



Properties of the Problematic Pornography Consumption Scale (PPCS-18) in community and subclinical samples in China and Hungary

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HIGHLIGHTS

- PPCS-18 yielded strong psychometric properties among Chinese men.
- The network analytic approach corroborated the six factors of the PPCS-18.
- PPCS-18 demonstrated high generalizability across cultures.
- PPCS-18 demonstrated high generalizability across community and subclinical men.
- PPCS-18 may be reliably used in subclinical samples.

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ABSTRACT

Several scales assessing problematic pornography use (PPU) are available. However, in most previous studies, primarily nonclinical and Western samples were used to validate these scales. Thus, further research is needed to validate scales to assess problematic pornography use across diverse samples, including subclinical populations. The aim of the present study was to examine and compare the psychometric properties of the PPCS-18 in Hungarian and Chinese community samples and in subclinical men. A sample of Chinese community men ($N_1 = 695$), a sample of subclinical men who were screened for PPU using the Brief Pornography Screen ($N_2 = 4651$), and a sample of Hungarian community men ($N_3 = 9395$) were recruited to investigate the reliability and validity of the PPCS-18. Item-total score correlation, confirmatory factor analyses, reliability, and measurement invariance tests showed that the PPCS-18 yielded strong psychometric properties among Hungarian and Chinese community men and indicated potential utility in the subclinical men. The network analytic approach also corroborates that the six factors of the PPCS-18 can reflect the characteristic of the participants from different cultural contexts, and participants from community and subclinical populations. In sum, the PPCS-18 demonstrated high generalizability across cultures and community and subclinical men.

1. Introduction

Data suggest that increased internet use has been accompanied by increases in pornography consumption and frequencies of problematic

pornography use (PPU), representing clinically relevant phenomena (Brand, Antons, Wegmann, & Potenza, 2019; Brand, Blycker, & Potenza, 2019; de Alarcón, de la Iglesia, Casado, & Montejo, 2019). Despite an increase in studies on internet-related problems and disorders,

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conceptualizations of PPU remain debated (Hertlein & Cravens, 2014; López-Fernández, 2015; Potenza, Gola, Voon, Kor, & Kraus, 2017; Stark, Klucken, Potenza, Brand, & Strahler, 2018; Wéry & Billieux, 2017; Young, 2008). Multiple terms have been used to describe the phenomenon (e.g., internet sex addiction, problematic online sexual activities, cybersex addiction, and problematic internet pornography use), and whether subjectively self-perceived addiction to pornography due to moral incongruence is regarded as PPU has been debated (Brand, Antons, & et al., 2019; Vaillancourt-Morel & Bergeron, 2019). Furthermore, there are no specific diagnostic criteria for PPU (Brand et al., 2020; Chen & Jiang, 2020; Cooper, Griffiths-Shelley, Delmonico, & Mathy, 2001; Fernandez & Griffiths, 2019; Hertlein & Cravens, 2014; Wéry & Billieux, 2017). In order to study and treat PPU, researchers have developed scales that measure different aspects of PPU; however, few have been validated across cultures and different populations (Chen & Jiang, 2020; Fernandez & Griffiths, 2019; Wéry & Billieux, 2017).

1.1. Assessment of problematic pornography use

Given debates on the conceptualization of and diagnostic criteria for PPU, assessment tools have varied across studies and emphasized different characteristics (Fernandez & Griffiths, 2019). Multiple scales have been based largely on proposed criteria for hypersexual disorder (e.g., the Hypersexual Behavior Inventory, Reid, Garos, & Fong, 2012). However, recent studies suggest differences between PPU and hypersexuality (Bóthe, Tóth-Király, & et al., 2019). Hypersexuality may include high engagement in various sexual behaviors, including masturbation, cybersex, pornography use, telephone sex, sexual behavior with consenting adults, strip club visitations, and other behaviors (Karila et al., 2014). Consistently, the Hypersexual Behavior Inventory (HBI) assesses hypersexual behaviors more broadly (Brahim, Rothen, Bianchidmicheli, Courtois, & Khazaal, 2019). Some scales have focused on compulsive sexual behaviors more generally (e.g., Compulsive Use of Sexually Explicit Internet Material), with these scales assessing features of compulsive searching for/viewing of pornography on the internet (Doornwaard, Eijnden, Baams, Vanwesenbeeck, & Bogt, 2016), rather than those of general compulsive pornography use, and it did not undergo extensive psychometric evaluation. Some concise scales exist that aim to measure PPU, but these have, at times, been criticized or debated regarding their construct validity. For example, the Cyber-Pornography Use Inventory-9 (CPUI-9, Grubbs, Sessoms, Wheeler, & Volk, 2010) has been used to assess self-reported addiction and considers moral incongruence, although what it precisely measures have been questioned (Brand, Antons, & et al., 2019). Several recent scales have been developed to assess aspects and domains of PPU more generally including the Short Internet Addiction Test Adapted to Online Sexual Activities (s-IAT-sex; Wéry, Burnay, Karila, & Billieux, 2015), the Problematic Pornography Use Scale (PPUS; Kor et al., 2014), and the Problematic Pornography Consumption Scale (PPCS-18; Bóthe, Tóth-Király, & et al., 2018). The last two scales were recommended by a recent systematic review (Fernandez & Griffiths, 2019). More recently, compared with the PPUS and s-IAT-sex, the PPCS-18 demonstrated higher sensitivity and more accuracy in screening for PPU (Chen & Jiang, 2020).

The PPCS-18, to our knowledge, is the only instrument that assesses six specified components of one addiction model: salience, mood modification, conflict, tolerance, relapse, and withdrawal (Griffiths, 2005). In particular, tolerance and withdrawal are important dimensions of PPU that are not assessed by the PPUS and s-IAT-sex (Bóthe, Tóth-Király, & et al., 2018; Fernandez & Griffiths, 2019). Compared with other measurements of PPU (i.e., the PPUS, s-IAT-sex, CPUI-9), another strength of the PPCS is that it is one of few instruments to provide a validated cutoff score (≥ 76 , range 18–126) to differentiate problematic from non-problematic pornography use (Fernandez & Griffiths, 2019), which adds to its research and clinical utility. Another recently published screen, the Brief Pornography Screen (BPS, Kraus

et al., 2020), also provides a cutoff (≥ 4 , range 0–10) to screen for PPU. Given its brevity and its unidimensional structure, the BPS does not assess components such as tolerance. While cutoffs of usage time per week have been proposed (Cooper, Delmonico, & Burg, 2000; Mechelmans et al., 2014), usage time is not consistently related to PPU (Bóthe, Tóth-Király, Potenza, Orosz, & Demetrovics, 2020; Chen, Ding, Jiang, & Potenza, 2019; Kühn, & Gallinat, 2014). In addition, convergent and divergent validity of the PPCS has been supported in studies of sexuality-related (Bóthe, Tóth-Király, Demetrovics, & Orosz, 2017) and personality-related (Bóthe, Koós, & et al., 2019; Bóthe, Tóth-Király, & et al., 2019; Bóthe, Tóth-Király, Potenza, & et al., 2020) variables.

Despite the previously presented strong psychometric properties of the PPCS-18, research is needed to further investigate its properties across cultural and clinical/subclinical contexts (Bóthe, Tóth-Király, Demetrovics & Orosz, 2020; Bóthe, Tóth-Király, & et al., 2018), as, for example, cultural characteristics may influence negative attitudes toward pornography use (Griffiths, 2012; Vaillancourt-Morel & Bergeron, 2019). It has been argued that pornography use may be self-considered as problematic in one cultural, religious, or moral background and possibly not in another (Grubbs & Perry, 2019). Prior PPCS-18 studies may have cultural limitations since they have been mainly conducted in Hungary (Bóthe, Bartók, & et al., 2018; Bóthe, Kovács, & et al., 2019; Bóthe, Tóth-Király, Demetrovics, & et al., 2020; Bóthe, Lonza, Štulhofer, & Demetrovics, 2020). This may constitute a significant limitation since norms, value systems, and experiences of individuals from other cultural backgrounds may differ from largely Western perspectives in Hungary. Regarding pornography use and other sexual behaviors, differences in sexual attitudes, behaviors, and well-being have been reported between Eastern and Western cultures (Laumann et al., 2006). Thus, research on PPU is needed to ensure that assessments are both translatable and accurate across cultures (Kraus & Sweeney, 2019). There is relatively little empirical research on PPU in China and in other Eastern countries, and only several studies have included participants from Eastern countries (Fernandez & Griffiths, 2019), and cross-cultural community comparisons have not been examined.

Individuals with PPU may exhibit specific characteristics including strong cravings, poor self-control, continued engagement despite social or occupational impairments, and adverse consequences, and using pornography in maladaptive ways such as to escape from stress or negative mood states (Chen et al., 2018; Cooper et al., 2004; Kraus, Martino, & Potenza, 2016; Young, Cooper, Griffiths-Shelley, O'Mara, & Buchanan, 2000). Wéry et al. (2016) reported that 90% of participants with PPU reported co-occurring psychiatric diagnoses, and only a few scales have been validated in treatment-seeking samples (Bóthe, Tóth-Király, Demetrovics, & et al., 2020; Kraus et al., 2020). Thus, in addition to the frequency of online sexual activities, craving, compulsive sexual behaviors, and general mental health were used to examine the criterion validity of the PPCS. In sum, primarily nonclinical and Western samples have been used in most studies of PPU assessments like the PPCS-18; therefore, more research is needed to validate the PPCS-18 across more diverse samples, including clinical or subclinical population and across cultures.

1.2. Network approach in psychopathology

Psychopathological states may exist as complex dynamic systems involving interacting components (Borsboom, 2017). In contrast to some latent models, network approaches propose that psychological disorders involve networks of related symptoms, and individual psychological states may rely more on direct connections between symptoms rather than on the existence of latent variables (Werner, Stulhofer, Waldorp, & Jurin, 2018). Network theories and methodologies have been fruitfully applied to different psychopathological phenomena including alcohol-use disorders (Anker et al., 2017), anxiety (Beard et al., 2016), depression (Schworen, van Borkulo, Fried, & Goodyer, 2018),

and hypersexuality (Werner et al., 2018). Such network models may provide important insight into the centrality of specific domains and the patterns of their relationships. Therefore, in the current study, we used a network approach to assess PPU network topology and identify symptoms that occupy central positions in the network, and explored patterns of relationships of symptom domains in the different populations. This approach will provide insight into how PPU may interact with symptomatology across cultures and community and subclinical samples.

1.3. The aims of the current study

Considering that men relative to women typically show stronger cravings for pornography and more frequent use (Weinstein, Zolek, Babkin, Cohen, & Lejoureux, 2015), more frequent PPU (Kafka, 2010; Kraus et al., 2016; Kraus, Potenza, Martino, & Grant, 2015), and more treatment-seeking for PPU (Bőthe, Tóth-Király, Demetrovics, & et al., 2020), the aims of the present study were (1) to examine the reliability, structure and convergent validity of the PPCS-18 both in community and subclinical samples of Chinese men; and (2) to examine and compare the factor structure of PPCS-18 across Hungarian and Chinese samples, and across community and subclinical samples; and, (3) to explore the extent to which the PPCS-18 reflects characteristics related to the different populations in network topology analyses.

2. Method

2.1. Participants and procedure

This study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Ethics Committee of the Department of Psychology, Fuzhou University, and by the Eötvös Loránd University. Data collection was conducted via online surveys. Participants were informed about the aims of the study. Only individuals aged 18 years or older were allowed to participate.

Sample 1: A community sample of Chinese men. This online study was conducted through a popular Chinese survey website, namely, Wenjuanxing (www.sojump.com, a website like Survey monkey). A total of 695 adult men (aged 18 to 48 years, $M_{age} = 25.39$, $SD = 7.18$) were recruited from participants from 110 cities in 28 of the 34 provinces/regions in China (i.e., identified using the internet protocol addresses). In May 2019, emails with a link that redirected them to the survey website and a brief introduction to our survey were sent to potential participants, and individuals were invited to participate in the survey if they were interested. In this sample, the most common sexual orientations reported were heterosexual (94.4%, 656), bisexual (4.2%, 29), and homosexual (1.4%, 9). Reported relationship status including being single (50.5%, 351), having committed sexual partners (48.0%, 334), and having casual sexual partners (1.4%, 14).

Sample 2: A subclinical sample of Chinese men. We invited 5536 men ($M_{age} = 22.70$ years, $SD = 4.33$) who felt they had experienced PPU and sought help on a website (www.ryeboy.org/, a nonprofit website focusing on interventions for PPU). These participants were newly registered users and were screened for potential PPU using the BPS (Kraus et al., 2020). Kraus et al. (2020) suggested a BPS cutoff score of ≥ 4 to indicate PPU, and 4651 individuals met this criterion. In this sample, reported sexual orientations were heterosexual (93.1%, 4330), bisexual (3.1%, 144), and homosexual (3.8%, 177). Reported relationship status included being single (81.6%, 3795), having committed sexual partners (16.9%, 786), and having casual sexual partners (1.5%, 70).

Sample 3: A community sample of Hungarian men. The survey in Hungary was part of a larger project (https://osf.io/hxj5q/?view_only=203035477bbd498eaa9108bd49755d1f; Bőthe, Kovács, & et al., 2019). Respondents were invited to participate via advertisements on one of the largest Hungarian news portals in January 2017. A total of 10,582 men participated in this survey; however, in order to

match the ages to the Chinese sample, we only selected the participants between 18 and 48 years old, resulting in a sample of 9395 Hungarian men ($M_{age} = 23.35$ years, $SD = 3.34$). The PPCS was developed in a different Hungarian sample (Bőthe, Tóth-Király, & et al., 2018), and reliability and structural validity have been reported previously in a Hungarian cultural context (Bőthe, Tóth-Király, & et al., 2018; Bőthe, Kovács, & et al., 2019; Bőthe, Tóth-Király, Potenza, & et al., 2020). As for relationship status, 30.3% (2847) were single, 68.5% (6436) were in any kind of romantic relationship (i.e., being in a relationship, engaged, or married), and 1.2% (113) indicated the “other” option.

2.2. Measures

Brief Pornography Screen (BPS, Kraus et al., 2020).² The BPS is a screening tool for PPU (Efrati & Gola, 2018; Gola et al., 2017). It is a five-item assessment and uses a three-point rating scale for each item (0 = never, 1 = occasionally, 2 = always). The Cronbach's alpha of the BPS was 0.89 in the Chinese community sample and 0.74 in the Chinese subclinical sample.

Problematic Pornography Consumption Scale (PPCS-18, Bőthe, Tóth-Király, & et al., 2018). The PPCS translation followed guidelines for the process of cross-cultural adaptation of self-report measures (Beaton, Bombardier, Guillemin, & Ferraz, 2000). The initial PPCS was translated into Chinese by two graduate students, one majoring in psychology, the other one majoring in Chinese. The PPCS includes 18-item and six core elements: salience, mood modification, conflict, tolerance, relapse, and withdrawal, and each factor included three items. Responses were recorded on the following 7-point scale: 1 = never, 2 = rarely, 3 = occasionally, 4 = sometimes, 5 = often, 6 = very often, 7 = all the time. The Cronbach's alpha of the PPCS-18 was 0.95 in the Chinese community sample, 0.94 in the Hungarian sample, and 0.94 in the Chinese subclinical sample.

Pornography Craving questionnaire (PCQ, Kraus & Rosenberg, 2014). This 12-item questionnaire is a unidimensional assessment (Kraus & Rosenberg, 2014; Rosenberg & Kraus, 2014). The respondents were required to indicate how strongly they agreed with each item using the following seven response options (presented without numerals): “completely disagree,” “somewhat disagree,” “disagree a little,” “neither agree nor disagree,” “agree a little,” “somewhat agree” and “completely agree.” Higher scores are indicative of a greater craving for pornography. The Chinese version of the PCQ has been used in a previous study (Chen et al., 2019). The Cronbach's alpha of this scale was 0.92 in the Chinese community sample and 0.91 in the Chinese subclinical sample.

Sexual Compulsivity Scale (SCS, Kalichman & Rompa, 1995). The extent to which participants exhibit characteristics of sexual compulsivity was assessed using the ten-item SCS. Responses were recorded on a four-point rating scale (1 = not at all like me, 2 = slightly like me, 3 = mainly like me, 4 = very much like me). The Chinese version of the SCS has been previously described (Chen & Jiang, 2020). The SCS demonstrated excellent reliability in the present study (α was 0.91 in community men and 0.90 in subclinical men).

Questionnaire of online sexual activities Chinese version (OSAs, Zheng & Zheng, 2014). Thirteen items were used to measure participants' use of the internet for the following purposes: (1) viewing sexually explicit material (SEM), (2) seeking sexual partners, (3) cybersex, and (4)

² The BPS was translated into Chinese based on a preestablished translation-back-translation protocol (Beaton et al., 2000). Confirmatory factor analysis (CFA) was conducted to examine its factor structure in the Chinese community and subclinical samples. According to the CFA results, the scale showed excellent structural validity in the community sample (CFI = 0.999, TLI = 0.997, RMSEA = 0.042 [90% CI 0.000-0.045]), and acceptable structural validity in the subclinical sample (CFI = 0.982, TLI = 0.964, RMSEA = 0.072 [90% CI 0.069-0.080]).

Table 1
Reliability and validity of the PPCS-18 in the three groups of men.

Samples	rs (item-total correlation)	Confirmatory factor analysis						
		WLSMV χ^2/df	CFI	TLI	RMSEA [90% CI]	SRMR	α	CR
Hungarian community men	(0.58–0.73)***	7155.758/120	0.973	0.965	0.079[0.077, 0.081]	0.029	0.94	0.97
Chinese community men	(0.61–0.83)***	723.926/120	0.980	0.974	0.085 [0.079, 0.091]	0.026	0.95	0.97
Chinese help-seeking men	(0.53–0.79)***	6381.479/120	0.951	0.938	0.106 [0.104, 0.108]	0.035	0.94	0.96

Notes. CFI = comparative fit index, TLI = Tucker-Lewis index, RMSEA = root mean square error of approximation, CI = confidence interval, SRMR = Standardized Root Mean Square Residual; α = Cronbach's alpha; CR = composite reliability *** $p < .001$.

flirting and sexual relationship maintenance. The Cronbach's alpha of the entire scale was 0.84 in the Chinese community men and 0.81 in subclinical men. Higher scores were indicative of more frequent engagement in OSAs.

12-item General Health Questionnaire (GHQ-12, Goldberg & Hillier, 1979). The GHQ-12 is a widely used screening instrument for common mental disorders and is recommended as a case detector since it is considered brief, effective and robust and works as well as its longer versions (Goldberg et al., 1997; Petkovska, Bojadziew, & Stefanovska, 2015). The GHQ-12 has been translated into many languages, including Chinese, and its psychometric properties have been studied among many different populations (Pan & Goldberg, 1990; Petkovska et al., 2015). The GHQ-12 includes 12 items total (six positive and six negative), each scored on a four-point Likert scale, with higher scores reflecting worse psychological health. The Cronbach's alpha of the scale was 0.89 in Chinese community men and 0.93 in subclinical men.

2.3. Statistical analyses

First, CFA was conducted on the Hungarian men, then on Sample 1 and Sample 2 to cross-validate the results in the community and subclinical samples of Chinese men. The mean- and variance-adjusted weighted least squares estimator (WLSMV) was used for parameter estimation. Model fit indices were determined by Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and the Root Mean Square Error of Approximation (RMSEA) and standardized root mean square residual (SRMR). CFI and TLI values greater than 0.95 were considered as excellent fit (≥ 0.90 for acceptable fit). RMSEA values of less than 0.06 were considered excellent (≤ 0.08 for adequate fit, and ≤ 0.10 for acceptable fit with its 90% confidence interval) (Browne & Cudeck, 1993; Schermelleh-Engel et al., 2003). SRMR values less than 0.08 (≤ 0.06 for a good fit) were considered indicative of an acceptable model (Hu & Bentler, 1999). Additionally, to test measurement invariance among different cultural contexts (Hungarian and Chinese), and community and subclinical populations, multi-group CFAs were conducted on the three samples. Six levels of invariance were tested and compared in each case: configural, metric, scalar, residual, latent variance, and latent mean. When comparing the increasingly constrained models, relative changes in fit indices were observed, with a recommended acceptable range as follows: $\Delta CFI \leq 0.010$; $\Delta TLI \leq 0.010$; and $\Delta RMSEA \leq 0.015$ (Meade, Johnson, & Braddy, 2008).

Cronbach's alpha and Composite Reliability (CR) values were also calculated. Associations between the sexual compulsivity scale (SCS), pornography craving questionnaire (PCQ), general health questionnaire (GHQ-12), frequency of OSAs, BPS, and PPCS-18 were assessed to corroborate the validity of the PPCS-18. Correlations between variables were examined using Pearson correlation coefficients after controlling for age, sexual orientation, and relationship status.

We estimated and analyzed the PPCS-18 networks in two steps. The first step was to establish a regularized network, also known as a markov random field. LASSO regression was adopted for adjustment to reduce the appearance of false connections. As described previously (Epskamp & Fried, 2017), the EBIC hyperparameter was set at 0.5. Second, we assessed the relative position of nodes using centrality

statistics and tested three common centrality metrics: node strength, closeness, and betweenness centrality. Among them, betweenness centrality refers to the number of times that a node stays on the shortest path between other nodes. Closeness centrality is the inverse of the sum of the shortest paths from one node to all other nodes. In addition, we compared the global strength of connectivity for each network (i.e., the sum of all the associated strengths) using the Network Comparison Test. All network analyses were performed using the *qgraph*, *dplyr*, *NetworkComparisonTest*, and *bootnet* packages in R. (Version 3.6.2).

3. Results

3.1. Validity and reliability of the PPCS-18 in Chinese community and subclinical men

Findings relating to item-total correlations, CFAs, reliability, and convergent validity are shown in Table 1. The correlation coefficients of the items and their corresponding total scores were calculated to demonstrate adequate fit of item analysis: the PPCS-18 had strong correlations between items in the subclinical Chinese men, and the PPCS-18 demonstrated good or acceptable fit indices using CFA among the two community samples. Although the RMSEA was slightly higher than the threshold in the subclinical men, the CFI, SRMR were good, and the TLI was acceptable. Based on the correlation analyses, the PPCS-18 had positive associations with qualitative indicators of sexual compulsivity, pornography craving, and general mental health, followed by quantitative indicators, including frequency of OSAs.

3.2. Measurement invariance test of the PPCS-18 across cultures and in community and subclinical men

The results of measurement invariance are shown in Table 3. For configural invariance, RMSEA was slightly higher than the recommended threshold value (i.e., 0.10), but the model demonstrated acceptable fit indices on the CFI, TLI, and SRMR values. Thus, we retained this model for the further steps of invariance testing. In the metric model, the fit indices were more suitable compared to the preceding model. Then, scalar and residual invariance were achieved, but latent mean invariance was not, suggesting the presence of latent mean differences between the community and subclinical men (see Table 3). When the subclinical men's latent mean differences were constrained to zero for the purpose of model identification, individuals' latent means in the community men were substantially lower than participants' latent means in the subclinical men (Sample 1: -0.88 to -1.81 SD in the six factors, $p < .001$; Sample 3: -0.39 to -2.46 SD in the six factors, $p < .01$), indicating that subclinical individuals demonstrated significantly higher scores on the PPCS-18 than those in the Chinese and Hungarian community samples. In sum, the PPCS-18 had similar meanings and latent structure in Chinese and Hungarian community men, and it may be used in comparisons of Chinese and Hungarian men.

3.3. Interaction of the six factors of the PPCS-18 in each sample

Results of Markov random fields showed that there was a significant

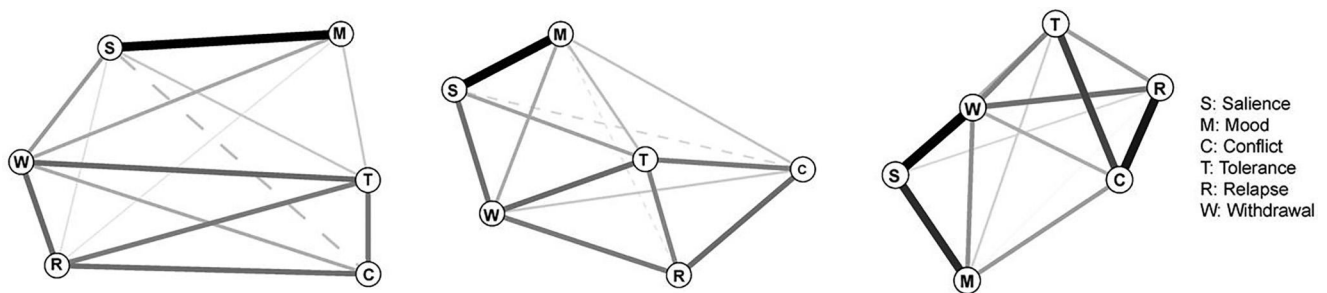


Fig. 1. Network schematic diagram in three groups of men. Notes. The Chinese community men’s network is presented on the left and the Hungarian community men’s network on the right. The middle is the network of Chinese subclinical sample men. Solid edges indicate positive and dashed edges indicate negative relationships.

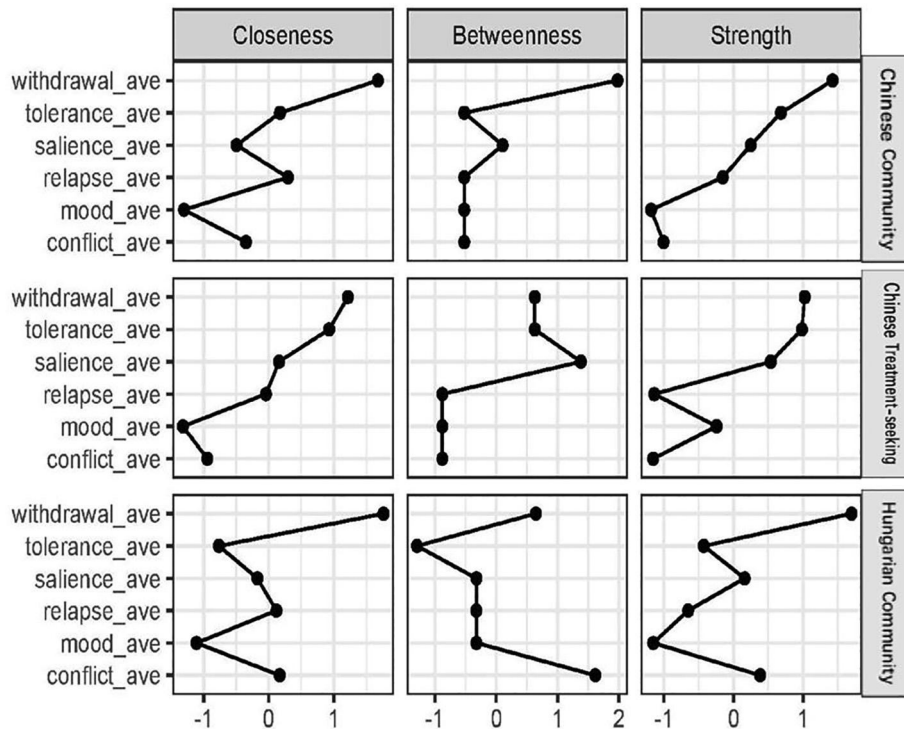


Fig. 2. Node centrality plot in the three groups of men.

difference between the Hungarian and Chinese men ($p < .01$). Among the Chinese community and subclinical men, conflict was negatively related to salience; otherwise, conflict did not relate to salience directly, and had positive correlations with other factors among Hungarian men (see Fig. 1). Schematic diagrams of Chinese community and subclinical men were similar, and no significant difference in the global strength of connectivity was observed ($p = 0.6$). Centrality estimates are presented in Fig. 2 (centrality plots). In the three samples’ networks, withdrawal was the most central node, while tolerance was also a central node in the subclinical individuals’ network. In support of these estimates, withdrawal was characterized by high predictability in all networks (Chinese community men: 76.8%, Chinese subclinical men: 68.8%, and Hungarian community men: 64.2%).

4. Discussion

Although several scales for assessing PPU are available to researchers and clinicians, few have been subsequently revalidated across different cultures, and the psychometric properties of scales in subclinical men have rarely been examined. Additionally, how symptom domains related to PPU relate (i.e., interrelationships between salience,

withdrawal, tolerance, mood modification, conflict, and relapse) in such samples is poorly understood (Bóthe, Lonza, & et al., 2020). Therefore, we examined the reliability and validity of the PPCS-18 in Chinese contexts and demonstrated support for its use in Chinese community and subclinical men. The Chinese version of the PPCS-18 demonstrated high internal consistency, composite reliability, and convergent validity in both Chinese community and subclinical men. Measurement invariance testing suggested that the scale was similarly applicable to the Hungarian community, the Chinese community, and the Chinese subclinical populations, supporting the scale’s potential cross-cultural and clinical utility. Network analysis showed that the interaction between the six factors of the PPCS-18 was significantly different in Hungarian and Chinese men. Centrality estimates indicated that the subclinical sample’s core symptoms were withdrawal and tolerance, but only the withdrawal domain was a central node in both community samples.

4.1. Validity and reliability of the PPCS-18 in Chinese populations

The construct validity and reliability of the PPCS-18 were cross-validated on these three independent and distinct samples. Not only

was the construct validity of the PPCS-18 supported, but also its convergent validity was established by reporting its associations with pornography craving, compulsive sexual behaviors, frequencies of OSAs, and participants' general psychological health levels. Similar to a prior study (Bóthe, Tóth-Király, Potenza, & et al., 2020), the frequency of OSAs did not appear as reliable an indicator of PPU, due to the correlation coefficients between four sub-types of OSAs and PPCS-18 ranging from small to large, which suggests that the PPCS-18 may also be sensitive to quantitative aspects of PPU in Chinese contexts, although this possibility warrants additional study.

Besides the frequency of consumption, qualitative aspects such as content that may elicit pornography craving should be considered (Kraus & Rosenberg, 2014). The subjective experience of craving is a common element of addictions (Kraus & Rosenberg, 2014), and is relevant in predicting the occurrence, maintenance and relapse of addictive behaviors after withdrawal (Drummond, Litten, Lowman, & Hunt, 2000). Consistent with previous studies (Gola & Potenza, 2016; Young et al., 2000), worse mental health scores and more compulsive sexual behaviors correlated with higher PPCS scores. These results suggest it may be advisable to consider craving, mental health factors, and compulsive use in screening and diagnosing PPU (Brand, Rumpf, & et al., 2020).

The PPCS-18 demonstrated scale invariance in Hungarian and Chinese community men, which indicated that it might be reliably used in both two cultures. Additionally, measurement invariance testing indicated that the latent mean of PPCS-18 scores was higher among subclinical men than in those in the community, corroborating previous findings (Bóthe, Tóth-Király, Demetrovics, & et al., 2020; Bóthe, Lonza, & et al., 2020). Subclinical men reported higher scores on all six factors of the PPCS-18 compared to community men (see Table 2), further supporting its validity and also demonstrating the scale's potential clinical utility. Consistent with current findings, individuals with PPU often exhibit craving, poor self-control, worse mental health (Chen et al., 2018; Cooper et al., 2004). In addition, excessive use and poor control (i.e., difficulty controlling urges/craving) are shared among various definitions of and scales assessing PPU (Goodman, 1998; Kafka, 2013; Kraus et al., 2016; Wéry & Billieux, 2017). Our data support that the PPCS-18 shows similar characteristics in China as in other jurisdictions and among subclinical men.

4.2. Networks of PPU symptoms in community and subclinical men

Similar to the application of a network approach in hypersexuality (Werner et al., 2018), we applied this approach to PPU in order to examine whether the PPCS-18 demonstrates similar or distinct relationships across different samples. The overall network topologies of the three samples suggest that the relationships between domains of the PPCS-18 may have culture-related differences. In Chinese men, the conflict factor was negatively associated with salience, while in Hungarian men, salience did not relate to conflict. In parallel with massive socio-economic changes over past decades in China, increasingly more Chinese people are criticizing conservative sexual attitudes, especially those who define sex as immoral, and instead, they have begun to highlight the importance of sexual pleasure (Lin, 2018; Wong, 2014). In the current study, participants were men. In predominating sexual scripts in China, men are encouraged to pursue sexual expression and exhibit more permissive sexual attitudes (Zheng et al., 2011). Therefore, when men's thoughts may be focused on pornography, they may not experience conflict. On the other hand, the assessment of the "conflict" component on the PPCS is limited to its inclusion of more peripheral aspects of conflict (e.g., negative effects on sexual life) and exclusion of more central aspects of conflict (e.g., interpersonal conflict) (Fernandez & Griffiths, 2019). However, the precise reasons for underlying differences in relationships between Chinese and Hungarian men in relationships between conflict and salience warrant additional study, particularly given that factors like social acceptance and governmental regulation of pornography use may differ across jurisdictions.

Additionally, centrality estimates in the six factors of the PPCS-18 displayed withdrawal as the most crucial factor in all three samples. According to the strength, closeness, and betweenness centrality results among subclinical participants, tolerance also contributed importantly, being second only to withdrawal. These findings suggest that withdrawal and tolerance are particularly important in subclinical individuals. Tolerance and withdrawal are considered as physiological criteria relating to addictions (Himmelsbach, 1941). Concepts like tolerance and withdrawal should constitute a crucial part of future research in PPU (de Alarcón et al., 2019; Fernandez & Griffiths, 2019). Griffiths (2005) postulated that tolerance and withdrawal symptoms should be present for any behavior to be considered addictive. Our analyses support the notion that withdrawal and tolerance domains are

Table 2
Descriptive analysis and associations between the PPCS-18 scores with other measures in Chinese community and subclinical men.

Scales	Chinese community men (N = 695)				Chinese subclinical men (N = 4651)				
	Range	Skewness (SE)	Kurtosis (SE)	M(SD)	PPCS-18	Skewness(SE)	Kurtosis (SE)	M(SD)	PPCS-18
1 PPCS-18	1-7	0.76 (0.09)	-0.15 (0.19)	2.58 (1.31)	-	0.10 (0.04)	-0.63 (0.07)	4.36 (1.33)***	-
1.1 Salience	1-7	1.01 (0.09)	0.72 (0.19)	2.22 (1.20)	0.78***	0.50 (0.04)	-0.88 (0.07)	3.39 (1.65)***	0.82***
1.2 mood modification	1-7	0.85 (0.09)	-0.06 (0.19)	2.48 (1.44)	0.82***	0.22 (0.04)	-0.47 (0.07)	3.76 (1.74)***	0.82***
1.3 conflict	1-7	0.79 (0.09)	-0.36 (0.19)	2.82 (1.73)	0.81***	-0.50 (0.04)	-0.99 (0.07)	5.09 (1.49)***	0.75***
1.4 tolerance	1-7	1.24 (0.09)	0.83 (0.19)	2.34 (1.52)	0.90***	-0.07 (0.04)	-0.60 (0.07)	4.34 (1.73)***	0.88***
1.5 relapse	1-7	0.71 (0.09)	-0.61 (0.19)	2.95 (1.80)	0.89***	-0.60 (0.04)	-0.45 (0.07)	5.30 (1.47)***	0.77***
1.6 withdrawal	1-7	0.92 (0.09)	0.13 (0.19)	2.53 (1.48)	0.91***	0.01 (0.04)	-0.89 (0.07)	4.31 (1.65)***	0.88***
2. SCS	1-4	0.76 (0.09)	0.10 (0.19)	1.99 (0.71)	0.75***	-0.29 (0.04)	-0.49 (0.07)	2.90 (0.68)***	0.57***
3. PCQ	1-7	0.57 (0.09)	-0.36 (0.19)	2.94 (1.30)	0.74***	0.26 (0.04)	-0.67 (0.07)	4.23 (1.37)***	0.65***
4. BPS	0-2	0.40 (0.09)	-0.96 (0.19)	0.75 (0.61)	0.81***	-0.43 (0.04)	-1.15 (0.07)	1.55 (0.39)***	0.61***
5. GHQ	0-3	1.10 (0.09)	1.37 (0.19)	0.93 (0.55)	0.43***	0.18 (0.04)	-0.68 (0.07)	1.57 (0.69)***	0.38***
6. OSAs	1-9	1.39 (0.09)	2.32 (0.19)	2.20 (1.01)	0.56***	1.68 (0.04)	4.03 (0.07)	2.90 (1.15)***	0.39***
6.1 Viewing SEM	1-9	0.83 (0.09)	0.29 (0.19)	2.91 (1.44)	0.63***	0.32 (0.04)	-0.07 (0.07)	4.49 (1.55)***	0.48***
6.2 Flirt and relationship	1-9	1.62 (0.09)	2.03 (0.19)	2.10 (1.56)	0.14***	2.12 (0.04)	4.29 (0.07)	1.95 (1.58)***	0.08***
6.3 Partner seeking	1-9	2.35 (0.09)	5.36 (0.19)	1.63 (1.24)	0.26***	2.87 (0.04)	8.75 (0.07)	1.64 (1.43)	0.15***
6.4 Cybersex	1-9	2.27 (0.09)	6.08 (0.19)	1.65 (1.13)	0.41***	1.98 (0.04)	3.88 (0.07)	2.02 (1.61)***	0.22***

Notes. PPCS-18 was developed in the Hungarian sample, so external and convergent in Hungarian sample was not measured. SCS = Sexual Compulsivity Scale, PCQ = Pornography Craving Questionnaire, OSAs = online sexual activities, BPS = the brief pornography screen, GHQ = general health questionnaire, SEM = sexually explicit material. *** above the M (SD) of subclinical men indicates a significant difference from the community men.

*** p < .001.

Table 3

Indices of the measurement invariance test for the PPCS-18 across cultural contexts and community/subclinical men.

Model	WLSMV $\chi^2(df)$	CFI	TLI	RMSEA	90% CI	SRMR	$\Delta\chi^2(df)$	Δ CFI	Δ TLI	Δ RMSEA
(A) Configural	25622.135*(360)	0.935	0.917	***0.120	0.118–0.121	0.035	—	—	—	—
(B) Metric	15057.070*(384)	0.962	0.955	0.088	0.087–0.089	0.031	–12490.935*(24)	0.007	0.038	–0.032
(C) Scalar	16788.044*(552)	0.958	0.965	0.077	0.076–0.078	0.034	1730.974*(168)	–0.004	0.010	–0.011
(D) Residual	17521.081*(588)	0.956	0.966	0.077	0.076–0.078	0.038	733.037*(36)	–0.002	0.001	0.000
(E) Latent variance	8649.892*(630)	0.981	0.986	0.049	0.048–0.050	0.050	–8871.189*(42)	0.025	0.020	–0.028
(F) Latent means	74078.612*(642)	0.811	0.865	0.153	0.152–0.154	0.082	65428.72*(12)	–0.170	–0.121	0.104

Notes. WLSMV = weighted least squares mean- and variance-adjusted estimator; χ^2 = Chi-square; df = degrees of freedom; Δ TLI is the TLI difference of the row model and the previous model; Δ CFI is the CFI difference of the row model and the previous model. Δ RMSEA is RMSEA change of the row model and the previous model. Bold letters indicate the final levels of invariance that were achieved. * $p < .01$.

important clinically for PPU. Consistent with Reid's view (Reid, 2016), evidence of tolerance and withdrawal in patients with compulsive sexual behaviors may be an important consideration in characterizing dysfunctional sexual behaviors as addictive.

4.3. Limitations and future studies

The present study is not without limitations. First, temporal stability was not tested. Second, data were collected using self-report measures; therefore, the reliability of the results depends on respondents' honesty and accuracy and their comprehension of items. Third, the RMSEA value was slightly higher in the subclinical samples, warranting further research. Participants included only men aged 18–48 years; thus, the applicability of the PPCS-18 in older populations and women should be further examined. It still unclear whether gender-related differences may be influenced by cultural or jurisdictional factors. Hence, more research is needed to validate the PPCS-18 across more diverse samples, including women, diverse age groups, and other cultures and jurisdictions. Additionally, the subclinical group studied was derived from an online forum. The extent to which the findings may extend to other settings (e.g., those providing face-to-face treatment) warrants further study.

4.4. Conclusions

The PPCS-18 had strong psychometric properties in community men from Hungary and China, and subclinical men from China who reported poorly controlled pornography use. Thus, the PPCS-18 appears to be a valid and reliable measure to assess PPU across specific Western and Eastern jurisdictions and may be used among subclinical individuals. Furthermore, relationships between the PPCS-18 domains also can reflect distinct characteristics of different populations, and the current findings suggest that withdrawal and tolerance are important to consider in PPU. The findings advance understanding by reporting subclinical and community samples in China, expanding the generalizability of the PPCS-18, and exploring relationships between different symptom domains across cultures.

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CRediT authorship contribution statement

Lijun Chen: Conceptualization, Methodology, Formal analysis, Resources, Data curation, Writing - original draft, Writing - review & editing. **Xiaohui Luo:** Methodology, Formal analysis, Investigation, Visualization. **Beáta Bóthe:** Formal analysis, Data curation, Writing - review & editing, Visualization. **Xiaoliu Jiang:** Investigation. **Zsolt Demetrovics:** Resources, Visualization, Supervision, Project administration. **Marc N. Potenza:** Resources, Writing - review & editing, Supervision, Project administration.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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