the same process.

We computed total scores of disclosure to multi-actor groups as sums of item scores for further analyses.

Comparing the relationship between disclosure measures for voluntary and involuntary disclosure with stigma and social support

We subsequently examined whether the developed scales for voluntary and involuntary disclosure relate to stigma and social support. The cumulative score (sum of all actor-categories to whom the participant disclosed) was considered as an alternative method for handling disclosure data, as often done in previous studies.

Correlational analyses (Table 4) showed that the cumulative score of voluntary disclosure was negatively related to self-stigma ($\tau = -.38$, $p < .01$), but unrelated to perceived stigma. The MSA-derived disclosure scores presented a more detailed picture. Perceived stigma increased significantly only with increased disclosure to the larger community ($\tau = .17$, $p < .01$), but was unrelated to disclosure to one's family or any of the other actors. Self-stigma was negatively related to disclosure to close family ($\tau = -.37$, $p <01$), larger community ($\tau = -.19$, $p < .01$) and any children ($\tau = -.19$, $p < .05$). Disclosure to one's spouse was unrelated to either perceived or self-stigma.

INSERT TABLE 4 ABOUT HERE

The cumulative score of voluntary disclosure was positively related only to Emotional/Informational Support ($\tau = .12$, $p < .05$), but relationships between Emotional/Informational support and MSA-derived disclosure categories were non-significant. From MSA-derived disclosure categories, Instrumental Support was associated positively with disclosure to spouse/partner ($\tau = .16$, $p < .05$) and negatively to disclosure to close family ($\tau = -.14$, $p < .05$), but unrelated to the cumulative score. Adherence support was unrelated to any disclosure categories.

Involuntary disclosure was overall positively associated with perceived stigma ($\tau = .26$, $p < .01$), but not with self-stigma, contrary to the voluntary disclosure total score (Table 5). Only two MSA-derived items were associated with an increased perception of being

stigmatized: close friends ($\tau = .17$, $p < .05$) and neighbors ($\tau = .18$, $p < .05$). Believing that close friends might know or suspect one's HIV status was also the only item significantly related to increased self-stigma ($\tau = .14$, $p < .05$). Involuntary disclosure scores were unrelated to social support dimensions.

INSERT TABLE 5 ABOUT HERE

Discussion

We found that reports of disclosure by PLWH in Tanzania do not form a single unidimensional process but rather group into several single or multi-actor dimensions, and that actors are ordered within multi-actor clusters by disclosure likelihood. Moreover, these disclosure dimensions showed different patterns of association with stigma and social support variables. These results indicate that investigating disclosure dimensionality can be more informative than using an overall cumulative disclosure score. Our study allowed a more in-depth understanding of the dynamics of HIV status disclosure in the communities in the Kilimanjaro region, Tanzania, and thus demonstrated the usefulness of this MSA-based approach to examining disclosure.

Our results suggest that voluntary disclosure may consist in our population of four distinct processes: disclosing to partner/spouse, children, close family, and the larger community. This means that for PLWH in this region disclosing to their partners is independent of their decision to disclose their status to their children, family, or community. Moreover, the latter two clusters involve multiple-actor categories each characterized by a different disclosure probability conditional on disclosure to other categories. For example, within their close family circle, people were most likely to disclose to a sister and least likely

to disclose to a father, while within their community, most people tended to disclose to other relatives and very few disclosed to the community in general. This also implies that people who have disclosed their HIV status to their father were very likely to have already disclosed to a sister, and similarly people that disclosed to a neighbor most probably also disclosed to a close friend. Moreover, the order in which people are likely to disclose this information is essentially the same in this population, irrespective of the overall degree of disclosure to a particular actor-cluster. Because of these properties, sum scores are meaningful indicators of the degree to which participants have disclosed their status to these two multi-actor groups. Involuntary disclosure, by contrast, consists of multiple unrelated processes involving single items or item-pairs, suggesting that each actor (or actor dyad) may discover one's HIV status due to unique circumstances.

The disclosure structure identified here mirrors previous findings in the region. Indeed, qualitative data show that PLWH opt to disclose mainly to spouse, close family and friends and less to the larger social network (Deribe et al., 2008; Lugalla et al., 2012), and that certain types of actors, e.g. partners and relatives, are sometimes considered mutually-exclusive choices for disclosure (Antelman et al., 2001, Greeff et al., 2008). Although levels of voluntary disclosure to specific actors are low compared with other populations (Mayfield Arnold et al., 2008), our sample has comparatively higher overall disclosure levels than other studies in the region (Medley et al., 2004). This may be explained by the longer time elapsed since diagnosis, as likelihood of disclosure increases with time (Antelman et al., 2001; Lugalla et al., 2012). While previous research offered information on selected disclosure aspects, our method adds a more precise description of the likelihood and interdependence of disclosure to various actors and thus allows a structural view on disclosure processes.

Given that the MSA analysis revealed distinct disclosure dimensions, it becomes possible to envisage differences between these regarding relevant correlates. Our analyses showed

that the relations between disclosure processes, on the one hand, and stigma and social support dimensions, on the other, depend on the types of actors or actor-clusters involved and the discloser's intention. In our sample, PLWH reported increased perceived stigma only if they disclosed their HIV status voluntarily to an increasing number of actors in their larger community, or involuntarily to close friends and neighbors. They reported reduced self-stigma if they disclosed their status to a larger number of close family members, children and community; and increased self-stigma if they perceived that close friends know or suspect their status. Participants reported receiving more instrumental support if they disclosed voluntarily to their partner/spouse, and less if they disclosed to their close family. These patterns of association suggest that differences in disclosure target and intention may partly explain the previous inconsistent results on disclosure, stigma and social support (Chaudoir et al., 2011; Smith et al., 2008). It confirms previous findings that stigma and social support may play different roles in disclosure decisions to partners, family, friends or broader community (Bairan et al., 2007; Derlega et al., 2002), and that consequences may differ when disclosing to different types of actors (Greeff et al., 2008; Norman et al., 2007).

These results encourage investigating the dimensionality of disclosure and warn against computing disclosure scores without such investigation. From a psychometric perspective, total scores are adequate only for item sets that form a scale and thus allow accurate ordering of respondents on a single dimension. In this dataset, although total scores explained a comparable amount of variance in some situations (e.g. regarding voluntary disclosure and self-stigma) and arguably provided a valuable overview, they could not provide specific information on which types of actors or actor-clusters were associated with stigma or support dimensions, and even obscured relevant significant relationships (e.g. regarding relations between voluntary disclosure and perceived stigma). Ignoring dimensionality in such analyses could lead to faulty conclusions that certain predictors or consequences are generally

(un)related to disclosure irrespective of disclosure target and intention. In contrast, the MSA analysis allows us to understand the structure of disclosure processes in this population and identify relevant relationships consistent with this structure. This nuanced information can be used to identify more precisely the motives, benefits and risks of disclosing one's HIV status in a particular population and possibly lead to more targeted interventions (e.g. patient counseling) that enable PLWH to make informed disclosure decisions in contexts where disclosure is voluntary and to respond and cope adequately when involuntary disclosure occurs.

The results need to be interpreted in light of several limitations. First, our sample consisted of Tanzanian adults receiving regular medical care, and actor categories were chosen as relevant based on preliminary qualitative work. Therefore, the results regarding disclosure dimensions and their correlates might be unique to this population. For example, the order in which participants tend to disclose their HIV status to actor categories in a multi-actor cluster may depend on population-specific factors, such as the proximity of the relationship, the relevance of the actor for coping with being HIV-positive, the actor's availability, etc. Indeed, previous studies show that some PLWH populations may find it easier or more relevant to disclose to a good friend before disclosing to family members (Kalichman et al., 2003), while some may perceive that disclosing to family is more appropriate (Armistead et al., 1999). Second, the relatively small sample size might have prevented the detection of smaller but substantively meaningful associations, while the cross-sectional design did not allow us to examine causal relations. These may be addressed in future studies by increasing sample size and adopting longitudinal or experimental designs. Third, our study had a predominantly exploratory approach as it focused on method development and used theory mainly to select relevant constructs and measurement and analysis methods. Future studies may choose a more extensive theoretical input to test

specific hypotheses regarding disclosure dimensionality in other populations, to investigate similar processes that involve communicating sensitive information to one's social network, or to improve disclosure measurement by selecting items with optimal psychometric properties or improving data collection methods.

In conclusion, we encourage HIV disclosure researchers to use this new 3-step approach to examine the structure of disclosure processes in existing and future datasets on different populations of PLWH. These analyses would help explore whether similar patterns apply to different contexts and whether prior evidence about disclosure predictors and consequences is confirmed or needs to be adjusted when disclosure scores take into account the type of actor and discloser's intent. Further research could extend beyond stigma and social support and investigate other disclosure correlates relevant to the target population, for example using the framework of the Disclosure Processes Model (Chaudoir & Fisher, 2010; Chaudoir et al., 2011), or investigate MSA-derived dimensions and total scores comparatively and explore their possibly complementary contributions in a causal perspective. We believe that our proposed 3-step procedure allows for a more nuanced examination of the dynamics of HIV-status disclosure, and thus can contribute to identifying concrete and context-appropriate strategies for managing disclosure such that PLWH have more positive and less negative experiences with HIV-status disclosure.

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Table 1. Socio-demographic and treatment-related characteristics (N=158)

Characteristic	**Value**
Male (*N*, %)	48 (30.4)
Age (in years), [Mean (standard deviation; SD); range]	43.8 (10.3); 18-74
Time since diagnosis (in years) [Mean (SD) ; range]	3.9 (2.7); 1-15
Time since starting ART (in years) [Mean (SD); range]	2.9 (1.5); 1-9
Viral load – detectable (N, %)	26 (16.5)
Education (*N*, %)	
No education/ Some primary education	24 (15.2)
Completed primary school/ Some secondary education	117 (74.1)
Completed secondary school	14 (8.8)
Post-secondary/vocational education	3 (1.9)
Type of economic activity (*N*, %)	
Salaried work	12 (7.6)
Self employed	100 (63.3)
No stable salary	13 (8.2)
Unemployed	15 (9.5)
Housewife	17 (10.8)
Student	1 (.6)
Marital status, (*N*, %)	
Married	61 (38.6)
Separated	19 (12)
Widowed	58 (36.7)

Single	20 (12.7)
Stigma [Mean (SD); range]	
Perceived stigma	10.8 (4.8); 5-24
Self-stigma	16.3 (6.1); 6-30
Social support [Mean (SD); range]	
Emotional/Informational support	17.3 (4.3); 8-25
Adherence support	8.6 (4.3); 3-15
Instrumental support	13.2 (4.3); 4-20

Table 2. Frequency of voluntary and involuntary disclosure to distinct actor categories (N=158; categories in order of presentation to respondents)

	Number of participants	
Actors	*...who have disclosed their HIV status to…*	*...who believe their HIV status is otherwise known or suspected by…*
Spouse	47	0
Partner	5	1
Mother	45	8
Father	26	3
Sister(s)	65	6
Brother(s)	46	5
Child(ren)	46	10
Other relative(s)	59	15
Close friend(s)	43	11
Acquaintance(s)	5	2
Neighbor(s)	27	47
Work colleague(s)	4	3
Boss	3	3
Religious leader	27	11
Village leader	19	6
Traditional healer	1	1
House owner	0	0
House boy/girl	2	0

Support group	26	37
Community	12	54
Any other…	0	0
Nobody	9	40
Cumulative		
Mean (*SD*)		
Median	3.2 (2.7)	1.4 (1.3)
(interquartile	2.0 (3.0)	1.0 (2.0)
range)		

Table 3. Homogeneity values (H) and standard errors (SE) for disclosure item-clusters (N=158)

Actors	***H (SE)***
Voluntary disclosure multi-actor clusters	
1. Close family	0.50 (0.07)
1.a. Mother	0.48 (0.07)
1.b. Father	0.58 (0.08)
1.c. Sister(s)	0.51 (0.08)
1.d. Brother(s)	0.46 (0.08)
2. Larger community	0.45 (0.08)
2.a. Other relative(s)	0.30 (0.10)
2.b. Close friend(s)	0.45 (0.08)
2.c. Acquaintance(s)	0.76 (0.18)
2.d. Neighbor(s)	0.45 (0.08)
2.e. Work colleague(s)	0.56 (0.17)
2.f. Religious leader	0.38 (0.09)
2.g. Village leader	0.54 (0.09)
2.h. Support group	0.37 (0.09)
2.i. Community	0.66 (0.10)
Involuntary disclosure two-actor clusters	
1. Close family	0.33 (0.18)

2. Children and/or other relatives	0.34 (0.17)
3. Pastor/religious leader & support group	0.53 (0.18)

Table 4. Associations between voluntary disclosure and stigma and social support dimensions (N=158; Kendall's τ correlations)

	Disclosure total score	Disclosure to partner or spouse	Disclosure to close family	Disclosure to any children	Disclosure to larger community
Disclosure total score		.05	.62**	.26**	.67**
Disclosure to partner or spouse			-.13	.03	-.10
Disclosure to close family				.04	.26**
Disclosure to any children					.17*
Perceived Stigma	.11	-.11	.06	.05	.17**
Self-Stigma	-.38**	.07	-.37**	-.19*	-.19**
Emotional/Informational support	.12*	.10	.02	.12	.11
Adherence support	.10	.08	.08	.03	.08
Instrumental support	-.08	.16*	-.14*	.00	-.10

Notes. * $p<0.05$; ** $p<0.01$, two-tailed

Table 5. Associations between involuntary disclosure and stigma and social support dimensions (N=158; Kendall's τ correlations)

	Disclosure total score	Disclosure to sister	Disclosure to parent and/or brother	Disclosure to children and/or other family members	Disclosure to pastor and/or support group	Disclosure to any close friends	Disclosure to any neighbor	Disclosure to any work colleagues	Disclosure to village leader	Disclosure to community in general
Disclosure total score		.09	.24**	.32**	.40**	.27**	.45**	.11	.24**	.46**
Disclosure to sister			.09	.12	-.12	-.05	.02	-.04	.13	-.14
Disclosure to parent and/or brother				.13	-.15	.13	.05	-.05	.09	-.08
Disclosure to children and/or other family members					.02	-.03	.03	.05	.03	-.08
Disclosure to pastor and/or support group						.05	-.10	-.03	.12	.08
Disclosure to any close friends							.15	-.05	.08	-.04
Disclosure to any neighbor								-.12	.09	.23**
Disclosure to any work colleagues									-.04	.10

Disclosure to village leader										.14
Perceived Stigma	.26**	.05	.08	.10	.08	.17*	.18**	.08	-.01	.12
Self-Stigma	.01	-.01	.09	.02	-.04	.14*	.02	.09	-.11	-.11
Emotional/Informational support	-.09	-.08	-.12	-.08	.02	-.03	.01	-.07	-.06	-.05
Adherence support	-.07	-.07	.02	-.05	-.02	-.01	-.04	-.05	-.04	.01
Instrumental support	-.09	-.01	-.08	-.04	-.08	.05	-.05	.05	-.08	.01

Notes. * $p<0.05$; ** $p<0.01$, two-tailed