Accurately assessing gay men's erectile functioning: A critique of the International Index of Erectile Function (IIEF) use with gay men.

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Abstract

The International Index of Erectile Function (IIEF) has been widely used to measure gay men's erectile functioning. However, the IIEF was initially developed using a sample of men whose sexual orientation was unspecified. Using scales not validated for specific populations can result in inaccurate assessments. The purpose of the current study is to evaluate the dimensionality, reliability, and validity of the IIEF with a large sample of gay men. One thousand and eighteen men self-identifying as "exclusively gay" completed an online survey consisting of demographics, IIEF, Hospital Anxiety and Depression Scale (HADS), Perceived Stress Scale 4 (PSS4), and Gay Male Sexual Difficulties (GMSD) erectile difficulties sub-scale. The replicability of the IIEF factor structure with a gay male sample was determined using exploratory and confirmatory factor analyses. Additionally, the HADS, PSS4, and GMSD were used to determine the validity of the IIEF. The current study was unable to replicate the IIEF factor structure. Four items required deletion and the factor solution differed from the original. Thus, reinterpretation of the latent variables was deemed necessary. Although the resultant 12-item IIEF evidenced model fit, validity, and reliability it is not recommended for use with samples of gay men. The revised IIEF is unable to accurately measure gay men's erectile functioning as the content of the items fail to capture their sexual behaviours (i.e., insertive and receptive anal sex).

Keywords: erectile dysfunction, gay men, IIEF, psychometric

Erectile difficulty (also known as erectile dysfunction; ED) is a physiological ailment that is conceptualized as a man's recurrent inability to attain and/or maintain an erection for a period necessary for satisfactory sexual activity (e.g., masturbation, oral sex, penetrative sex; Lue, 2000; Hatzimouratidis et al., 2010). The intervals in which ED may manifest varies, as do thresholds for diagnoses, which can range from four weeks to three months (Hatzimouratidis et al., 2010; Rosen et al., 1997). The source of ED symptoms may be attributed to existing physiological and psychological ailments (varies, as do thresholds for diagnoses, which can range from four weeks to three months (Hatzimouratidis et al., 2010; Kesler et al., 2009, Raymond & Rosen, 2001). Although wide-scale studies assessing the prevalence of men with ED are relatively sparse, the available research suggests it may manifest differently depending on variables such as age and location. For instance, in one U.S. sample of 2,126 adult males, the average prevalence of ED among men was 18.4%, ranging from 5.1% in men aged 20 and 39% to 70.2% in men over seventy years of age (Selvin, Burnett, & Platz, 2007). A sample of middle- and older-aged men from New Zealand also reported increases of ED across age span, with 24% of men in their forties having some prevalence of ED compared to 38% of men in their fifties and 60% of men in their sixties (Quilter, Hodges, von Hurst, Borman, & Coad, 2017). However, roughly half of these cases were deemed mild. A systematic review of global ED prevalence (k = 41) noted that ED differed appreciably across studies, ranging from 3.0% to 76.5% (Kessler et al., 2019). They also observed that ED becomes more prevalent with age, with less than half of men under age 50 (9.1% to 49.9%) experiencing difficulties with erections compared to 54.9% to 94.7% of men over 70 years of age.

Comorbidity with Physical and Mental Health Issues

Researchers have observed that ED is often comorbid with poor physical health (Selvin et al., 2007). Kessler and colleagues' (2019) noted that men with ED are roughly 1.4 times more likely to experience cardiovascular disease mortality, 1.3 to 6.2 times more likely to be diagnosed with benign prostatic hyperplasia, and 1.7 times more likely to develop dementia. Numerous studies have associated ED with diabetes. In a recent meta-analysis, across 145 studies, diabetic men were 3.5 times more likely to experience ED than non-diabetic men (Kouidrat et al., 2017). Others have found associations between ED and kidney disease (Navaneethan et al., 2010) as well as prostate cancer (Lin, Burri, & Pakpour, 2016).

Recent research has moved beyond physical ailments and identified a link between ED and select mental health outcomes, such as elevated levels of anxiety (Mourikis et al., 2015), depression (McCabe & Althof, 2014; Suija et al., 2014) and stress (McCabe & Althof, 2014; Hatzimouratidis et al., 2010). For instance, in a sample of middle-aged Greek men, both moderate and severe ED was associated with similarly lower levels of sexual and life satisfaction in comparison to men without ED (Mallis et al., 2006). A European study of 3,810 men found that lower mental health scores (indicative of greater mental health issues) in men with ED were mediated, in part, by their decreased sexual satisfaction (Korfage et al., 2009). A study of Finnish men, which found that depressive symptoms were associated with 2.6 to 3.3 times greater odds for ED, suggests that the relationship between depression and ED may be bidirectional, with depressive moods (and/or antidepressant medication) causing ED and consequently exacerbating depressive symptoms (Shiri et al., 2007). Similar odds ratios for depression (i.e., 2.02 to 2.09) have also been found in samples of men from Brazil, Italy, Japan, and Malaysia (Nicolosi, Morerra, Villa, & Glasser, 2004; Sugimori et al., 2005). Araujo and colleagues (1998) have noted that the association between ED and depression is independent of demographic, lifestyle,

and other health factors (e.g., medication use, hormone levels), suggesting that this relationship is not purely the result of behavioural or physiological changes.

Sugimori et al (2005) note in their Japanese sample that ED only appears to be correlated with elevated levels of anxiety for men in their fifties (but not forties). A Greek sample of men primarily in their mid-thirties indicated that ED was associated with higher rates of both state and trait anxiety (Mourikis et al., 2015). Another sample of Greek men in their mid-thirties found that roughly one-quarter of men who present ED symptoms had an anxiety disorder diagnosis (Rajkumar & Kumaran, 2015). Interestingly, the anxiety disorder predated the onset of ED in two-thirds of cases. Other psychiatric diagnoses, such as PTSD (Cosgrove et al., 2002; Kotler et al., 2000; Letourneau, Schewe, & Frueh., 1997; Tran, Dunckel, & Teng, 2015) and schizophrenia (Dossenbach et al., 2005; Fortier, Mottard, Trudel, & Even, 2003) have also been associated with ED, as has methadone (Hallinan et al., 2008), cigarette (Mannino, Klevens, & Flanders, 1994), alcohol (Nicolosi et al., 2003), and heroin use (Bang-Ping, 2009).

The International Index of Erectile Function

Given that ED may an indicator of other underlying physical and mental health issues, it is imperative that the tools used to assess and diagnose ED are valid and reflect a diversity of sexual practices. Due, in part, to its brevity, simplicity, and availability in short-form and multiple languages (Conway, Mishra, & Giroudet, 1999; Rosen, Cappelleri, & Gendrano, 2002; Utomo, Blok, Pastoor, Bangma, & Korfage, 2015), the International Index of Erectile Functioning (IIEF; Rosen et al., 1997) is often considered to be the gold standard measure used to diagnose and assess the presence or severity of ED. The standard IIEF is comprised of 15-items with five dimensions: 1) erectile function; 2) orgasmic function; 3) sexual desire; 4) intercourse satisfaction; and 5) overall satisfaction. The erectile function domain consists of six

items relating to the ability to get (e.g., “How often were you able to get an erection during sexual activity?”) and maintain (e.g., “During sexual intercourse, how often were you able to maintain your erection after you had penetrated [entered] your partner?”) erections. Orgasmic functioning is assessed with two items, reflecting the frequency of orgasm and ejaculation (e.g., “When you had sexual stimulation or intercourse, how often did you ejaculate?”). The sexual desire domain also consists of two items pertaining to the frequency and intensity of sexual desire (e.g., “How often have you felt sexual desire?”). Three items measure the intercourse satisfaction subscale, which encompasses frequency of sexual intercourse and enjoyment/satisfaction (e.g., “When you attempted sexual intercourse, how often was it satisfactory for you?”). The remaining two items comprise the overall satisfaction subscale, a more general measure of one’s satisfaction with their sexual activity (e.g., “How satisfied have you been with your sexual relationship with your partner?”). Shortly after the development of the scale, multiple studies observed that the scale score reliability of each dimension ranged from moderate to extremely high (α = .73 to .99; Cappelleri et al., 1999a; 1999b; Rosen et al., 1997; 2002). Similarly, test-retest reliability ranged from moderate to high (r = .64 to .84). The IIEF’s discriminant, convergent, and divergent validity have also been documented, a review of which can be found in Rosen et al. (2002).

Erectile Difficulties & Gay Men

Accurate measurement of ED for distinctive groups of men is crucial because it may signal existing health conditions that require treatment. Problematically, to date, the measurement of ED in samples of gay men has been largely inconsistent which suggests that this group of men may be denied the accurate assessment of erectile functioning. Thus, risking potential misdiagnosis and the myriad of implications associated with incorrect health

evaluation. For instance, studies assessing ED in samples of gay men are uncommon when compared with the data concerning primarily or predominantly heterosexual men. The research that has been conducted on gay men has been disproportionately focused on ED in HIV-positive samples, which ignores the vast majority of gay men who are HIV-negative (Holt et al., 2015; Marcus et al., 2012; Moreno-Pérez et al., 2010; Parsons, Grov, & Golub, 2012; Vansintejan, Janssen, De Vijver, Vandevoorde, & Devroey, 2013; Wang et al., 2013). A study that measured ED using a sizeable sample of gay men found that those under 60 years old generally reported minimal issues with erections (Shindel et al., 2012). However, similar to their heterosexual counterparts they noted that the prevalence of ED increased with age, as over half of gay men who were 60+ reported having at least mild issues with ED. A study of 7,001 American men who have sex with men (MSM)— men who do not consider themselves to be gay but engage in sexual relations with other men (e.g., bisexual, gay curious)— that consisted of 89% exclusively gay men, noted much higher rates of ED in their sample, with 45% of men reporting erection problems (median age = 38; Hirshfield et al., 2010). Among MSM over 50, the prevalence of ED more than doubled. Another recent study compared the prevalence of ED in heterosexual and gay Portuguese men and found no differences, although participant age (roughly 28 years old) and ED prevalence were considerably lower (7.6% and 7.3%, respectively) than in the above studies (Peixoto & Nobre, 2014).

Although Peixoto and Nobre (2014) did not observe differences in ED prevalence between heterosexual and gay men, they did note the importance of considering gay men's preferred sexual position(s) with respect to anal sexual intercourse. Specifically, some gay men identify as "bottoms" (i.e., they adopt the receptive role in anal intercourse), "tops" (i.e., they adopt the penetrative role in anal intercourse), or "versatile" (i.e., they are open to adopting

either role; Johns, Pingel, Eisenberg, Santana, & Bauermeister, 2012; Moskowitz, Rieger, & Roloff, 2008). Given that maintaining an erection is not necessarily a requirement when serving as a "bottom," gay men who perform this role exclusively may afford less attention to erectile functioning during sex or consider it an area of unconcern. While the IIEF has been validated with various ethnicities (Lim et al., 2003; Mahmood, Rehman, Khan, & Sultan, 2012), age groups (Dargis et al., 2013), and languages (Wiltink, Hauck, Phädayanon, Weidner, & Beutel, 2003), gay men have yet to be considered. Given that ED is considered a proxy of underlying health problems, and the variance in sexual roles and practices that exist in gay sexual culture, it is paramount that tools used for measuring erectile functioning be validated for use with gay men.

IIEF & Gay Men

Despite the widespread psychometric support for the IIEF for assessing ED, it primarily has been validated using samples that consist primarily of heterosexual men (e.g., Breyer, Smith, Eisenberg, Ando, & Rowen, 2010; Hart et al., 2012; Peixoto & Nobre, 2016). Literature suggests that assessing gay men's behaviour with measures that have only been validated with heterosexual men can be problematic (Sandfort & Keizer, 2001), as the applicability of the items to the sample is not guaranteed. For instance, sexual functioning and sexual satisfaction, as well as what constitutes sexual intercourse, may differ between gay and heterosexual men (McDonagh, Stewart, Morrison, & Morrison, 2016). For example, the IIEF includes an array of questions on "sexual intercourse" (e.g., "When you attempted sexual intercourse, how often were you able to penetrate [enter] your partner?"), which for heterosexual men may indicate only penetrative sex. Gay men, however, may participate in a wider variety of sexual activities under the umbrella of sexual "intercourse" (i.e., insertive or receptive anal intercourse). Similarly,

another item asks, “How much have you enjoyed sexual intercourse?” which, depending upon the broader definition of sexual intercourse among gay men, their enjoyment may not be related to one’s ability to get or maintain an erection. Furthermore, it has been noted that the distinction between the sexual behaviour of gay and heterosexual men may cast doubt on any results which ostensibly measure the degrees of sexual functioning and sexual satisfaction of both groups simultaneously (McDonagh et al., 2016).

Numerous studies have used the IIEF to assess ED in populations of HIV-positive gay men without assessing the factor structure or validity of the scale (e.g., Chirca, Aurelian, Persu, Săndulescu, Streinu-Cercel, & Jinga, 2018; Hart et al., 2015; Moreno-Pérez et al., 2010). However, Coyne et al. (2010) adapted the IIEF to assess ED in HIV-positive MSM (IIEF-MSM), adding eight items to the original 14-item measure, with further modification done to existing items. While the authors contend that the additional items and modifications were necessary to increase the measure’s saliency for MSM, there is a lack of detail regarding the process used to generate items. Further, an exploratory factor analysis on the adapted measure did not align with the original factor structure of the IIEF; a distinction that was largely ignored by the researchers. Lastly, the scale was validated with a sample consisting of MSM, who may be dissimilar to a sample of exclusively gay men due to differences in sexual behaviour (i.e., MSM may partake in vaginal sex). Also, the portion of exclusively gay men in the sample was not specified. Thus, a tool to accurately assess ED in gay men has yet to be determined.

Purpose

Previously, the psychometric integrity of the IIEF has been assessed with a sample that was composed of men whose sexual orientation was not provided (Rosen et al., 1997). Literature suggests that assessing gay men mental or physical health with measures that were not validated

with a sample of gay men can be problematic (Sandfort & Keizer, 2001). Thus, the purpose of the current study is to evaluate the dimensionality, reliability, and validity of the IIEF with a large sample of gay men. It is important to note that the current study appears to be critical of the IIEFs development as Rosen et al. (1997) did not explicitly consider gay men's sexual behaviour in relation to ED. The study is not suggesting that this omission is an indicator of the attitudes or viewpoints the original authors hold toward gay men. Nor is it suggesting the development of the IIEF was inadequate or conducted incorrectly. Rather, the purpose is to illustrate the need to assess the factor structure, validity, and reliability of scales used on samples whose characteristics differ from the original developmental study or risk potential mismeasurement and misdiagnosis.

Research suggests that ED is frequently related to depression, anxiety, and stress (McCabe & Althof, 2014; Hatzimouratidis et al., 2010; Mourikis et al., 2015; Suija et al., 2014). Therefore, in the current study, these three mental health issues will serve to provide a strand of evidence of the convergent validity of the IIEF. Additionally, the IIEF should correlate with a measure that is designed to specifically assess ED in gay men whereby scores indicating the severity of ED correlate.

Method

Ethical approval was obtained from the research ethics committee affiliated with the second author's university. Using Surveygizmo®, a questionnaire package was created which consisted of an information sheet, informed consent, and relevant measures. The participant information sheet, presented on the first page of the survey, clearly stated that only men aged 18 years and older were eligible to participate. The purpose of the study and ethical requirements for research with human participants were described (e.g., participation was anonymous and

voluntary). The consent sheet appeared under the information sheet; demographic questions and all scales were presented on the remaining pages. Secure Sockets Layer encryption was used to ensure participant confidentiality.

Participants were recruited through a variety of means. In Ireland, a national campaign was launched seeking participation from all gay men aged 18 years and over. Advertisements were placed in local and national newspapers, and the research was discussed on local and national radio stations. Posters detailing the study were displayed in gay bars and nightclubs throughout Ireland. Internationally, LGBT organisations and groups (e.g., Pride event organisers) were contacted and asked to forward "an invitation e-mail" to their members. Invitations to participate in a study on ED were posted online on several websites frequented by gay men (e.g., blogs and discussion forums). The administrators of these websites, blogs, and forums were also asked to forward information about the study to personal contacts. As well, chain-referral sampling was used whereby acquaintances of the authors were asked to inform other men about the study. A Facebook page ("Gay Men's Sex Survey") was created, which described the research and provided links to the survey. Other LGBT-related Facebook pages (e.g., gay choirs) also were contacted and asked to post a link to the survey on their page. Despite the extensive recruitment efforts in Ireland, the majority of the participants in the current study were recruited from the internationally based online promotional initiatives.

Measures

In addition to demographic questions (e.g., age, location, and ethnicity), participants were asked to complete a questionnaire package. Four attention check questions (e.g., "For this question, please select "Never") were inserted throughout to ensure the data gathered was authentic.

Sexual Orientation: Determining sexual orientation was of especial importance because the analysis required exclusively gay men. A 7-point Likert single item measure developed by Vrangalova & Savin-Williams (2012) was utilized. Participants were asked "How would you describe your sexual orientation?" The response options were: "Decline", "Other", "Exclusively heterosexual," "More heterosexual than gay", "Bisexual", "More gay than heterosexual", and "Exclusively gay". Participants that indicated a sexual orientation other than exclusively gay were removed from analysis.

International Index of Erectile Function (IIEF; Rosen et al., 1997). The IIEF is a 15-item measure of erectile functioning over the past four weeks. Each question is answered using a Likert scale with a variety of response formats where higher scores indicate normative erectile functioning. The measure consists of five domains: 1) Erectile functioning (6-items); 2) Orgasmic functioning (2-items); 3) Sexual desire (2-items); 4) Intercourse satisfaction (3-items); and 5) Overall satisfaction (2-items). Total scores for each domain have clinical implications and treatment recommendations. The current study modified the IIEF to include 16-items because item 15 was double-barrelled (i.e., "How do you rate your confidence that you could get and keep an erection?"). As previous research has indicated that "double-barrelled" items are problematic (Simms & Watson, 2007), the item was split according to the distinction of "get" and "keep." A "not applicable" option also was added to items (10, 13, and 14) which assumed sexual activity had occurred or that the participant was in a relationship (e.g., Item 14: "Over the last month, how satisfied have you been with your sexual relationship with your partner?"). This alteration is in accordance with contemporary recommendations for best-practice administration of the IIEF (Yule, Davison, and Brotto, 2011). As per the recommendations of administering the IIEF to prevent overestimates of sexual difficulties (Yule et al., 2011), the "not applicable"

option was coded as missing values for validity analyses. The IIEF reliability and validity for the current study are discussed in the results section.

Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983). The HADS is a 14-item scale used to clinically assess anxiety and depression over the past week. This instrument consists of seven items measuring depression and seven items measuring anxiety; both use a 4-point Likert scale (responses vary per item with 0 referring to the absence of symptoms; 3 indicating acute symptoms). Eight items on the HADS must be reverse scored for analysis. Respondents can score between 0 and 21 for each subscale, with higher scores indicating greater anxiety or depression. In the current study, theta reliability for the subscales was excellent (Depression: $\Theta = .86$; Anxiety: $\Theta = .88$).

Perceived Stress Scale 4 (PSS4; Cohen, Kamarck, & Mermelstein, 1983). The PSS4, which was adapted from the 14-item PSS (Cohen et al., 1983), is a 4-item measure designed to assess perceived stress over the past month. The scale utilizes a 5-point Likert scale (0 = "Never", 1 = "Almost never", 2 = "Sometimes", 3 = "Fairly often", 4 = "Very often") with scores ranging from 0 to 16; higher scores indicate greater perceived stress. In the current study, the reliability for the PSS4 was strong ($\Theta = .84$).

*Gay Male Sexual Difficulties scale (*GMSD; McDonagh et al., 2016). The GMSD consists of six factors to measure sexual difficulties experienced specifically by gay men. The current study utilizes the 4-item ED subscale. Responses use a Likert format with higher scores indicating greater sexual difficulties (0 = "Not applicable", 1 = "Never 2 = "Once or twice", 3 = "Several times", 4 = "Most of the time", 5 = "All of the time"). The reliability for the GMSD-ED subscale was strong for the current study ($\Theta = .86$).

Results

The sample of exclusively gay men (N = 1,118) was randomly divided into two subsamples (Sample A [n = 567]; Sample B [n = 551]) using SPSS. An exploratory factor analysis (EFA) was conducted using Sample A to determine the IIEF factor structure followed by a confirmatory factor analysis (CFA) with Sample B. Scale score reliability and indicators of construct validity (specifically, convergent validation) were tested separately for each sample.

Demographics. The mean age of the sample was 34.5 years old (Sample A = 34.9, Sample B = 34.1). The sample was primarily Caucasian (85%; Sample A = 84.5%; Sample B = 86.4%) and from the United States (44.4%; Sample A = 44.1%, Sample B = 43.9%), United Kingdom (14.4%; Sample A = 14.5%, Sample B = 14.1%), and Ireland (13.2%; Sample A = 12.7%, Sample B = 13.7%). The most common relationship status was single (34%; Sample A = 35.5%, Sample B = 33.8%).

Sample A: Dimensionality. The IIEF uses a Likert-type response format and, thus, provides ordinal rather than interval data. Unfortunately, the most commonly used statistical packages (e.g., SPSS) cannot perform an EFA using polychoric correlations, which is the appropriate analysis when data are ordinal. Thus, R programming language was employed via an SPSS version 25 plug-in (see Basto and Pereira, 2012).

The dimensionality of the IIEF was examined using principal axis factor analysis (PAF), with oblique rotation (oblimin quartimin). To assist with factor retention, parallel analysis was utilized. This method has been reported to be one of the most accurate in identifying the appropriate number of factors to retain (Çokluk & Koçak, 2015).

The data were suitable for factor analysis: 1) The Kaiser-Meyer-Olkin's measure of sampling adequacy was .84; 2) the determinant was .0001; and 3) Bartlett's test of sphericity was

statistically significant ($\chi^2 = 9952.20$, $p < .001$). Individual measures of sampling adequacy (IMSA) were appropriate (> .6, Cerny & Kaiser, 1977).

Four eigenvalues generated by the real dataset exceeded the randomly created polychoric correlation matrices eigenvalue. The first eigenvalue was 7.97 which was greater than the random generated 1.35. The second eigenvalue was 2.15 which was greater than the randomly generated 1.28. The third eigenvalue was 1.41 which was greater than the randomly generated 1.22. The fourth eigenvalue was 1.27 which was greater than the randomly generated 1.18. Lastly, the fifth eigenvalue of 1.02 was less than the randomly generated 1.10. This result suggests that a four-factor solution would be suitable; however, it was theoretically uninterpretable, and four items double loaded (greater than .3 loadings on two or more factors). Furthermore, two additional items verged on double loading (> .280 on two factors). Instead, a five-factor solution was considered because the IIEF measure normally contains five factors. Although the eigenvalues suggested a four-factor structure, the fifth eigenvalue (1.02) was relatively close to the randomly generated value; thus, was deemed to be acceptable. Furthermore, the five-factor solution was theoretically interpretable.

For the five-factor solution, four items loaded onto two or more factors and were removed. Factor loadings for the remaining items are provided in Table 1. Inspection of this table reveals that the retained items had loadings ranging from .71 to .91. A 12-item IIEF with five factors was posited. The factors were interpreted as “Erectile functioning” (Factor 1: 4-items), “Orgasmic functioning” (Factor 2: 2-items), “Sexual desire” (Factor 3: 2-items), “Overall satisfaction” (Factor 4: 2-items)” and “Confidence” (Factor 5: 2-items). It is important to note that these factors greatly differed from the original IIEF. Generally, 2-item factors are not recommended because they underrepresent the factor (Courtney & Gordon, 2013); however, the

original IIEF contained three factors that consisted of 2-items, so the choice was made to retain these factors rather than delete them.

Sample B: Dimensionality. The replicability of the five-factor solution obtained with Sample A was tested with Sample B using CFA. AMOS version 22.0 was utilized. Model fit was assessed using multiple criteria: 1) Root Mean Square Error of Approximation (RMSEA); 2) Bentler's comparative fit index (CFI); and 3) the Tucker-Lewis fit Index (TLI). The cut-offs for excellent model fit are: RMSEA < .06, CFI > .95, and TLI > .95; Byrne, 2005). The initial CFA suggested that the 5-factor model for the 12-item IIEF was acceptable: RMSEA = .062, 95% CI [.052,.075], CFI = .98, TLI = .97. Factor loadings ranged from .71 to .97 (see Figure 1).

Samples A and B: Scale Score Reliability. Ordinal theta is often used to determine the scale score reliability of ordinal data, which the IIEF produces (Morera & Stokes, 2016). The ordinal theta scores for the 12-item version of the IIEF were excellent (Sample A, Θ = .92, Sample B, Θ = .92.). Theta values for individual factors were: Factor 1: Erectile functioning (Sample A, Θ = .96, Sample B, Θ = .96); Factor 2: Erectile functioning (Sample A, Θ = .90, Sample B, Θ = .91); Factor 3: Sexual desire (Sample A, Θ = .90, Sample B, Θ = .87); Factor 4: Overall satisfaction (Sample A, Θ = .87, Sample B, Θ = .88); Factor 5: Confidence (Sample A, Θ = .97, Sample B, Θ = .97).

Samples A and B: Convergent Validity. Moderate negative correlations were observed between scores on the IIEF and the HADS depression subscale (Sample A: r [567] = -.30, p < .001; Sample B: r [551] = -.27, p < .001). Also, negative correlations observed between the IIEF and the HADS anxiety subscale were statistically significant (Sample A: r [567] = -.20, p < .001; Sample B: r [551] = -.13, p =.003). The scores for PSS4 negatively correlated with the IIEF (Sample A: r [567] = -.27, p < .001; Sample B: r [551] = -.15, p < .001); however, the correlation

strength for Sample A was appreciably stronger (z = -2.11, p < .001) than the correlation for Sample B. For the GMSD-ED subscale that is used to specifically assess ED in gay men, moderate negative correlations were observed with the IIEF (Sample A: r [567] = -.37, p < .001; Sample B: r [551] = -.38, p < .001). The negative correlation can be attributed to the GSMD indicating the presence of ED with greater total scores. In comparison, lower total scores on the IIEF indicate ED.

Discussion

The purpose of the current study was to assess the dimensionality, validity, and reliability of the IIEF using a sample of gay men. The scale was developed with a sample that consisted of men whose sexual orientation was not specified (Rosen et al., 1997). Using assessment scales that have not been validated for specific populations may lead to inaccurate results and, potentially, misdiagnoses. Therefore, the current study explicitly tested the psychometric properties of the IIEF for usage with gay men.

The current study was unable to duplicate the factor structure of the IIEF (Rosen et al., 1997). Certain items loaded unexpectedly, four items required removal because they loaded onto two factors (> .3), and factors required reinterpretation. The revised IIEF five factors were interpreted as: “Erectile function” (items 2, 3, 4 & 5), “Orgasmic functioning” items 9 & 10), “Sexual desire” (items 11 & 12), “Overall satisfaction” (items 13 & 14), and “Confidence” (items 15 & 16). The most significant alteration of the IIEF is the removal of the “Intercourse satisfaction” factor, which was comprised of items 6, 7, and 8 (“How many times have you attempted sexual intercourse?”; “When you attempted sexual intercourse, how often was it satisfactory for you?”; and “How much have you enjoyed sexual intercourse?”). All three of

these items loaded weakly onto both "Erectile function" and "Overall satisfaction". The deletion of the "Intercourse satisfaction" subscale may be attributed to the differences in gay men's sexual behaviour compared to heterosexual men. Gay men may engage in receptive and/or insertive anal sex, rather than strictly insertive (Johns et al., 2012; McDonagh et al, 2016). For instance, Wei and Raymond (2011) observed that 21% of gay men surveyed were exclusively receptive, 37% were exclusively insertive, and 47% engaged in both (i.e., were "versatile"). Therefore, it is possible that the term "intercourse" fails to capture gay men's sexual positions during anal sex. Rosen et al. (1997) developed the IIEF using a sample of men (N = 58) from five countries but participants' sexual orientations were not reported. The resultant content of the items used to assess ED appear to reflect heteronormative sexual situations where an erection would be important for vaginal penetration. The removal of the "Intercourse satisfaction" factor may indicate an inconsistent conceptualization of the term intercourse. For instance, inspection of the current study's responses on the four "Erectile functioning" items indicated that 22% to 39% of the gay men in our study had not attempted penetration during the past four weeks. Each of these questions explicitly assess a man's ability to "penetrate" with their erect penis, which would only apply to gay men who engage in insertive anal sex. Consequently, gay men who exclusively participate in receptive anal intercourse may be at risk for inaccurate ED assessments when using the IIEF.

For the purpose of the current study, item 15 was separated into two items because the question was deemed to be "double loaded" as it assessed both "getting" and "maintaining" an erection (items 15 and 16). In the original IIEF, item 15 loaded onto the "Erectile functioning" factor; however, in the current study, items 15 and 16 loaded onto a novel factor that was interpreted as "Confidence." The scale score reliability for the "Confidence" factor was very

high ($\Theta > .98$), which may suggest these two items can be treated as a single item, as original intended. However, in that case, the one item "Confidence" that would require deletion. For the purpose of the current study, the factor was retained because its removal did not alter the CFA model fit.

Moderate evidence of convergent validity was observed for the 12-item IIEF for gay men. Research suggests that ED is related to depression, anxiety, and stress (McCabe & Althof, 2014; Hatzimouratidis et al., 2010; Mourikis et al., 2015; Suija et al., 2014). The current study observed that greater depression, anxiety, and stress was related to higher ED but the strength of the associations were weak ($< r = .30$). Thus, providing questionable evidence attesting to the convergent validity of the revised scale. A significant difference between samples on the PSS4 was detected. This may suggest that stress as an indicator of validity may be especially contentious in comparison to the others. Lastly, the scores on the GMSD-ED subscale significantly correlated with IIEF scores. Despite each measure evaluating the same construct, the correlational strength was moderate. This may reflect the difference in measurement approaches employed by each of the scales whereby one is gay male specific and the other heteronormative.

Limitations

The current study was not without limitations. First, the results of the EFA suggested five factors, with four two-item factors. Previous research recommends a cut-off of three items per factor (Raubenheimer, 2004). Two item factors are not recommended when conducting a CFA because they result in statistical error where the model is underdetermined due to a negative degree of freedom (Hair et al., 2010). The decision was made to retain the two-item factors because the original IIEF has three factors that include two-items. Furthermore, removing the

two-item factors would result in a single factor, four-item IIEF measure for gay men. Thus, the results of the CFA may be questionable due to adhering to the original factor structure of the IIEF. Second, due to the sexual nature of the research, our participants may have been more interested in sexual topics and willing to answer questions of a more intimate and personal nature. Thus, those who tend to be less inclined to share candid details of their sexual experiences and preferences may be less likely to partake in a study assessing ED. Third, the online format of the current study has limitations. For instance, the survey cannot be monitored as it would be in a structured setting such as a lab, meaning the researchers were unable to assist participants if it were required. Additionally, gay men without Internet access could not be recruited (Eysenbach & Wyatt, 2002). Fourth, response bias may have been a limiting factor as certain gay men may underreport their ED to maintain their self-esteem or may be experiencing denial due the connotations that a man's reduced sexual fidelity is shameful (Potts, 2000). Lastly, the current study attempted to recruit participants from diverse ethnicities and cultures by targeting a worldwide community sample; however, most of the respondents were English speaking, Caucasian, and originated from Westernized countries. Consequently, the results of the current study cannot be generalized to gay men of all ethnicities and cultural backgrounds.

Recommendations

For the current study, we assessed the dimensionality, validity, and reliability of the IIEF using a large sample of gay men. The necessary removal of three items measuring intercourse satisfaction – an entire factor – is problematic because it suggests that the content of the scale may not be salient to gay men. The term "intercourse" might possess varied meanings across gay men and lacks the precision necessary to measure ED in relation to insertive and receptive anal sex. As discussed, the IIEF items measure erectile function during penetrative sex so it cannot

capture the sexual behaviours of all gay men (i.e., ED experienced while being penetrated anally).

Based on the findings of the current study, the IIEF is **not recommended** for use assessing ED in populations of gay men. The scale would require significant alterations to capture the sexual behaviours of gay men; specifically, erectile functioning during insertive and receptive anal sex. The current study suggests that some of the existing terminology may not be applicable to gay men ("intercourse"), so salient terms must be determined using best practice item generation. Furthermore, the ability to skip questions if they do not pertain to the respondent is crucial, as some gay men strictly practice receptive sex, so the insertive items would not be applicable. This could be realized by creating separate subscales for insertive and receptive anal sex or including a widely implemented "not applicable" response option. Due to the extensive changes necessary to the IIEF to accurately measure ED in gay men and the need to assess the dimensionality, validity, and reliability of the resultant alterations, an alternative scale may be used to determine the absence or presence of ED in gay men. For instance, the Gay Male Sexual Difficulties scale (McDonagh et al., 2016) was developed and validated using a sample of exclusively gay men and includes a 4-item subscale concerning ED. Future research would benefit from the construction of a long-form ED scale for gay men or a substantive alteration of the IIEF using best practices in scale development.

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Table 1
Factor loadings of IIEF for gay men items (Sample A, *n* = 567)

IIEF Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Q1: How often were you able to get an erection during sexual activity?	-.240	-.452	.048	.027	.369
Q2: When you had erections with sexual stimulation, how often were your erections hard enough for penetration?	**-.787**	-.064	.017	.143	.218
Q3: When you attempted intercourse, how often were you able to penetrate (enter) your partner?	**-.914**	–.048	-.014	-.024	-.042
Q4: During sexual intercourse, how often were you able to maintain your erection after you had penetrated (entered) your partner?	**-.914**	-.017	-.020	-.051	.006
Q5: During sexual intercourse, how difficult was it to maintain your erection to completion of intercourse?	**-.788**	-.044	-.013	-.129	.113
Q6: How many times have you attempted sexual intercourse?	-.383	.017	.156	-.488	-.156
Q7: When you attempted sexual intercourse, how often was it satisfactory for you?	.436	-.164	.030	-.527	-.164
Q8: How much have you enjoyed sexual intercourse?	-362	-.060	.153	-.596	-.118
Q9: When you had sexual stimulation or intercourse, how often did you ejaculate?	-.015	**-.792**	.017	-.064	-.110
Q10: When you had sexual stimulation or intercourse, how often did you have the feeling of orgasm or climax?	.019	**-.806**	.021	.005	-.041
Q11: How often have you felt sexual desire?	.047	-.049	**.881**	.071	.000
Q12: How would you rate your level of sexual desire?	.025	.027	**.808**	-.029	.062
Q13: How satisfied have you been with your overall sex life?	.064	-.114	-.007	**-.714**	.134
Q14: How satisfied have you been with your sexual relationship with your partner?	.043	-.030	-.036	**-.734**	.121
Q15: How do you rate your confidence that you could get an erection?	-.064	-.002	.109	-.101	**.808**
Q16: How do you rate your confidence that you could keep an erection?	-.094	-.041	.074	-.088	**.782**

Items in bold indicate item retention in the final IIEF/significant factor loading