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The Psychometric Properties of the Hypersexual Behavior Inventory Using a Large-Scale Nonclinical Sample

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The conceptualization of hypersexuality has begun to converge as a result of proposed diagnostic criteria. However, its measurement is still diverse. The Hypersexual Behavior Inventory (HBI) is one of the most appropriate scales used to assess hypersexuality, but further examination is needed to test its psychometric properties among different clinical and nonclinical groups, including samples outside of the United States. The aim of the present study was to investigate the reliability and the generalizability of HBI and to determine a cutoff score on a large, diverse, online, nonclinical sample ($N = 18,034$ participants; females = 6132; 34.0%; $M_{age} = 33.6$ years, $SD_{age} = 11.1$). Confirmatory factor analysis (CFA) and reliability indices provided support for the structure of the HBI and demonstrated excellent reliability. Employing latent profile analysis (LPA), seven classes emerged, but they could not be reliably distinguished by objective sexuality-related characteristics. Moreover, it was not possible to determine an adequate cutoff score, most likely due to the low prevalence rate of hypersexuality in the population. HBI can be reliably used to measure the extent of hypersexual urges, fantasies, and behavior; however, objective indicators and a clinical interview are essential to claim that a given individual may exhibit features of problematic sexual behavior.

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Supplemental data for this article can be accessed [here](#).

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Hypersexuality is becoming a widely studied behavior (e.g., Montgomery-Graham, 2016; Schultz, Hook, Davis, Penberthy, & Reid, 2014; Womack, Hook, Ramos, Davis, & Penberthy, 2013). Furthermore, the conceptualization of hypersexuality has started to converge as a result of the proposed diagnostic criteria by Kafka (2010) and subsequent *Diagnostic and Statistical Manual of Mental Disorders*, Fifth Edition (DSM-5),

field trial of the proposed criteria (Reid, Carpenter, et al., 2012). Hypersexuality refers to excessive and uncontrollable sexual fantasies, urges, and behaviors accompanied by significant personal distress and adverse consequences. Individuals with hypersexuality use sexual fantasies, urges, and behaviors to cope with stress or negative emotions, such as anxiety or depression. The excessive time spent with these sexual fantasies, urges, and behaviors leads to conflicts in other important aspects of the individual's life (e.g., obligations or goals) and can cause physical and/or emotional harm to the individual with hypersexual behavior or others. In some extreme cases it could lead to suicidal behavior (Chatzittofis et al., 2017). Although individuals with hypersexuality try to control or reduce their sexual fantasies, urges, and behavior, they experience multiple unsuccessful efforts, often returning to previous behavioral patterns (Kafka, 2010).

Nevertheless, the assessment of hypersexuality is diverse and mainly focuses on males with hypersexuality (e.g., Montgomery-Graham, 2016; Reid, Garos, & Carpenter, 2011; Yeagley, Hickok, & Bauermeister, 2014), although recent studies have started to examine hypersexuality in female samples (e.g., Dhuffar & Griffiths, 2014, 2015; Kelly, Bimbi, Nanin, Izienicki, & Parsons, 2009; Klein, Rettenberger, & Briken, 2014). Clinical interviews and self-reported scales are currently the two predominant approaches to assessing hypersexuality, both with advantages and disadvantages. Clinical interviews assessing hypersexuality (e.g., Hypersexual Disorder Diagnostic Clinical Interview [Reid, Carpenter, et al., 2012]; Diagnostic Interview for Sexual Compulsivity [Morgenstern et al., 2011]) are usually conducted by clinicians, and these kinds of measures assess symptoms and consequences of excessive and uncontrollable sexual fantasies, urges, and behaviors. However, they do not provide detailed information on each criterion. They are more objective than self-reported scales, but they are more time-consuming and require clinician involvement. In contrast, self-report scales (e.g., Compulsive Sexual Behavior Inventory [Coleman, Miner, Ohlerking, & Raymond, 2001]; Sexual Addiction Screening Test—Revised [Carnes, Green, & Carnes, 2010]; Sexual Symptom Assessment Scale [Raymond, Lloyd, Miner, & Kim, 2007]; Hypersexual Disorder Questionnaire [Reid et al., 2012]) can provide a more widespread overview of the hypersexuality criteria and can be used quickly and easily. However, these measures have limitations, as individuals might not fully understand all questions and statements, leading to invalid results (Womack et al., 2013).

Several scales were created to assess hypersexuality before the establishment of the broadly accepted criteria of Kafka (2010). Consequently, these scales do not assess all the necessary information to measure the extent of hypersexual fantasies, urges, and behaviors (e.g., Marshall & Briken, 2010; Montgomery-Graham, 2016; Womack et al., 2013). Moreover, to fully grasp the complex nature of hypersexuality, psychometric scales that focus on only one aspect of hypersexuality (e.g., cybersex, masturbation, visiting strip clubs) or those scales that use one item to assess

each criterion of hypersexuality are limited in their scope. According to recent reviews (e.g., Marshall & Briken, 2010; Montgomery-Graham, 2016; Stewart & Fedoroff, 2014), the Hypersexual Behavior Inventory (HBI; Reid et al., 2011) appears to be the most reliable and valid scale for assessing hypersexuality based on Kafka's (2010) criteria.

The HBI is both theoretically and psychometrically robust, and assesses hypersexuality via three factors: control, coping, and consequences. The *control* factor refers to perceived diminished ability to self-regulate sexual fantasies, urges, and behaviors. Individuals with hypersexuality feel that their sexual behavior is uncontrollable, and they repeatedly return to this behavior. The second factor, *coping*, refers to the mood and feeling modifying aspects of sexual behavior, such as using sex to forget about daily problems, to relieve stress, or to reduce negative feelings (e.g., anger, anxiety, or frustration). The final factor, *consequences*, describes the potential negative effects that individuals with hypersexuality experience due to their sexual behavior. This factor includes interference with education or work-related tasks, sacrifice of important things in order to engage in sexual behavior, and neglect of duties. The HBI's three-factor, first-order model of hypersexuality has shown strong psychometric properties in terms of confirmatory factor analysis (CFA), high internal consistency, and high test-retest reliability (e.g., Klein, Rettenberger, Boom, & Briken, 2014; Reid et al., 2011; Yeagley et al., 2014). Moreover, the HBI has been demonstrated to have strong concurrent, criterion, discriminant, and clinical validity in previous studies (e.g., Montgomery-Graham, 2016; Reid, Dhuffar, Parhami, & Fong, 2012; Yeagley et al., 2014).

Despite the psychometric strengths of the HBI, research is needed to further consolidate the results of previous studies across cultures and non-treatment-seeking individuals (Montgomery-Graham, 2016; Reid et al., 2011). To the best of the authors' knowledge, apart from the original validation studies (i.e., Reid & Garos, 2007; Reid et al., 2011), only two studies have examined the psychometric properties of the HBI in terms of factor structure and reliability among non-English-speaking populations or in non-clinical settings. Klein et al. (2014) used an online sample of German men and women to assess whether the HBI could be reliably used in a non-English-speaking sample. Their results showed that the HBI had acceptable structural validity, high internal consistencies, and strong convergent, divergent, and clinical validity, indicating that the HBI can be used to assess hypersexuality symptoms and consequences in non-English-speaking populations. In the second study, Yeagley and her colleagues (2014) examined the psychometric properties of HBI among young nonheterosexual males in a nonclinical setting. They revised the scale and removed several items due to cross-loadings. However, the three-factor, first-order factor structure remained intact. On the basis of these two studies, it can be argued that the three-factor, first-order model of the HBI is theoretically and psychometrically plausible, and the scale can also be used in nonclinical populations.

Among clinicians and researchers, there is a strong need to use a psychometrically robust measure of hypersexuality with a valid cutoff score to identify individuals with hypersexuality (Montgomery-Graham, 2016). Over a decade ago, Reid and Garos (2007) suggested a possible cutoff score of 53 (out of the maximum 95) for the HBI using a sample of men on the basis of guidelines suggested by Jacobson and Truax (1991). The scale with this cutoff score showed excellent sensitivity (.92). However, there was only moderate specificity (.62), and the scale's positive predictive value (PPV), negative predictive value (NPV), and accuracy were not reported. These results suggest that a score of 53 on the HBI might be an acceptable cutoff score for males, but as yet there is no cutoff score for the general population.

On the basis of previous literature, the aims of the present study were twofold: (a) to examine the factor structure and reliability of the HBI in a large, nonclinical sample, and (b) to determine the cutoff score for the HBI on the basis of latent profile analysis (LPA), sensitivity, specificity, PPV, NPV, and accuracy.

Method

Participants and Procedure

The present study was conducted in accordance with the approval of the institutional review board (IRB) of the related university and following the Declaration of Helsinki. The research was conducted via an online questionnaire that took approximately 30 minutes to complete. Data collection occurred in January 2017. Prior to enrollment, consent was obtained from those 18 years of age and older before they began completing questionnaires via one of the largest Hungarian news portals. A total of 31,883 participants visited the website, with 7,256 individuals declining to participate in the study. A further 145 individuals were removed because they were underage, and 110 individuals were removed for inconsistent responses.

Two major types of analyses were used to identify inconsistent responses. The first type of analysis was based on the standard deviation of the responses. When given participants chose the same response categories for each item on each scale (e.g., the participants scored 5 for each item, even if the scales contained reverse items), then their responses were excluded from further analysis. The second type of analysis was based on the content of the responses. In this case, it was examined whether the responses made sense. For example, individuals were excluded from further analyses if they indicated a higher age for their first sexual experience than their actual age (e.g., first sexual experience at the age 23 but said they were currently age 20). Out of 24,372 participants, 18,034 participants had sexual experiences; therefore, they filled out the HBI.

Consequently, a total of 18,034 participants (females = 6,134 [34.0%], males = 11,792 [65.4%], other = 110 [0.6%]) aged between 18 and 76 years ($M_{\text{age}} = 33.6$, $SD_{\text{age}} = 11.1$) were included in the final data set. Previous studies (e.g., Klein,

Schmidt, Turner, & Briken, 2015; Reid et al., 2011; Sutton, Stratton, Pytyck, Kolla, & Cantor, 2015) have demonstrated that older participants (i.e., 60 years or older) can experience hypersexuality; therefore, it was decided to include older participants in the present study. Participants reported their place of residence as the capital city (53.9%), county towns (15.3%), towns (21.4%), or villages (9.3%); their highest level of education as primary (2.7%), secondary (36.5%), and higher education (60.8%).

Measures

Hypersexual Behavior Inventory. The HBI is a 19-item scale that assesses hypersexuality via three factors. Participants indicated their answers on a 5-point Likert scale (1 = *Never*; 5 = *Very often*). The coping factor (seven items) assesses sex and sexual behaviors as a response to emotional distress such as sadness, restlessness, or daily life worries. The control factor (eight items) assesses the lack of self-control in sexuality-related behaviors, such as an individual's attempt to change his or her sexual behavior fails. The consequences factor (four items) assesses the diverse consequences of sexual thoughts, urges, and behaviors, such as sexual activities that interfere with educational or occupational duties (Reid et al., 2011). The HBI was translated into Hungarian on the basis of Beaton, Bombardier, Guillemin, and Ferraz's (2000) protocol. The Hungarian version of the scale is reproduced in online supplemental file 1.

Sexuality-Related Questions. In addition to standard demographic questions (e.g., age, gender, education) further topic-relevant questions were asked (Bóthe et al., 2018). These included number of sexual partners, number of casual sexual partners, frequency of sex with the partner, frequency of sex with casual partners, and frequency of masturbation. Respondents were also asked about the frequency of viewing pornographic videos online and about the time spent accessing pornography.

Statistical Analysis

For the statistical analysis, SPSS 21 and Mplus 7.3 (Muthén & Muthén, 1998–2015) were used. CFA was used to assess the dimensionality of the HBI. The items were treated as categorical indicators, because they had severe floor effects (on the basis of skewness and kurtosis); thus, the mean- and variance-adjusted weighted least squares estimator (WLSMV) was used (Finney & DiStefano, 2006). In the structural assessment, commonly used goodness-of-fit indices (Brown, 2015; Kline, 2011) were observed (Bentler, 1990; Brown, 2015; Browne & Cudeck, 1993; Hu & Bentler, 1999; Schermelleh-Engel, Moosbrugger, & Müller, 2003; Tabachnick & Fidell, 2001). More specifically, the analyses examined the comparative fit index (CFI; $\geq .95$ for good, $\geq .90$ for acceptable), the Tucker–Lewis index (TLI; $\geq .95$ for good, $\geq .90$ for acceptable), and the root mean square error of

approximation (RMSEA; $\leq .06$ for good, $\leq .08$ for acceptable) with a 90% confidence interval (CI).

Reliability was assessed using Cronbach's alpha (Nunnally, 1978). However, due to its potentially decreased appropriateness (e.g., Sijtsma, 2009), one additional index was used (i.e., composite reliability), because it may better represent the construct as it takes into account the factor loadings with their respective measurement errors, which was computed based on the formula of Raykov (1997) ($> .60$ acceptable, $> .70$ good; Bagozzi & Yi, 1988).

To identify possible groups of individuals with high levels of hypersexuality—whose activity may be considered problematic—LPA was used (such as in the case of problematic pornography use [Bóthe, Tóth-Király, Zsila et al., 2018]; or in the case of Internet gaming disorder [Pontes, Király, Demetrovics, & Griffiths, 2014]). LPA is a person-centered mixture modeling technique that can classify subgroups of individuals who gave similar responses to the three dimensions of HBI (Collins & Lanza, 2010). The analysis was performed with two to eight classes on the full sample. To determine the number of latent classes, the following indices were used: the Akaike information criterion (AIC), the Bayesian information criterion (BIC), and the sample-size adjusted Bayesian information criterion (SSABIC), where lower values indicate more parsimonious models. Entropy was also examined, indicating the accuracy of the classification process. Higher values indicate higher accuracy, with .40 being low, .60 being medium, and .80 being high entropy (Clark & Muthén, 2009). Finally, the Lo-Mendell-Rubin adjusted likelihood ratio test (L-M-R test) was also used, which compares the estimated model (e.g., three classes) with a model having one less class (e.g., two classes). A statistically significant p value ($p < .05$) suggests that the model with more classes fits the data better (Muthén & Muthén, 1998–2015).

To determine the cutoff point for the HBI, a sensitivity analysis was carried out based on membership in the high-risk group in the LPA. Considering membership in this group as the gold standard, sensitivity, specificity, PPV, NPV, and accuracy values for all HBI cutoff points were calculated. Sensitivity was defined as the proportion of true positives belonging to the most problematic group based on the LPA, while specificity was defined as the proportion of the true negatives (Altman & Bland, 1994a; Glaros & Kline, 1988). PPV was defined as the proportion of the individuals with positive test results that was correctly diagnosed as hypersexual individuals, while NPV was defined as the proportion of participants with negative test results that were correctly diagnosed as nonhypersexual individuals (Altman & Bland, 1994b; Glaros & Kline, 1988). Moreover, taxometric analysis was conducted to investigate the latent structure of hypersexuality (Ruscio, Ruscio, & Carney, 2011). The detailed description of the taxometric analysis is in online supplemental file 2.

Results

Descriptive Statistics

Regarding the participants' relationship status, 4,080 were single (22.6%), 7,847 were in a relationship (43.5%), 731 were engaged (4.1%), 4,505 were married (25.0%), 505 were divorced (2.8%), 87 were widows/widowers (0.5%), and 279 indicated the "other" option (1.5%). Regarding their sexual orientation, 15,080 were heterosexual (83.6%), 1,724 were heterosexual with homosexuality to some extent (9.6%), 486 were bisexual (2.7%), 121 were homosexual with heterosexuality to some extent (0.7%), 458 were homosexual (2.5%), 20 were asexual (0.1%), 93 were unsure about their sexual orientation (0.5%), and 52 indicated the "other" option (0.3%).

On average, participants had seven sexual partners in their lifetime, of which four were casual partners. Regarding past-year sexual behavior, they masturbated once a week, watched online pornography two or three times a month, and spent 26 minutes per session using it ($SD = 20.9$).

Dimensionality and Structural Validity

CFA was performed to test the hypothesized dimensionality of the HBI on the nonclinical sample. The CFA results showed that the first-order, three-factor model had acceptable fit (CFI = .940, TLI = .931 RMSEA = .071 [90% CI = .070–.072]). Factor loadings were adequate (ranging from .60 to .86) (see Figure 1).

Reliability

Descriptive statistics and reliability measures are described in Table 1. All Cronbach's alpha coefficients and composite reliability values were good, apart from the Cronbach's alpha coefficient of the consequences factor, which was in the acceptable range. The means on each factor were relatively low; the control and consequences scales had higher skewness and kurtosis values, indicating a violation of normal distribution. The correlation between the factors was positive and moderate, apart from the association between control and consequences.

Latent Profile Analysis

LPA was performed on the three factors of the HBI to differentiate between the possible latent classes regarding hypersexuality. The AIC, BIC, and SSABIC values continuously decreased as more latent classes were added. Regarding entropy, all solutions had high levels of accuracy. The nonsignificant p value of the L-M-R test suggested that the eight-class solution should be rejected in favor of the seven-class solution (see Table 2). Based on these criteria, the seven-class solution was accepted as the best model.

The seven latent classes with their respective relationship patterns are outlined in Figure 2. In the case of the control [$F(6,$

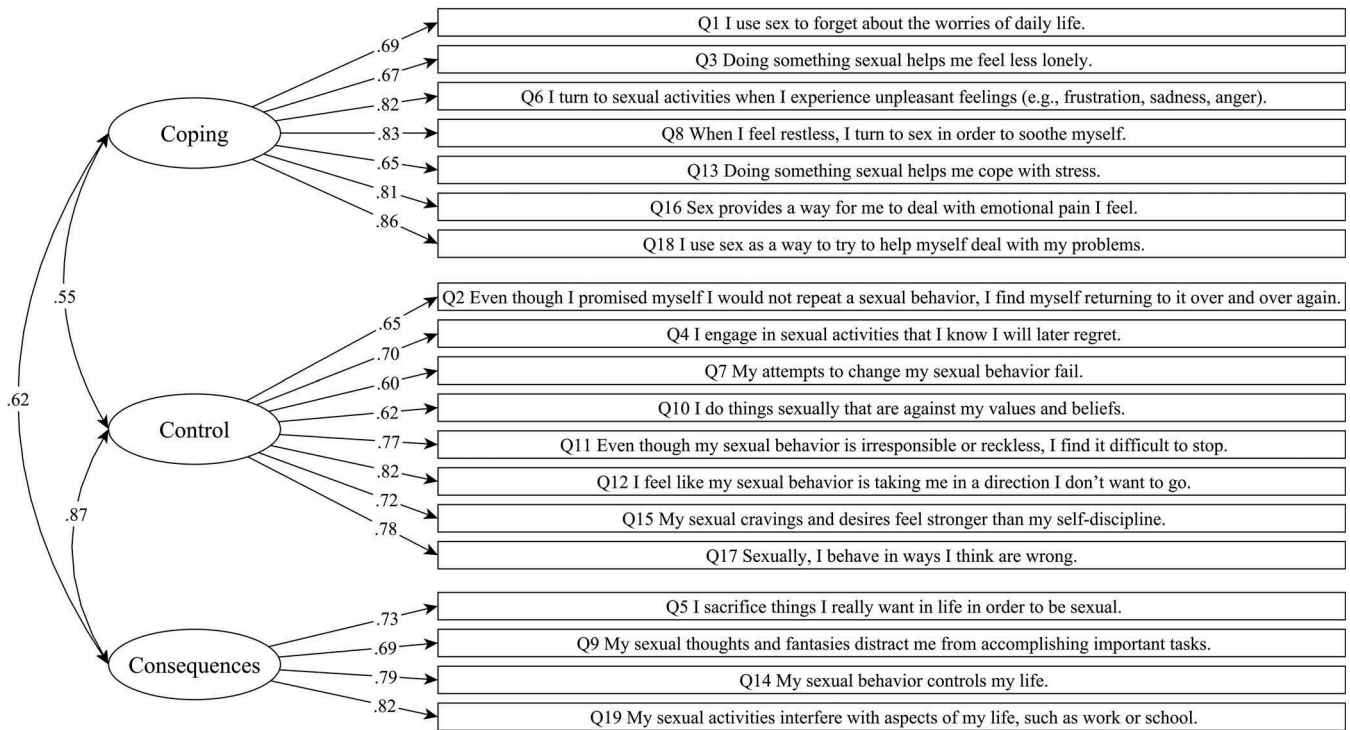


Figure 1. The factor structure of the Hypersexual Behavior Inventory. Standardized loadings are indicated on the arrows. All loadings are significant at $p < .001$.

Table 1. Means, Reliability Indices, and Interfactor Correlations Between the Dimensions of the Hypersexual Behavior Inventory

Factors	Range	<i>M</i> (<i>SD</i>)	Skewness (SE)	Kurtosis (SE)	α	CR	1	2
1. Coping	1–5	2.06 (0.78)	0.82 (0.02)	0.32 (0.04)	.86	.91	—	—
2. Control	1–5	1.64 (0.64)	1.56 (0.02)	2.78 (0.04)	.82	.89	.45*	—
3. Consequences	1–5	1.55 (0.64)	1.67 (0.02)	3.27 (0.04)	.75	.84	.48*	.67*

Note. HBI = Hypersexual Behavior Inventory; α = Cronbach’s alpha; CR = composite reliability; SE = standard error.

* $p < .001$.

Table 2. Fit Indices for the Latent Profile Analysis on the Hypersexual Behavior Inventory

Classes	AIC	BIC	SSABIC	Entropy	L-M-R Test	<i>p</i>
2	95,627	95,705	95,673	.911	16,685	< .001
3	90,478	90,588	90,543	.881	5,028	< .001
4	88,366	88,506	88,449	.880	2,068	< .001
5	86,753	86,924	86,854	.881	1,581	< .001
6	85,602	85,805	85,722	.869	1,130	.010
7	84,516	84,750	84,654	.873	1,067	.004
8	83,710	83,975	83,867	.874	794	.075

Note. Classes = number of latent classes; AIC = Akaike information criterion; BIC = Bayesian information criterion; SSABIC = sample-size adjusted Bayesian information criterion; L-M-R test = The Lo-Mendell-Rubin adjusted likelihood ratio test; $p = p$ value associated with the L-M-R Test. Bold indicates that the seven-class solution was selected as the final model.

18,033) = 8204.00; $p < .001$] and consequences [F (6, 18,033) = 23576.40; $p < .001$] factors, all post hoc tests were significant, indicating that there are significant differences between the seven classes in the control of sexual behavior and its consequences. However, in the case of coping [F (6,

18,033) = 1151.38; $p < .001$], the post hoc tests between the second and the third class, and between the fourth and the fifth class, were not significant, indicating that these groups cannot be differentiated on the basis of their coping scores. The coping factor of HBI did not differentiate perfectly among the seven

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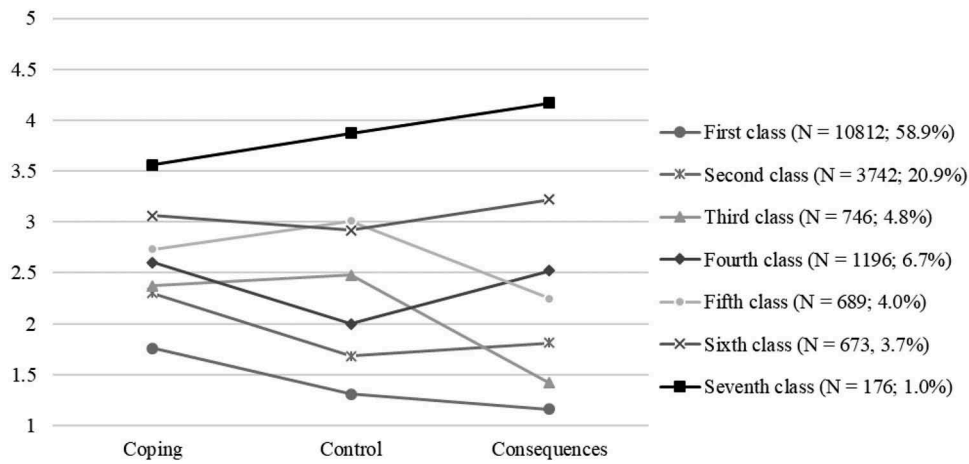


Figure 2. Latent classes based on the dimensions of the Hypersexual Behavior Inventory.

Table 3. Comparison of Latent Classes on the Objective Indicators of Hypersexuality

Indicators	Range	(1)	(2)	(3)	(4)	(5)	(6)	(7)	Wald χ^2
		First Class (N = 10,812; 58.9%)	Second Class (N = 3742; 20.9%)	Third Class (N = 746; 4.8%)	Fourth Class (N = 1196; 6.7%)	Fifth Class (N = 689; 4.0%)	Sixth Class (N = 673; 3.7%)	Seventh Class (N = 176; 1.0%)	
Number of sexual partners	1–16 ^a	7.96 ^{2,3,4,5,6,7} (0.04)	8.72 ^{1,4,5,6} (0.08)	8.66 ^{1,5,6} (0.17)	9.09 ^{1,2,6} (0.14)	9.43 ^{2,3} (0.19)	9.65 ^{1,2,3,4} (0.19)	9.42 ¹ (0.37)	160.38*
Number of casual sexual partners	1–16 ^a	3.58 ^{2,3,4,5,6,7} (0.05)	3.95 ^{1,4,5,6,7} (0.08)	4.31 ^{1,6,7} (0.16)	4.38 ^{1,2,6,7} (0.14)	4.75 ^{1,2,7} (0.18)	5.13 ^{1,2,3,4} (0.18)	5.68 ^{1,2,3,4,5} (0.39)	151.13*
Frequency of having sex with the partner	1–10 ^b	7.12 ^{3,5,6,7} (0.02)	7.12 ^{3,5,6,7} (0.04)	6.77 ^{1,2,4,5} (0.10)	7.02 ^{3,5,6,7} (0.07)	6.47 ^{1,2,3,4} (0.11)	6.67 ^{1,2,4} (0.11)	6.56 ^{1,2,4} (0.22)	77.63*
Frequency of having sex with casual partners [#]	1–10 ^b	3.75 ^{2,4,5,6,7} (0.04)	4.08 ^{1,4,5,6} (0.06)	3.90 ^{4,5,6,7} (0.10)	4.34 ^{1,2,3} (0.09)	4.35 ^{1,2,3} (0.10)	4.50 ^{1,2,3} (0.11)	4.45 ^{1,3} (0.22)	80.45*
Frequency of masturbation	1–10 ^b	6.43 ^{2,3,4,5,6,7} (0.02)	7.26 ^{1,3,4,5,6,7} (0.04)	7.54 ^{1,2,5,6,7} (0.08)	7.63 ^{1,2,5,6,7} (0.07)	7.88 ^{1,2,3,4,6,7} (0.08)	8.36 ^{1,2,3,4,6,7} (0.08)	8.74 ^{1,2,3,4,5,6} (0.13)	1068.57*
Frequency of pornography viewing	1–10 ^b	5.50 ^{2,3,4,5,6,7} (0.03)	6.53 ^{1,3,4,5,6,7} (0.05)	6.84 ^{1,2,5,6,7} (0.10)	7.10 ^{1,2,5,6,7} (0.09)	7.41 ^{1,2,3,4,6,7} (0.11)	7.79 ^{1,2,3,4,5,7} (0.11)	8.25 ^{1,2,3,4,5,6} (0.20)	942.04*
Duration of pornography viewing per occasion	0–180 ^c	23.84 ^{2,3,4,5,6,7} (0.20)	27.73 ^{1,4,5,6,7} (0.42)	27.38 ^{1,4,5,6,7} (0.87)	31.75 ^{1,2,3,6,7} (0.84)	31.05 ^{1,2,3,6,7} (1.09)	36.73 ^{1,2,3,4,5,7} (1.38)	47.31 ^{1,2,3,4,5,6} (3.16)	216.77*

Note. The class cells (1–7) contain the mean and standard errors (in parentheses) of the corresponding variable row. Superscript numbers (1, 2, 3, 4, 5, 6, 7) indicate significant differences between the given class and the indexed classes according to the Wald χ^2 test.

^a1: 0 partner; 2: 1 partner; 3: 2 partners; 4: 3 partners; 5: 4 partners; 6: 5 partners; 7: 6 partners; 8: 7 partners; 9: 8 partners; 10: 9 partners; 11: 10 partners; 12: 11–20 partners; 13: 21–30 partners; 14: 31–40 partners; 15: 41–50 partners; 16: more than 50 partners.

^b1: never; 2: once in the last year; 3: 1–6 times in the last year; 4: 7–11 times in the last year; 5: monthly; 6: two or three times a month; 7: weekly; 8: two or three times a week; 9: four or five times a week; 10: six or seven times a week.

^cParticipants indicated their responses in minutes.

^dNumber of partnered respondents.

^eNumber of respondents who had casual sexual partners.

[#]The frequency of having sex with a casual partner was only assessed among those respondents who indicated that they had casual partner(s) in the last year.

* $p < .001$.

groups, while the control and consequences factors differentiated more clearly.

Those in the first (10,812 individuals, 58.9%), second (3,742 individuals, 20.9%), third (746 individuals, 4.8%),

fourth (1,196 individuals, 6.7%), fifth (689 individuals, 4.0%) and sixth classes (673 individuals, 3.7%) represented individuals with little differentiated sexual behavior patterns (see Table 3). These individuals (a) use sex infrequently to

Table 4. Calculation of Cutoff Thresholds for the Hypersexual Behavior Inventory

Cutoff Score	True Positive	True Negative	False Positive	False Negative	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
50	174	16,355	1,503	2	98.86	91.58	10.38	99.99	91.65
51	174	16,521	1,337	2	98.86	92.51	11.52	99.99	92.58
52	173	16,660	1,198	3	98.30	93.29	12.62	99.98	93.34
53	173	16,797	1,061	3	98.30	94.06	14.02	99.98	94.10
54	172	16,928	930	4	97.73	94.79	15.61	99.97	94.82
55	171	17,033	825	5	97.16	95.38	17.17	99.97	95.40
56	171	17,136	722	5	97.16	95.96	19.15	99.97	95.97
57	168	17,237	621	8	95.46	96.52	21.29	99.95	96.95
58	167	17,338	520	9	94.89	97.09	24.31%	99.95	97.07
59	166	17,408	450	10	94.32	97.48	26.95	99.94	97.45
60	158	17,467	391	18	89.77	97.81	28.78	99.90	97.73
61	156	17,529	329	20	88.64	98.16	32.16	99.89	98.06
62	155	17,584	274	21	88.07	98.47	36.13	99.88	98.36
63	152	17,630	228	24	86.36	98.72	40.00	99.86	98.60
64	147	17,669	189	29	83.52	98.94	43.75	99.84	98.79
65	144	17,706	152	32	81.82	99.15	48.65	99.82	98.98
66	141	17,734	124	35	80.11	99.80	53.21	99.80	99.12
67	131	17,766	92	45	74.43	99.48	58.74	99.75%	99.24
68	128	17,784	74	48	72.73	99.59	63.37	99.73	99.32
69	122	17,798	60	54	69.32	99.66	67.00	99.70	99.37
70	115	17,804	54	61	65.34	99.70	68.05	99.67	99.36
71	109	17,822	36	67	61.93	99.80	75.17	99.63	99.43
72	102	17,834	24	74	57.95	99.87	80.95	99.59	99.46
73	97	17,846	12	79	55.11	99.93	88.99	99.56	99.50
74	87	17,849	9	89	49.43	99.95	90.63	99.50	99.46
75	76	17,853	5	100	43.18	99.97	93.83	99.44	99.42

cope with negative feelings or emotions, (b) control their sexual behavior most of the time, and (c) rarely experience negative consequences of their sexual behavior. However, the seventh class (176 individuals, 1.0%) represented individuals with high risk of serious hypersexuality. These individuals often (a) use sex frequently to reduce negative feelings, emotions, and stress, (b) cannot control their sexual behavior, and (c) experience negative consequences of their sexual behavior. The seven latent classes and their characteristics are described in Table 3. Overall, individuals in the seventh class masturbated and viewed pornography more frequently than the other six classes, and they spent more time with it on each occasion. However, they did not have more sexual partners in their lives and they did not have sex more frequently than individuals in the other classes.

Determination of a Potential Cutoff Score to Be Classified as Hypersexual: Sensitivity and Specificity Analysis

Based on the membership in the seventh class (i.e., the high-risk group) as a gold standard, the sensitivity, specificity, PPV, NPV, and accuracy of the HBI at all possible cutoff scores were calculated. The results are outlined in Table 4. On the basis of this analysis, it was not possible to determine a reliable cutoff score. For example, if 59 is selected as a possible cutoff score, all the indices would be excellent except for PPV, which would be low (27%).

This low level of PPV indicates that if this cutoff score was used, only 27 out of 100 would be reliably identified as having problems with their sexual behavior, while 73 would be false-positive cases. Increasing the cutoff score leads to more false-negative cases (i.e., individuals highly engaged in hypersexuality with serious consequences would be mistakenly diagnosed as having nonproblematic sexual behavior), while decreasing the cutoff score results in more false-positive cases (i.e., individuals with nonproblematic sexual behavior would be mistakenly diagnosed as individuals having high levels of hypersexuality with serious consequences).

Moreover, the results of taxometric analysis did not indicate definitive evidence toward either a dimensional or a categorical latent structure for hypersexuality in the present sample (for details, see online supplemental file 2). Although the results of the taxometric analysis suggested a more dimensional structure for hypersexuality, some requirements of taxometric analysis were violated (e.g., within-group correlations between some indicators exceeded the suggested threshold). The results depended on the applied methods (e.g., MAMBAC versus MAXEIG) and on the applied indicator sets (HBI versus HBI-SF). Therefore, further research is needed to determine whether hypersexuality is a dimensional or a categorical construct. It is possible that the aforementioned contradictions regarding the latent structure of hypersexuality could explain why a reliable cutoff value could not be determined

for the HBI (e.g., Graham, Walters, Harris, & Knight, 2016; Ruscio, Haslam, & Ruscio, 2006).

Discussion

According to the results of the present study, the HBI has strong psychometric properties in terms of internal consistency, composite reliability, dimensionality, and structural validity. The results also indicate that the HBI can be used in diverse, nonclinical populations. However, a general, reliable cutoff score could not be determined on the basis of LPA and alongside the sensitivity and specificity analysis.

According to CFA, the first-order model with three factors demonstrated an acceptable fit. Furthermore, the factor loadings were adequate, and the correlations between the factors were acceptable. In comparison to the original validation study of the HBI (i.e., Reid et al., 2011), the fit indices and the factor loadings were lower. These lower values may be caused by the diversity of the present large-scale sample. Reid and colleagues (2011) conducted their analysis on treatment-seeking males only, while Yeagley et al. (2014) and Klein et al. (2014) employed more diverse samples and, like the present study, achieved lower fit indices and factor loadings. In line with previous studies (Klein et al., 2014; Reid et al., 2011; Yeagley et al., 2014), the internal consistencies of the coping and control factors in the present study were the highest, and the internal consistency of the consequences factor was the lowest (but still within acceptable range).

These results also indicated that the coping and control factors of hypersexuality represent a narrower and more strongly connected concept than the consequences factor. This latter factor covers a broader range of symptoms, including work- and education-related problems, feeling distracted from important tasks due to sexual behavior, and/or sacrificing important things in life to engage in sexual fantasies, urges, and behavior. Moreover, in the case of consequences, it is possible that some of these are not so frequently experienced as the others, resulting in lower internal consistency of this factor. Alternatively, individuals may develop difficulty regulating their sexual behavior for some period of time before the consequences begin to arise. Subsequently, they would be more likely to endorse items on the coping and control subscales compared to items on the consequences subscale.

To get a clearer view of the consequences of hypersexuality, Reid and colleagues (2012) developed the Hypersexual Behavior Consequences Scale (HBCS) to assess a broader variety of consequences related to hypersexuality. Items on the HBCS query consequences associated with work, educational activities, commitment, legal, health, self-esteem, well-being, and social problems due to engagement in sexual activities. All things considered, the HBI could be used as the first step of the diagnostic process, while the HBCS could be used later in the development of the treatment process or as an outcome measure of treatment effectiveness.

The correlations between HBI factors were moderate, apart from the association between control and consequences factors, which was strong. In previous studies (Klein et al., 2014; Reid et al., 2011; Yeagley et al., 2014), this association was also strong, and in most of the cases, it was the strongest one between factors (Klein et al., 2014; Yeagley et al., 2014). This strong association between controlling one's behavior and having negative consequences of one's behavior is not surprising. In the case of hypersexuality, if individuals cannot control their sexuality-related fantasies, urges, and behaviors (having high levels of impulsivity, e.g., Bóthe et al., 2018; Reid, Bramen, Anderson, & Cohen, 2014), they will engage in sexuality-related activities more frequently, which in turn can lead to frequent mild or severe consequences. Therefore, if the individual learns how to control sexual activities, the negative consequences will decrease or even disappear.

Although the HBI has good theoretical underpinnings and robust psychometric properties, a reliable cutoff score cannot be determined using the results of LPA alongside sensitivity and specificity analysis. On the one hand, LPA was unable to fully differentiate groups according to either severity of the problem or other patterns. In the case of previous studies using LPA to identify at-risk problematic user groups or individuals with a given behavior in diverse activities, three to five groups emerged in which individuals had different, distinguishable behavioral patterns (e.g., Bóthe et al., 2018; Demetrovics et al., 2012; Mueller et al., 2010; Pontes et al., 2014; Steuwe, Lanius, & Frewen, 2012; Wartberg, Kriston, Kammerl, Petersen, & Thomasius, 2015). In the present case, seven groups emerged as a statistically acceptable solution. However, the behavioral patterns of individuals in these groups could not be differentiated on the basis of HBI scores. Moreover, the comparison of these groups using objective indicators of sexuality did not lead to the demonstration of distinguishable behavioral patterns.

On the other hand, according to the calculations of Maraz, Király, and Demetrovics (2015), when the prevalence of a behavior or addiction is low in the population (e.g., approximately 1% or lower in the population), the sensitivity and the specificity can be high (even 99%). However, the PPV will be low, indicating that even if the screening measure showed a positive test result, there would be a high probability of having no problems at all. Although estimations of up to 3% in general populations are available (Stewart & Fedoroff, 2014; Sussman, Lisha, & Griffiths, 2011), the prevalence of hypersexuality in the population has yet to be properly established. Therefore, it might be assumed that the low prevalence rate of this behavior led to the low PPV of the HBI when the sensitivity and specificity rates were adequate. In cases when the prevalence rate of a behavior or addiction is low, the most appropriate use of screening measures is to rule out a condition, not to establish a diagnosis (Streiner, 2003).

Therefore, in the clinical evaluation of hypersexuality a multistep approach is ideal. The first step of such a diagnosis would include valid and reliable self-report scales of typical symptoms based on the hypersexuality criteria, followed by objective indicators of hypersexuality (e.g., frequency of masturbation, visits to strip clubs, having sex with consenting adults, frequency of pornography use). Finally, a clinical interview should be administered. Using this stepped approach, a more comprehensive and accurate view of the individual's condition can be assessed.

Another possible explanation why it was impossible to determine a reliable cutoff is that the coping factor did not differentiate appropriately between the participants in the present study. Coping can be seen more as a motivational factor than as a problem factor, and as such it describes having sex or having sex-related urges and fantasies to reduce negative feelings, emotions, and stress. However, this motive is not directly associated with problems in contrast to the other two factors. Losing control over the activities as well as negative consequences of the behavior are purely symptomatic of the problematic behavior, while using sex to cope with negative feelings might lead to problematic behavior or not. However, all this means is that coping might not be an ideal factor to directly assess severity of the problems, especially in isolation from the other factors of the HBI. It is possible that other motivational dimensions (such as escapism in the case of problematic online gaming; Király et al., 2015) may differentiate more clearly according to problem severity. This could be the topic of further research that focuses on the association between motivational factors and problem severity. Moreover, further discussion is needed to determine how severity should be best characterized (Reid, 2015).

The present study had some limitations. The data were cross-sectional and the sample was self-selecting and nonrepresentative (although the sample size was very large). Participants were recruited via the Internet, where the real identity of the respondents can be questioned, although anonymous data collection could be beneficial in sexuality-related studies (especially if participants are asked about behaviors that are both problematic and sensitive in nature). The anonymity of responding online is likely to alleviate stress levels and could result in more honest responses when it comes to sexually-related behavior (Griffiths, 2012). The scales utilized assess self-reported ratings, which can distort reality; for example, participants may perceive their behavior as problematic even though there is no objective evidence for it being problematic. Biases concerning recall and social desirability may have also been present. In the present study, participants indicated the frequency of sexuality-related variables according to predetermined categories (such as frequency of masturbation or frequency of viewing pornographic videos

online) that might have led to socially desirable responding (e.g., if the highest option for pornography viewing is six to seven times a week, it is possible that people report less frequent behavior because the highest value might make them feel abnormal). Moreover, the categories regarding sexuality-related variables did not allow participants to record their own values (which could have been much higher than the closed choices they were given) that might have indicated the severity of hypersexuality more precisely. Therefore, open-ended questions would be preferable in future hypersexuality studies regarding sexuality-related variables. Taxometric analysis did not yield reliable results as to whether hypersexuality has a categorical or a dimensional latent structure; therefore, further research is needed to examine the latent structure of hypersexuality on diverse samples with different indicator sets. Although participants were aged between 18 and 76 years, the study excluded those who did not use the Internet. Future research should try to recruit individuals using a wider range of recruitment strategies, as well as try to increase the representativeness of the sample. Finally, although the frequency and duration of several sexuality-related activities were referred to as "objective" indicators of hypersexuality, self-report biases relating to these particular behaviors may also have occurred.

Conclusions

Hypersexuality is becoming a widely studied behavior, but as yet there is no consensus as to which measure is the most reliable to assess the severity of hypersexuality. According to previous reviews (Marshall & Briken, 2010; Montgomery-Graham, 2016; Stewart & Fedoroff, 2014) and the results of the present study, the Hypersexual Behavior Inventory (HBI) is a reliable instrument to assess hypersexuality that can be employed in clinical and nonclinical settings across diverse populations. However, when the prevalence of a behavior or addiction is low, as is likely in the case of hypersexuality, the most appropriate use of screening measures is to rule out a condition (rather than to rule it in). Therefore, the HBI can be used as the first step of a diagnostic process, but objective indicators and a clinical interview are essential to establish that a given individual's behavior is truly pathological.

Conflict of Interest

The authors declare no conflict of interest.

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