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Withdrawal and tolerance as related to compulsive sexual behavior disorder and problematic pornography use – Preregistered study based on a nationally representative sample in Poland

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ABSTRACT

Background: The addiction model of compulsive sexual behavior disorder (CSBD) and problematic pornography use (PPU) predicts the presence of withdrawal symptoms and increased tolerance for sexual stimuli in the disorder phenotype. However, clear empirical evidence supporting this claim has largely been lacking. *Methods:* In the preregistered, nationally representative survey ($n = 1,541$, 51.2% women, age: $M = 42.99$, $SD = 14.38$), we investigated the role of self-reported withdrawal symptoms and tolerance with respect to CSBD and PPU severity. *Results:* Both withdrawal and tolerance were significantly associated with the severities of CSBD ($\beta = 0.34$; $P < 0.001$ and $\beta = 0.38$; $P < 0.001$, respectively) and PPU ($\beta = 0.24$; $P < 0.001$ and $\beta = 0.27$; $P < 0.001$, respectively). Of the 21 withdrawal symptom types investigated, the most often reported symptoms were frequent sexual thoughts that were difficult to stop (for participants with CSBD: 65.2% and with PPU: 43.3%), increased overall arousal (37.9%; 29.2%), difficult to control level of sexual desire (57.6%; 31.0%), irritability (37.9%; 25.4%), frequent mood changes (33.3%; 22.6%), and sleep problems (36.4%; 24.5%). *Conclusions:* Changes related to mood and general arousal noted in the current study were similar to the cluster of symptoms in a withdrawal syndrome proposed for gambling disorder and internet gaming disorder in DSM-5. The study provides preliminary evidence on an understudied topic, and present findings can have significant implications for understanding the etiology and classification of CSBD and PPU. Simultaneously, drawing conclusions about clinical importance, diagnostic utility and detailed characteristics of withdrawal symptoms and tolerance as a part of CSBD and PPU, as well as other behavioral addictions, requires further research efforts.

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KEYWORDS

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INTRODUCTION

Compulsive sexual behavior disorder (CSBD) as introduced in the International Classification of Diseases, 11th revision (ICD-11; World Health Organization [WHO], 2020) is developed and perpetuated by a core pattern of difficulties controlling one's behavior, thoughts, emotions and impulses in the sexual domain, generating negative consequences relating to impaired functioning in other areas of life. Traditionally, researchers described CSBD-like behavior in terms of models of sexual addiction (a "behavioral addiction"), sexual compulsivity and sexual impulsivity, with the addiction model being the oldest and arguably the most widely discussed in the literature (for a review of the models see: Bancroft & Vukadinovic, 2004; Kafka, 2010; Walton, Cantor, Bhullar, & Lykins, 2017). Although CSBD was included in the ICD-11 as an impulse control disorder, authors have proposed that it may be better classified as an addiction, similar to gambling disorder, which was included as a behavioral/non-substance addiction in DSM-5 and ICD-11 (American Psychological Association [APA], 2013; Potenza, Gola, Voon, Kor, & Kraus, 2017; WHO, 2020). The possible re-classification of CSBD in future versions of ICD and DSM classifications is still under active discussion (Brand et al., 2020; Gola et al., 2020; Sassover & Weinstein, 2020). The addiction model can be, and often is, applied to problematic pornography use (PPU), often described as experiencing poor control, distress and/or negative consequences related to pornography use (de Alarcón, de la Iglesia, Casado, & Montejo, 2019; Kraus, Voon, & Potenza, 2016).

Addiction model of CSBD and PPU

The addiction model of CSBD posits that the disorder fits the characteristics of a "behavioral addiction" (Potenza et al., 2017). The behavioral addiction framework proposes that engagement in certain behaviors, like gambling, may generate gratification and therefore promote strong tendencies for repeated engagement, eventually leading to continued behavior despite adverse consequences. Behavior may be repeated more frequently due to tolerance and behavioral engagement warding off withdrawal symptoms, with poor behavioral control experienced (e.g., Kraus, Voon, & Potenza, 2016; Potenza et al., 2017). Data supporting CSBD as an addictive disorder come from multiple domains including neuroimaging studies that show brain structural and/or functional similarities between CSBD and substance and behavioral addictions (Gola & Draps, 2018; Kowalewska et al., 2018; Kraus, Martino, & Potenza, 2016; Stark, Klucken, Potenza, Brand, & Strahler, 2018). However, prior studies have not yet provided strong evidence to support for such a classification to exist (e.g., Miner, Raymond, Mueller, Lloyd, & Lim, 2009; Sassover & Weinstein, 2020). Thus, further efforts should investigate predictions of the addiction model, including withdrawal symptoms and tolerance (Kraus, Voon, & Potenza, 2016).

Withdrawal symptoms. Withdrawal symptoms (also termed withdrawal syndrome) constitute a set of adverse feelings or physiological responses that occur when abstaining from or limiting engagement in substance use or addictive behaviors following longer-term, regular or habitual engagement. Withdrawal symptoms may manifest for many if not all substances of abuse (e.g., Bayard, McIntyre, Hill, & Woodside, 2004; Kosten & O'Connor, 2003; Vandrey, Budney, Hughes, & Liguori, 2008) but also for behavioral addictions (e.g., gambling disorder and internet gaming disorder) (Blaszczynski, Walker, Sharpe, & Nower, 2008; Griffiths & Smeaton, 2002; Kaptsis, King, Delfabbro, & Gradisar, 2016; King, Kaptsis, Delfabbro, & Gradisar, 2016; Lee, Tse, Blaszczynski, & Tsang, 2020; Rosenthal & Lesieur, 1992). For internet gaming disorder and other behavioral addictions, withdrawal syndrome may include irritability, dysphoric mood, poor cognitive functioning and focus, restlessness and elevated levels of craving which occur during immediate or early abstinence (2016). In fact, withdrawal symptoms are reflected in a formal criterion for internet gaming disorder (APA, 2013). According to the DSM-5, withdrawal syndrome can be identified as: "Withdrawal symptoms when Internet gaming is taken away (these symptoms are typically described as irritability, anxiety, or sadness, but there are no physical signs of pharmacological withdrawal." (APA, 2013)). Similarly, withdrawal symptoms are described within the formal criteria for gambling disorder. In line with this definition, withdrawal symptoms include restlessness or irritability when trying to stop or cut down on gambling (APA, 2013). It is worth noting that both these definitions point to a similar set of affective changes (and not physical symptoms). In the ICD-11's (WHO, 2020) conceptualization of gaming and gambling disorder (both belonging to "Disorders due to addictive behaviors" category) withdrawal symptoms are not identified as a formal criterion.

To the best of our knowledge, only one study has quantitively examined withdrawal symptoms for CSBD-like behavior (1997). During a diagnostic interview, 52 of 53 participants (98%) with sex addiction reported three or more types of symptoms experienced because of withdrawing from sexual activity, with the most prevalent symptom types being depression, anger, anxiety, insomnia, and fatigue. Recently, Fernandez, Kuss, and Griffiths (2021) conducted a qualitative analysis of pornography and masturbation abstinence reports taken from an online forum dedicated to this subject. A subset of analyzed reports mentioned the occurrence of negative emotional and cognitive states, which could be attributed to withdrawal effects; however, other mechanisms could also be at play (e.g., worse coping with negative affective states when sexual behavior cannot be employed as a coping mechanism (Fernandez et al., 2021)).

Withdrawal symptoms remain poorly assessed in most studies examining PPU and CSBD in clinical and non-clinical samples and most standardized instruments do not assess this phenomenon. However, the Problematic Pornography Consumption Scale (Bőthe et al., 2018) contains several items related to withdrawal symptoms from pornography use, which are viewed as components of PPU, and, based on the reliability and validity indices, these items

seem to be a coherent and important part of the construct assessed by the questionnaire (Bőthe et al., 2018). The questionnaire operationalizes withdrawal as (1) agitation, (2) stressing out, and (3) missing pornography when one cannot watch it. While important, a broader and more complex analysis of withdrawal symptoms is largely lacking in the literature. To our knowledge, no other standardized measure of PPU/CSBD includes items directly assessing withdrawal.

Tolerance. Tolerance reflects a decreasing sensitivity over time to a particular substance or behavior, which results in a need to take increasingly higher doses of a substance (or engage more frequently in a behavior or more extreme forms thereof) to achieve the same level of response (or that the same level of engagement leads to a weaker response). Similar to the presence of withdrawal symptoms, increased tolerance during the course of addiction has been shown for most substances of abuse (e.g., Colizzi & Bhattacharyya, 2018; Perkins, 2002). However, data regarding tolerance and CSBD are limited and indirect e.g., a longer history of pornography use related to lower left putaminal responses to erotic photos (Kühn & Gallinat, 2014). Given the possible importance of tolerance for the classification of CSBD as an addictive disorder, the issue merits further research efforts. In line with the addiction model of CSBD, tolerance may manifest in at least two ways: (1) higher frequency or more time devoted to sexual behavior to achieve the same level of arousal, and (2) consuming more stimulating pornographic material, engaging in new types of sexual behavior, as one becomes desensitized and searches for more arousing stimuli to achieve the same level of sexual excitation. As noted by Wines (1997), 39 out of 53 individuals with self-identified sex addiction (74%) reported engaging in the addictive behavior more often to achieve the same response. Hence, in the study, tolerance was reported less often than withdrawal symptoms (74% vs 98% of the sample). In more recent research, 46% of students using pornography reported switching to new types of pornography, and 32% of this group reported a need for viewing more extreme (e.g., violent) pornography (Dwulit & Rzymski, 2019). Although such changes may reflect tolerance to sexual stimuli, the issue requires further investigation in larger clinical and nonclinical samples.

Although most of the instruments assessing PPU and CSBD do not include the assessment of tolerance, the previously mentioned Problematic Pornography Consumption Scale conceptualizes and assesses tolerance to pornography use as a core component of PPU (Bőthe et al., 2018). Similarly to withdrawal symptoms, tolerance is also a part of the formal criteria for gambling disorder introduced in DSM-5 (APA, 2013). In line with this conceptualization, tolerance is reflected in the need to gamble with increasing amounts of money in order to achieve the desired excitement (APA, 2013). Tolerance is, however, not included as a formal criterion in the ICD-11's conceptualization of gambling and gaming disorders (WHO, 2020).

Withdrawal and tolerance as components of behavioral addictions: A critical view

It is important to note that the place and salience of withdrawal symptoms and tolerance with the diagnostic framework of behavioral addictions remains unsettled. Firstly, as some addiction researchers argue, tolerance and withdrawal may not be a core component of multiple substance addictions, and therefore should not be required as a crucial part of the behavioral addiction symptom classification (Starcevic, 2016). Related to this, some studies – focused mostly on internet gaming disorder – indicate that tolerance and withdrawal symptoms may not be highly useful to distinguish problematic users from high frequency non-problematic users (e.g., Billieux, Flayelle, Rumpf, & Stein, 2019; Castro-Calvo et al., 2021). Moreover, increased frequency of engagement in a particular, potentially addictive behavior (including sexual activity or pornography use) may not necessarily reflect increasing levels of tolerance. Instead, increased time devoted to sexual activities and/or engagement in novel forms of these behaviors can be attributed to other motives, including sexual curiosity and exploration motives or fulfilling the need for psychological intimacy with sexual behavior (see: Billieux, Schimmenti, Khazaal, Maurage, & Heeren, 2015; Blaszczynski et al., 2008; Starcevic, 2016). The same can be true for withdrawal symptoms, as withdrawal-like experiences may reflect an adverse psychological reaction to one's way of relieving sexual tension and experiencing pleasure, as well as sexual and emotional intimacy being constrained (see: Grant, Potenza, Weinstein, & Gorelick, 2010; Kaptsis et al., 2016). Moreover, it is worth noting that the current debate is based mostly on data specific to studies on internet gaming and gambling disorders (e.g., Blaszczynski et al., 2008; Castro-Calvo et al., 2021); therefore, conclusions drawn from such studies may not be transferrable to CSBD and PPU (as well as other behavioral addictions), thus further work is needed to investigate the role of withdrawal and tolerance within the diagnostic framework of PPU and CSBD.

Present study

Given the current state of knowledge and available literature reviewed above, we designed and preregistered a study investigating the CSBD and PPU and withdrawal and tolerance. Consistent with conceptualizations discussed previously, for the current study, we defined withdrawal with regards to sexual activity as a set of adverse cognitive, emotional and/or physiological changes that occur as a direct result of abstaining from or limiting engagement in a previously habitual form of sexual behavior, occurring as a result of psycho- and physiological dependence on this activity. Tolerance with regards to sexual activity is defined as decreasing sensitivity to sexual behavior and stimuli over time, resulting in a need to engage in more stimulating/intensive forms of the behavior or increasing the frequency of the behavior, to achieve the same level of stimulation (for related definitions, see, e.g., Bőthe et al., 2018; Kaptsis et al., 2016; King et al., 2016, 2017). In the current study, we

sought to collect information on specific characteristics of withdrawal and tolerance facets, including their frequency and strength in individuals with and without CSBD and PPU. Moreover, important sociodemographic characteristics including age and gender seem to be significantly related to problematic sexual behavior (Kowalewska, Gola, Kraus, & Lew-Starowicz, 2020; Kürbitz & Briken, 2021; Lewczuk, Szmyd, Skorko, & Gola, 2017; Studer, Marmet, Wicki, & Gmel, 2019), thus we also planned to include these indicators as adjusted factors in our analysis. Furthermore, previous studies also showed that problematic sexual behaviors can be significantly affected by being in an intimate relationship (Kumar et al., 2021; Lewczuk, Wizła, & Gola, 2022), and higher sexual behavior frequency, including higher consumption of pornography was linked to higher PPU and CSBD symptom severity (Chen et al., 2022; Gola, Lewczuk, & Skorko, 2016; Lewczuk, Glica, Nowakowska, Gola, & Grubbs, 2020; Lewczuk, Lesniak, Lew-Starowicz, & Gola, 2021; see also: Bőthe, Tóth-Király, Potenza, Orosz, & Demetrovics, 2020), we also included these additional factors in our analysis. This allowed us to investigate whether the relationships between withdrawal symptoms and tolerance on one side, and CSBD and PPU symptoms on the other, are not accounted for by the relationship that problematic sexual behavior symptoms have with these factors. For example, broadening our analysis in this way enabled us to examine whether the relationship between tolerance and PPU symptoms is not underlined by the relationship that PPU may have with basic frequency and duration of pornography use (as habits of pornography use may possibly be connected to both tolerance and PPU). Due to this, we included age, gender, relationship status as well as frequency and duration of pornography use as adjusted variables in our analysis. As our sample is representative of the Polish general adult population, we also sought to investigate the prevalence of CSBD and PPU.

Main predictions: As stated in the preregistration form (https://osf.io/5jd94), we predicted that withdrawal symptoms and tolerance would be significant and positive statistical predictors of CSBD and PPU severity, also when adjusting for socio-demographic factors (e.g., gender, age), patterns of pornography use (frequency and duration of use), and relationship status. We also hypothesized that frequency of pornography use would have a strong association with CSBD and PPU. As previous studies have suggested (Grubbs, Perry, Wilt, & Reid, 2019; Lewczuk, Glica, et al., 2020; Lewczuk, Nowakowska, Lewandowska, Potenza, & Gola, 2021), we hypothesized that male gender, younger age (for age we expected only a weak relationship), and higher pornography use (both duration and frequency) will be related to higher CSBD and PPU symptoms severity.

METHODS

Procedure and sample

Survey data were collected through an online research platform, Pollster (https://pollster.pl/). Participants ($n = 1,541$)

were recruited to be representative of the Polish general, adult population, aged 18–69 years. Representativeness was targeted in accordance with official norms provided by Statistics Poland (2018 norms for gender and age; 2017 norms for education, country region, size of the place of residence). Those norms were previously used by our research team for similar purposes (Lewczuk et al., 2022).

We ordered a sample size of $n = 1,500$ from Pollster, as stated in the preregistration report. However, Pollster collected an additional 41 participants and we saw no reason to exclude them from the analysis – thus the final sample consists of 1,541 individuals.

The sample consisted of 51.2% women ($n = 789$) and 48.8% men ($n = 752$) aged between 18 and 69 years ($M_{age} = 42.99$; $SD = 14.38$). Sample characteristics, measures used, and aims of and plans for the current analyses were preregistered via the Open Science Framework https://osf.io/5jd94. The data on which the current analyses are based are available at https://osf.io/bdskw/ and are open to use by other researchers. More information regarding participants' education and size of the place of residence is given in Appendix.

Measures

Following other studies (e.g., Grubbs, Kraus, & Perry, 2019), at the start of the survey, a definition for pornography was given ("any sexually explicit films, video clips or pictures displaying genital areas which intends to sexually arouse the viewer [this may be seen on the internet, in a magazine, in a book, or on television]").

Variables investigated in the current analysis, and their operationalization are as follows:

Compulsive sexual behavior disorder severity was measured with the CSBD-19 scale (Bőthe, Potenza, et al., 2020). Answer options were between 1 (*totally disagree*) and 4 (*totally agree*). The questionnaire underwent standard translation and back-translation processes, and the final version was approved by the main author of the original instrument. In analyses, we used the general score obtained with the CSBD-19 (19 items; $\alpha = 0.93$) and a diagnostic score of 50 points proposed in the original version (Bőthe, Potenza, et al., 2020).

Problematic pornography use was measured using a 5-item ($\alpha = 0.84$) Brief Pornography Screen (Kraus et al., 2020). Answer options: 0 (*never*), 1 (*sometimes*), 2 (*frequently*). In analyses, we utilized the diagnostic cutoff score of four points (Kraus et al., 2020).

Sexual behavior withdrawal symptoms were assessed by our own, newly created inventory of possible withdrawal symptoms, based on measures previously used to assess withdrawal syndrome in other behavioral addictions, and the literature review. To create the questionnaire, we also aggregated withdrawal symptom types reported in previous studies for behavioral addictions (Blaszczynski et al., 2008; Griffiths & Smeaton, 2002; Kaptsis et al., 2016; King et al., 2016; Lee et al., 2020; Rosenthal & Lesieur, 1992), included withdrawal symptoms reported by individuals with self-

reported sex addiction (Wines, 1997) and removed duplicates or highly related items. The resulting questionnaire ($\alpha = 0.94$) is a broad measure consisting of 21 possible withdrawal symptom types and includes assessment of a possible withdrawal syndrome in the cognitive, emotional, and physical domains (sample items corresponding to specific withdrawal symptoms include "More frequent sexual thoughts which are difficult to stop", "Irritability" or "Frequent mood changes"). Answer options included 1 (*never*), 2 (*sometimes*), 3 (*often*), and 4 (*very often*).

Tolerance was assessed using our own, newly created 5-item questionnaire ($\alpha = 0.80$) based on standardized measures of tolerance used in previous studies for PPU (Bőthe et al., 2018) as well as a literature review of research on tolerance in other behavioral addictions (e.g., Blaszczynski et al., 2008; King, Herd, & Delfabbro, 2017). The five items (answer scale: 1 – *definitely no*, 5 – *definitely yes*) reflected five possible ways in which tolerance for sexual stimuli may manifest itself (sample item: "I watch more extreme and diverse types of pornography than in the past because they are more stimulating").

The full content of the scales was preregistered and, along with the appropriate instructions, is given in Appendix (all items are additionally given in Tables 3 and 4).

Frequency of sexual behavior Following previous studies (Grubbs, Kraus, & Perry, 2019; Lewczuk, Glica, et al., 2020; Lewczuk, Nowakowska, et al., 2021), we assessed frequency of sexual activity by asking participants how often they (1) viewed pornography, (2) masturbated, and (3) had sex with a partner within the past 12 months (8-point answer scale ranging between *never* and *once a day or more*).

Duration of pornography use Following previous studies (Grubbs, Kraus, & Perry, 2019; Lewczuk, Glica, et al., 2020; Lewczuk, Nowakowska, et al., 2021) as an additional descriptor of patterns of pornography use, we asked participants how many minutes they were viewing pornography on average, weekly.

Socio-demographic characteristics including age (in years), gender (0 – woman; 1 – man), education, size of the place of residence, country region and income (see *Procedure and sample* characteristics subsection) were assessed to ensure the representativeness of the sample. Moreover, age, gender, and *relationship status* (1 – in a romantic relationship [formal or informal], 2 – single) were preregistered and used as adjusted variables statistically predicting CSBD and PPU symptoms in analyses.

Statistical analysis

In the first step, we analyzed bivariate correlations between all analyzed variables. Secondly, we investigated the prevalence of each specific withdrawal symptom in the whole sample and compared them between groups above vs below the diagnostic threshold for CSBD and PPU. Corresponding analysis was repeated for items reflecting tolerance. For the mentioned comparisons of prevalence, we used a χ^2 (chi-square) test, with the corresponding Cramer's V effect size estimate. In agreement with previous studies, we consider values of

$V = 0.10$ as a small effect size, 0.30 as medium, and 0.50 as large effect size (Cohen, 1988). Additionally, comparing groups above vs. below diagnostic threshold for CSBD and PPU we also conducted a Mann-Whitney U test. We chose this test because we found elevated levels of kurtosis (2.33 [Standard Error = 0.137]) as well as slightly elevated skewness (1.33 [0.068]) (e.g., Hair et al., 2021) for withdrawal symptoms. Along with the results of the Mann-Whitney U test, we also reported a Cohen's d effect size estimate. As defined by Cohen (1988), the value of $d = 0.2$ can be considered a small effect size, $d = 0.5$ a medium effect size and $d = 0.8$ a large effect size. In the last analytic step, we conducted linear regression in which withdrawal symptoms and tolerance (as well as controlled variables: sex, age, relationship status) were considered as statistical predictors (serving as independent variables) of CSBD and PPU severity (dependent variables). As we planned in the preregistration report, the severity of withdrawal symptoms and tolerance were investigated only among people who reported engaging in sexual activity (pornography use, masturbation and/or dyadic sexual intercourse) monthly or more frequently ($n = 1,277$ out of 1,541 individuals). We did not see a strong rationale for investigating possible withdrawal among people who engaged in sexual activity less frequently than monthly. All analyses were conducted in R statistical environment (R Core Team, 2013).

Ethics

The study procedures were carried out in accordance with the Declaration of Helsinki. The Institutional Review Board of the Cardinal Stefan Wyszyński University in Warsaw approved the study. All subjects were informed about the study and all provided informed consent.

RESULTS

In the first step, we present bivariate correlations between all analyzed variables (Table 1). The severity of reported withdrawal symptoms was positively related to both CSBD severity measured by the CSBD-19 ($r = 0.50$; $P < 0.001$) and PPU severity assessed by the BPS ($r = 0.41$; $P < 0.001$). Tolerance was also positively related to both CSBD ($r = 0.53$; $P < 0.001$) and PPU severity ($r = 0.46$; $P < 0.001$). Moreover, both withdrawal ($r = 0.22$; $P < 0.001$) and tolerance ($r = 0.34$; $P < 0.001$) were positively associated with the frequency of pornography use (Table 1).

Prevalence estimates of CSBD were 4.67% for all participants ($n = 72$ of $n = 1,541$), including 6.25% of men ($n = 47$ of $n = 752$) and 3.17% of women ($n = 25$ of $n = 789$). Prevalence estimates of PPU were 22.84% for all participants ($n = 352$ of $n = 1,541$), 33.24% for men ($n = 250$ of $n = 752$) and 12.93% for women ($n = 102$ of $n = 789$).

Among individuals who reported pornography use (participants who reported having used pornography at least once in the previous year, $n = 1,014$ out of $n = 1,541$) prevalence of CSBD was 5.62% (6.40% among men and 4.37% among women). The prevalence of PPU was 32.35%

Table 1. Descriptive statistics and correlation indices (Pearson's r) estimating the strengths of relationships between variables

	M (SD)	Range	1	2	3	4	5	6	7
1. Age	42.99 (14.38)	18.00–69.00	-						
2. Frequency of pornography use	3.42 (2.34)	1.00–8.00	−0.20**	-					
3. Duration of pornography use (min./week)	45.56 (141.41)	0.00–2790.00	−0.08*	0.31**	-				
4. CSBD severity (CSBD-19 General Score)	32.71 (9.59)	19.00–76.00	−0.07*	0.32**	0.15**	-			
5. PPU severity (BPS General Score)	1.81 (2.38)	0.00–10.00	−0.12**	0.49**	0.26**	0.50**	-		
6. Withdrawal symptoms	30.93 (9.37)	21.0–84.00	−0.14**	0.22**	0.14**	0.50**	0.41**	-	
7. Tolerance	10.91 (4.56)	5.00–25.00	0.01	0.34**	0.15**	0.53**	0.46**	0.37**	-

$^{*}P < 0.05$; $^{**}P < 0.001$.

(38.24% among men and 22.88% among women) in the same group.

Next, we present means and standard deviations for the analyzed variables: withdrawal, tolerance, frequency and duration of pornography use in the whole sample, as well as divided into groups below and above thresholds for CSBD and PPU (Table 2). Intergroup comparisons showed that participants who scored above the threshold for CSBD had higher levels of withdrawal ($M_{above} = 43.36$; $SD_{above} = 12.83$; $M_{below} = 30.26$; $SD_{below} = 8.65$, $U = 8.49$; $P < 0.001$; $d = 1.20$) and tolerance ($M_{above} = 16.24$; $SD_{above} = 4.95$; $M_{below} = 11.10$; $SD_{below} = 4.43$, $U = 7.89$; $P < 0.001$; $d = 1.10$) than those who scored below the threshold. Similarly, participants who scored above the threshold for PPU also had higher levels of withdrawal symptoms ($M_{above} = 36.80$; $SD_{above} = 9.76$; $M_{below} = 28.98$; $SD_{below} = 8.36$, $U = 13.37$; $P < 0.001$; $d = 0.86$) and tolerance ($M_{above} = 14.37$; $SD_{above} = 4.63$; $M_{below} = 10.36$; $SD_{below} = 4.13$, $U = 14.20$; $P < 0.001$; $d = 0.91$; see Table 2).

Further, we present the scores obtained for each of the 21 studied possible withdrawal symptoms. Table 3 presents means and standard deviations for each of the symptom classes as well as the percentages of people reporting experiencing each symptom (in the whole sample, as well as below and above thresholds for CSBD and PPU). The percentage indices depicted in Table 3 reflect the combined scores for "often" and "very often" responses supporting the presence of a particular symptom. In the whole sample, 56.9% of participants did not report experiencing any withdrawal symptoms, 15.7% reported the presence of five or more symptoms and 4.6% reported 10 or more symptoms. The most frequently reported symptoms were more

frequent sexual thoughts which were difficult to stop (in participants who scored above the threshold for CSBD: $CSBD_{ABOVE} = 65.2\%$; and above the threshold for PPU: $PPU_{ABOVE} = 43.3\%$), increased overall arousal ($CSBD_{ABOVE} = 37.9\%$; $PPU_{ABOVE} = 29.2\%$), difficult to control level of sexual desire ($CSBD_{ABOVE} = 57.6\%$; $PPU_{ABOVE} = 31.0\%$), irritability ($CSBD_{ABOVE} = 37.9\%$; $PPU_{ABOVE} = 25.4\%$), frequent mood changes ($CSBD_{ABOVE} = 33.3\%$; $PPU_{ABOVE} = 22.6\%$), and sleep problems ($CSBD_{ABOVE} = 36.4\%$; $PPU_{ABOVE} = 24.5\%$). Physical symptoms were reported least frequently: nausea ($CSBD_{ABOVE} = 6.1\%$; $PPU_{ABOVE} = 3.1\%$), stomachache ($CSBD_{ABOVE} = 13.6\%$; $PPU_{ABOVE} = 6.0\%$), muscle pain ($CSBD_{ABOVE} = 16.7\%$; $PPU_{ABOVE} = 7.5\%$), pain in other parts of the body ($CSBD_{ABOVE} = 18.2\%$; $PPU_{ABOVE} = 8.2\%$), and other symptoms ($CSBD_{ABOVE} = 4.5\%$; $PPU_{ABOVE} = 3.1\%$) (Table 3).

Additional intergroup rank comparisons (Mann-Whitney U test) between groups below vs. above thresholds for CSBD and PPU indicated that for every symptom class and both CSBD and PPU, the group scoring above the diagnostic threshold also reported higher results for each withdrawal symptom ($P < 0.001$; see Table 3). For 16 out of 21 withdrawal symptoms, we denoted at least medium effect size estimates (Cohen's $d > 0.5$) for these comparisons for both CSBD and PPU (Table 3). Lastly, corresponding χ^2 tests carried out for groups below vs. above diagnostic thresholds for CSBD and PPU also yielded significant results for every symptom, excluding the "Other symptoms" group – small to medium effect sizes were obtained for these comparisons (Cramer's V between 0.05 and 0.35; see Table 4).

Table 2. Means (standard deviations) and intergroup comparisons (using the Mann-Whitney U test, standardized value, with the corresponding Cohen's d effect size) for groups with and without CSBD and PPU

	CSBD			PPU		
	Above threshold (n = 66) M (SD)	Below threshold (n = 1,211) M (SD)	Mann-Whitney U | Cohen's d	Above threshold (n = 319) M (SD)	Below threshold (n = 958) M (SD)	Mann-Whitney U | Cohen's d M (SD)
Withdrawal	43.36 (12.83)	30.26 (8.65)	8.49** | 1.20	36.80 (9.76)	28.98 (8.36)	13.37** | 0.86
Tolerance	16.24 (4.95)	11.10 (4.43)	7.89** | 1.10	14.37 (4.63)	10.36 (4.13)	14.20** | 0.91
Frequency of pornography use	5.12 (2.52)	3.75 (2.32)	4.74** | 0.57	5.45 (1.82)	3.28 (2.25)	15.63** | 1.06

$^{**}P < 0.001$.

Table 3. Percentages, means (standard deviations) for analyzed specific withdrawal symptoms in the whole analyzed sample, as well as for groups with and without CSBD and PPU, along with the intergroup comparisons (using the Mann-Whitney U Test, standardized value, as well as χ^2 test with the corresponding effect size estimates: Cohen's d and Cramér's V)

| | All (n = 1,277) % \| M (SD) | CSBD | | Mann-Whitney U \| Cohen's d | χ^2 \| Cramér's V | PPU | | Mann-Whitney U \| Cohen's d | χ^2 \| Cramér's V |
		Above threshold (n = 66) % | M (SD)	Below threshold (n = 1,211) % | M (SD)			Above threshold (n = 319) % | M (SD)	Below threshold (n = 958) % | M (SD)		
More frequent sexual thoughts which are difficult to stop	19.4% | 1.83 (0.86)	65.2% | 2.79 (0.87)	16.9% | 1.77 (0.82)	8.56** | 1.20	93.01** | 0.27	43.3% | 2.39 (0.93)	11.5% | 1.64 (0.74)	13.01** | 0.90	154.43** | 0.35
Increased arousal	17.6% | 1.81 (0.77)	37.9% | 2.29 (0.91)	16.5% | 1.79 (0.76)	4.54** | 0.60	19.68** | 0.12	29.2% | 2.14 (0.77)	13.8% | 1.70 (0.74)	8.91** | 0.58	38.97** | 0.18
Irritability	14.4% | 1.71 (0.77)	37.9% | 2.30 (0.93)	13.1% | 1.68 (0.75)	5.63** | 0.74	31.09** | 0.16	25.4% | 2.04 (0.79)	10.8% | 1.61 (0.74)	9.12** | 0.57	41.59** | 0.18
Frequent mood changes	13.2% | 1.66 (0.75)	33.3% | 2.27 (0.87)	12.1% | 1.63 (0.73)	6.21** | 0.80	24.80** | 0.14	22.6% | 1.98 (0.76)	10.0% | 1.56 (0.72)	9.34** | 0.58	32.99** | 0.16
Difficult to control level of sexual desire	13.0% | 1.61 (0.79)	57.6% | 2.73 (0.90)	10.6% | 1.55 (0.74)	10.10** | 1.43	122.28** | 0.31	31.0% | 2.12 (0.91)	7.0% | 1.44 (0.67)	12.84** | 0.85	122.30** | 0.31
Increased stress	12.0% | 1.61 (0.75)	39.4% | 2.27 (0.97)	10.5% | 1.57 (0.72)	6.27** | 0.82	49.59** | 0.20	23.5% | 1.92 (0.85)	8.1% | 1.51 (0.68)	8.05** | 0.53	53.60** | 0.21
Sleeping problems	11.8% | 1.57 (0.77)	36.4% | 2.15 (1.03)	10.5% | 1.54 (0.74)	5.30** | 0.69	40.20** | 0.18	24.5% | 1.95 (0.89)	7.6% | 1.44 (0.68)	9.96** | 0.64	65.02** | 0.23
Restlessness	9.5% | 1.66 (0.68)	36.4% | 2.33 (0.88)	8.0% | 1.63 (0.65)	6.74** | 0.91	58.66** | 0.21	18.2% | 1.99 (0.71)	6.6% | 1.56 (0.64)	9.76** | 0.64	37.58** | 0.17
Drowsiness	8.2% | 1.43 (0.71)	30.3% | 2.06 (0.99)	7.0% | 1.39 (0.67)	6.60** | 0.79	44.97** | 0.19	17.9% | 1.76 (0.86)	5.0% | 1.32 (0.61)	9.75** | 0.60	52.43** | 0.20
Problems with concentration	8.1% | 1.51 (0.70)	37.9% | 2.24 (0.95)	6.5% | 1.47 (0.66)	7.40** | 0.95	82.26** | 0.25	16.9% | 1.85 (0.78)	5.2% | 1.39 (0.63)	10.38** | 0.64	43.86** | 0.19
Depressive mood	7.7% | 1.45 (0.68)	27.3% | 2.06 (0.93)	6.6% | 1.41 (0.65)	6.66** | 0.81	37.73** | 0.17	15.4% | 1.74 (0.79)	5.1% | 1.35 (0.61)	8.99** | 0.55	35.46 | 0.17**
Guilt or embarrassment	7.6% | 1.41 (0.67)	31.8% | 2.12 (0.97)	6.3% | 1.37 (0.63)	7.52** | 0.91	58.18** | 0.21	17.6% | 1.72 (0.84)	4.3% | 1.31 (0.57)	8.73** | 0.56	60.09** | 0.22
Difficulty making decisions	6.9% | 1.42 (0.66)	33.3% | 2.18 (0.94)	5.5% | 1.37 (0.62)	8.26** | 1.02	75.84** | 0.24	14.7% | 1.71 (0.77)	4.3% | 1.32 (0.59)	9.56** | 0.58	40.76** | 0.18
Headache	6.5% | 1.38 (0.66)	27.3% | 1.94 (0.99)	5.4% | 1.35 (0.62)	5.91** | 0.72	49.42** | 0.20	12.5% | 1.56 (0.77)	4.5% | 1.31 (0.60)	5.80** | 0.36	25.52** | 0.14
Strong heartbeats	5.2% | 1.36 (0.61)	19.7% | 1.88 (0.90)	4.5% | 1.33 (0.58)	6.18** | 0.73	29.23** | 0.15	10.0% | 1.58 (0.71)	3.7% | 1.28 (0.55)	7.73** | 0.46	19.58** | 0.12
Difficulty solving tasks and problems	4.6% | 1.39 (0.62)	25.8% | 2.00 (0.91)	3.5% | 1.36 (0.58)	6.86** | 0.84	70.56** | 0.24	9.4% | 1.69 (0.70)	3.0% | 1.29 (0.55)	10.75** | 0.64	22.09** | 0.13
Muscle pain, rigidity, or muscle spasms	4.5% | 1.36 (0.61)	16.7% | 1.79 (0.97)	3.8% | 1.34 (0.58)	4.36** | 0.56	24.30** | 0.14	7.5% | 1.50 (0.72)	3.4% | 1.32 (0.57)	4.20** | 0.27	9.34* | 0.09
Pain in other parts of the body (e.g., arms, legs, chest, back)	4.0% | 1.29 (0.58)	18.2% | 1.67 (0.85)	3.2% | 1.27 (0.55)	4.78** | 0.56	36.54** | 0.17	8.2% | 1.43 (0.71)	2.6% | 1.24 (0.52)	4.88** | 0.31	19.16** | 0.12
Stomachache	3.8% | 1.29 (0.57)	13.6% | 1.61 (0.88)	3.2% | 1.27 (0.54)	3.60** | 0.46	18.77** | 0.12	6.0% | 1.40 (0.65)	3.0% | 1.25 (0.53)	4.13** | 0.25	5.68* | 0.07
Nausea	1.6% | 1.13 (0.41)	6.1% | 1.45 (0.75)	1.4% | 1.11 (0.38)	6.53** | 0.58	8.39* | 0.08	3.1% | 1.21 (0.50)	1.1% | 1.10 (0.38)	4.36** | 0.24	5.84* | 0.07
Other symptoms	1.6% | 1.07 (0.36)	4.5% | 1.23 (0.63)	1.5% | 1.06 (0.34)	4.05** | 0.32	3.62 | 0.05	3.1% | 1.13 (0.48)	1.1% | 1.05 (0.31)	3.87** | 0.20	5.84* | 0.07

* $P < 0.05$; ** $P < 0.001$.

Table 4. Percentages, means (standard deviations) for analyzed tolerance items in the whole analyzed sample, as well as for groups with and without CSBD and PPU, along with the intergroup comparisons (using the Mann-Whitney U test, standardized value, as well as χ^2 test with the corresponding effect size estimates: Cohen's d and Cramér's V)

	All (n = 1,277) % |M(SD)	CSBD Above threshold (n = 66) % |M (SD)	CSBD Below threshold (n = 1,211) % |M (SD)	Mann-Whitney U | Cohen's d	χ^2 | Cramér's V	PPU Above threshold (n = 319) % |M (SD)	PPU Below threshold (n = 958) % |M (SD)	Mann-Whitney U | Cohen's d	χ^2 | Cramér's V
(1) I currently need sexual activities to be more stimulating to reach the same level of arousal as in the past.	30.5% | 2.69 (1.31)	50.0% | 3.47 (1.23)	29.5% | 2.65 (1.31)	4.81** | 0.65	12.42** | 0.10	45.8% | 3.21 (1.23)	25.5% | 2.52 (1.30)	8.26** | 0.55	46.48** | 0.19
(2) I watch more extreme and diverse types of pornography than in the past because they are more stimulating.	15.8% | 2.00 (1.26)	40.9% | 3.12 (1.45)	14.5% | 1.94 (1.22)	6.69** | 0.88	32.90** | 0.16	34.5% | 2.86 (1.35)	9.6% | 1.72 (1.09)	14.11** | 0.93	111.24** | 0.30
(3) I spend more time engaging in sexual activities than in the past.	11.3% | 2.05 (1.12)	45.5% | 3.26 (1.29)	9.4% | 1.99 (1.08)	7.67** | 1.07	81.26** | 0.25	21.0% | 2.56 (1.19)	8.0% | 1.88 (1.05)	9.37** | 0.61	40.21** | 0.18
(4) With time, I have noticed that I need to engage in more and more new types of sexual behavior in order to experience the same sexual arousal or to reach an orgasm.	17.2% | 2.19 (1.19)	42.4% | 3.24 (1.30)	15.9% | 2.13 (1.16)	6.64** | 0.91	30.98** | 0.16	21.7% | 2.80 (1.22)	12.4% | 1.98 (1.10)	10.54** | 0.71	62.12** | 0.22
(5) In general, sexual activity is often less satisfying to me than it used to be in the past.	22.7% | 2.43 (1.26)	40.9% | 3.15 (1.30)	21.7% | 2.39 (1.25)	4.50** | 0.59	13.13** | 0.10	33.2% | 2.93 (1.21)	19.2% | 2.27 (1.24)	8.27** | 0.54	26.81** | 0.14

**$P < 0.001$.

Next, we analyzed each of the items reflecting tolerance in the whole sample as well as in groups above the diagnostic threshold for CSBD or PPU (see Table 4). Values presented in Table 4 represent the percentages of participants for whom each statement was marked as true.

The need to engage in more stimulating sexual behavior to achieve the same level of arousal was the most frequently supported statement (CSBD$_{ABOVE}$ = 50.0%; PPU$_{ABOVE}$ = 45.8%). Participants also often reported increasing time spent on sexual activities (CSBD$_{ABOVE}$ = 45.5%; PPU$_{ABOVE}$ = 21.0%). Moreover, 42.4% of participants at high risk for CSBD and 21.7% for PPU reported that they needed to engage in more and more new types of sexual activities to achieve the same level of arousal or to reach an orgasm. Sexual activity had become less satisfying than before for 40.9% of respondents scoring above the diagnostic threshold for CSBD and 33.3% for PPU. Further, 34.5% of respondents at risk for PPU and 40.9% of respondents at risk for CSBD reported engaging in more extreme and diverse forms of pornography because they are more stimulating. Additional rank comparisons (Mann-Whitney U test) between groups below vs. above thresholds for CSBD and PPU indicated that for each of five tolerance facets, the group scoring above the diagnostic threshold reported significantly higher results (all P's < 0.001, medium to large effect size estimates, see Table 4). Lastly, χ^2 tests conducted for the same groups also led to significant results for each tolerance component, with mostly small effect sizes (Cramer's V between 0.10 and 0.30; Table 4).

In the last analytic step, we considered withdrawal symptoms and tolerance as statistical predictors of CSBD and PPU severity, adjusting for sex, age, relationship status, frequency and duration of pornography use (Table 5). Both withdrawal symptoms (β = 0.34; P < 0.001) and tolerance (β = 0.38; P < 0.001) were positively related to CSBD severity. The same was the case for PPU severity (withdrawal: β = 0.24; P < 0.001; tolerance: β = 0.27; P < 0.001). The frequency of pornography use was also positively

associated with PPU (β = 0.26; P < 0.001) and CSBD symptom severity. The strength of association between CSBD and withdrawal, as well as tolerance, seemed to be weaker than that of CSBD and the frequency of pornography use (β = 0.06; P < 0.001). Duration of pornography use was positively related to PPU (β = 0.09; P < 0.001), but not CSBD. Moreover, males had higher severities of both CSBD (β = 0.11; P < 0.001) and PPU (β = 0.14; P < 0.001). Age was not significantly associated with CSBD severity and had only a marginally significant, negative relationship with PPU symptoms (β = −0.05; P = 0.043). Our models explained a significant portion of the variance in severities of CSBD (40%) and PPU (41%, as measured by R^2_{adj}) (Table 5).

DISCUSSION

The current study investigated withdrawal symptomatology and tolerance for sexual stimuli in CSBD and PPU and prevalence estimates of CSBD and PPU in a nationally representative adult Polish sample. The significance of the current study centered on (1) providing initial evidence of the presence and characteristics of withdrawal symptoms and tolerance related to sexual behavior and stimuli, (2) gathering data on their significant relation with the severity of CSBD and PPU symptoms, and as a result (3) supporting a scientifically accurate conclusion about the validity of the addiction model of CSBD and PPU.

Below, we summarize the findings and discuss their implications for clinical practice and future research studies.

Withdrawal syndrome and tolerance association with CSBD and PPU

Withdrawal symptom severity was positively associated with both CSBD and PPU severities; similar findings were observed for tolerance. Further, consistent with our hypotheses, both withdrawal and tolerance were associated with severities of CSBD and PPU, when adjusting for sociodemographic features and frequency and duration of pornography use. Moreover, mean comparisons showed that withdrawal and tolerance were higher in the groups meeting previously determined thresholds for CSBD and PPU. While additional studies should further investigate and extend these findings, the results of this preregistered study and analyses provide evidence that both withdrawal symptoms and tolerance are related to CSBD in this representative sample of Polish adults. Further research should investigate withdrawal symptoms and tolerance in the development and maintenance of CSBD in clinical and community-based samples.

Based on prior findings, we hypothesized that frequency of pornography use would have a particularly strong relationship with CSBD severity, relative to withdrawal symptoms and tolerance. This, interestingly, did not appear to be the case, as both withdrawal symptoms and tolerance had numerically stronger relationships than did frequency with

Table 5. Regression analysis in which withdrawal symptoms, tolerance and adjusted variables statistically predict CSBD and PPU severities

	CSBD β (P)	PPU β (P)
Withdrawal	0.34 (<0.001)	0.24 (<0.001)
Tolerance	0.38 (<0.001)	0.27 (<0.001)
Frequency of pornography use	0.06 (<0.001)	0.26 (<0.001)
Duration of pornography use (min./week)	0.01 (0.764)	0.09 (<0.001)
Sex	0.11 (<0.001)	0.14 (<0.001)
Age	−0.03 (0.288)	−0.05 (0.043)
Relationship status	−0.00 (0.879)	−0.03 (0.209)
F	124.09 (<0.001)	128.52 (<0.001)
R^2_{adj}	0.403	0.412

Note. Sex (0 – female, 1 – male); Relationship status (0 – not in a relationship; 1 – in a relationship)

severities of PPU and especially CSBD. The significance of these findings is discussed further below.

Prevalence of specific withdrawal symptom types and tolerance components

The most frequently reported symptoms connected to withdrawal were more frequent sexual thoughts which were difficult to stop, increased overall arousal and difficult to control sexual desire. This is not surprising as these changes can, at least to some degree, reflect the natural, though possibly elevated, response to difficulties relieving sexual tension (at all, or with the same frequency to which a person is accustomed). Although the current ICD-11 conceptualization of CSBD does not specifically include withdrawal symptoms, it is possible that difficulties in controlling the increased frequency of sexual thoughts or higher sexual desire in the period of withdrawal may be related to the CSBD component of "numerous unsuccessful efforts to control or significantly reduce repetitive sexual behaviour" (Kraus et al., 2018, p. 109). In other words, difficulties in controlling sexual behavior, which is an important component of CSBD as proposed in the ICD-11 (WHO, 2020), may arise in part due to withdrawal symptoms when one attempts to stop or limit their sexual behavior. Such experiences may feel overwhelming, unmanageable and abnormal, which could dissipate by returning to the sexual behavior.

Also, withdrawal symptoms may be more pronounced for CSBD than for other behavioral addictions, for which the presence of withdrawal is currently being discussed/debated, like gaming (e.g., Kaptsis et al., 2016), as withdrawal in CSBD may be perpetuated by unrelieved sexual drives which may represent a physiological need. Moreover, unrelieved sexual drives may constitute physiological factors for the possible development of multiple withdrawal symptoms. For example, experiencing a higher level of sexual desire may lead to a higher frequency of sexual thoughts, which may then generate concentration problems, worsen cognitive performance and lead to difficulties making decisions, which may then further increase other negative emotions and feelings of perceived stress.

Increased general arousal which, as mentioned above, was also frequently reported when withdrawing from sexual activity and may reflect increased sexual arousal. In general, problems related to hyperarousal (irritability, high general arousal or sexual desire) were reported more frequently than hypoarousal problems (like drowsiness). However, higher general arousal may be generated by limiting the time devoted to sexual behaviors and devoting more time to other activities. Members of "NoFap" groups (Sproten, 2016) (those who have discontinued pornography viewing and masturbation) sometimes report higher levels of energy, activity and getting more work accomplished after a period of sustained abstinence. It is possible that these effects may occur for a subset of individuals when cycles of compulsive sexual behavior are discontinued. Future studies involving clinical samples and longitudinal measures are needed to investigate the effect of pornography and/or masturbation abstinence further.

Irritability, frequent mood changes, increased stress and sleep problems were also frequently reported. Such symptoms appear related to those reported for gambling disorder and internet gaming disorder in the DSM-5 (restlessness and irritability for gambling disorder; irritability, anxiety or sadness for internet gaming disorder, (APA, 2013)). One might argue that if such symptoms constitute an important diagnostic criterion for these disorders, similar symptoms should be considered in the contexts of CSBD and PPU.

The current results are also consistent with Wines' study (1997) in which people with sex addiction reported withdrawal symptoms such as depression, anger, anxiety, insomnia and fatigue most frequently. However, in the current study, the prevalence of withdrawal symptoms in the group meeting criteria for CSBD was lower than in Wines' study (in which 52 out of 53 participants reported at least one withdrawal symptom). This is not surprising, as Wines' study involved a clinical group of patients who, with high probability, experienced more severe symptoms of compulsive sexual behavior than our participants recruited from the general population. Due to its large-scale, non-clinical nature, our study provides complementary preliminary data, which should be replicated and extended in clinical, treatment-seeking groups that have all been formally evaluated and diagnosed with CSBD.

In line with previous studies of behavioral addictions, physical symptoms were reported to a lesser degree including headache, strong heartbeats, stomachache, muscle pain, and pain in other parts of the body. Physical symptoms of withdrawal are a hallmark of substance use disorders (Bayard et al., 2004; Kosten & O'Connor, 2003), but less so for behavioral addictions like gambling and internet gaming disorders (APA, 2013). The current study provides preliminary support for withdrawal symptoms in CSBD and PPU, and these clinical features should be examined further in large, culturally diverse clinical samples.

For tolerance, each of the five investigated facets was supported decidedly stronger for participants with CSBD as well as those with PPU than for participants not fulfilling these criteria. The need for sexual activities to be more stimulating to reach the same level of arousal as in the past was supported the most strongly in both groups with problematic sexual behavior. However, this statement was also highly supported for other sexually active participants. However, facets of tolerance reflecting active attempts at counteracting its effects seem to be more specific for people high in CSBD and PPU symptoms. This included – for CSBD – increasing the time devoted to sexual activities, as well as engagement in novel types of sexual behavior to experience the same sexual arousal level or reach an orgasm. For PPU – watching more extreme and diverse pornographic material than before, because this material is more stimulating. This pattern of results is understandable, as the first of the analyzed facets (the need for sexual activities to be more stimulating to reach the same level of arousal as in the past) may be also related to other factors, e.g., age, and age-related decreases in sexual arousability and drive. Thus, this facet may be specific for participants with PPU and/or CSBD.

Thus, our results indicate that measuring not only the experienced increasing tolerance for sexual stimuli, but especially the active (and in some cases compulsive) attempts at counteracting such effect may be important in considering tolerance in CSBD and PPU.

Associations between sociodemographic characteristics, relationship status and pornography use habits with CSBD and PPU

As hypothesized, regression analyses showed that those who consumed pornography with higher frequency had greater PPU severity. Although the bivariate correlation between the frequency of pornography use and CSBD was moderate, positive and significant, when adjusting for other variables in the regression models, the impact of the frequency of pornography use on CSBD symptoms was small, although still significant. The association strength of the frequency of pornography use for CSBD when adjusting for other variables was numerically weaker than those for withdrawal and tolerance, contrary to our predictions in the preregistration report. Further, duration of pornography use appeared to contribute to CSBD severity less prominently than the frequency of use. Specifically, duration of pornography use was only a significant factor for PPU severity, but not for CSBD severity when other indicators were included in the model. The obtained pattern of results is consistent with those from our previous studies, as well as several studies by other researchers (Grubbs, Kraus, & Perry, 2019; Lewczuk, Glica, et al., 2020). Relationship status did not relate to PPU or CSBD severities. Age had a significant, albeit relatively weak, inverse relationship with PPU severity, which is consistent with previous studies (Lewczuk, Nowakowska, et al., 2021), but age was not related to CSBD severity. Lastly, as supported by prior literature, male gender was related to more pornography use (Grubbs, Kraus, & Perry, 2019; Lewczuk, Wójcik, & Gola, 2022) and greater CSBD and PPU severities (de Alarcón et al., 2019; Kafka, 2010; Lewczuk et al., 2017). Overall, the regression models explained 40% of the variance in CSBD and 41% in PPU, which are relatively high values, especially when considering that the primary purpose of our analysis was to investigate specific, preregistered predictions and not to maximize the predictive value of the models.

CSBD and PPU prevalence

Furthermore, in the current nationally representative, adult sample, the prevalence of CSBD among all participants was 4.67% (6.25% among men, 3.17% among women), and the prevalence of PPU was 22.84% (33.24% among men, 12.92% among women). Among individuals reporting pornography use, the prevalence of CSBD was estimated at 5.62% (6.40% among men, 4.37% among women), and the prevalence of PPU was 32.35% (38.24% for men, 22.88% for women). The difference between the estimates based on the two questionnaires may stem in part from the stringencies in thresholding for the assessment instruments. Previous studies conducted by our team also using the BPS to estimate PPU also generated high estimates, 17.8% for a study conducted on

a representative sample in 2019 ($n = 1,036$; pre-covid, Lewczuk, Wizła, & Gola, 2022), and 22.92% in a convenience sample recruited on social media in 2020 (during the COVID-19 pandemic) (Wizła et al., 2022). The issue of overinclusive thresholds for PPU measures, and thus possible over-pathologization of non-pathologic sexual activity, has been discussed and debated (Kohut et al., 2020; Lewczuk, Wizła, & Gola, 2022; Walton et al., 2017). Studies involving participants seeking treatment for CSBD and PPU should be conducted to gather more data relevant to diagnostic criteria and thresholds for CSBD and PPU and measures thereof.

The current study was conducted during the COVID-19 pandemic (January 2021), which may have influenced the findings. Some studies have reported that pornography use and PPU may have increased during the pandemic (Döring, 2020; Zattoni et al., 2020), which could be one possible explanation for the high PPU prevalence estimates observed in the current study. However, it is important to note that other studies did not find significant long-term increases in pornography use frequency or PPU symptom severity during the COVID-19 pandemic (Bőthe et al., 2022; Grubbs, Perry, Grant Weinandy, & Kraus, 2022).

Diagnostic and clinical implications

The present findings, although preliminary, have potentially significant diagnostic and clinical implications – however, they should be corroborated and extended by future research, also based on clinical samples, before strong conclusions can be drawn. The presence of withdrawal symptoms and tolerance in the symptom picture of CSBD may indicate that these phenomena should be assessed as part of a diagnostic process for this disorder. This would indicate the possible need to change the current assessment instruments for CSBD to also include tolerance and withdrawal components, similarly to the Problematic Pornography Consumption Scale assessing PPU (Bőthe et al., 2018). Moreover, therapy for CSBD and PPU should be tailored accordingly and consider the possible occurrence of withdrawal symptoms during the therapeutic process (i.e., these symptoms can occur when a client limits or abstains from problematic forms of sexual behavior while in treatment). Lastly, the presence of tolerance and withdrawal symptoms in CSBD corroborates the addiction model of the disorder, and thus future clinical research may benefit from testing the effectiveness of therapeutic methods that are effective in the treatment of other addictions. However, as tolerance and withdrawal in CSBD and behavioral addictions more broadly are still much-discussed concepts with only initial evidence gathered hitherto (Castro-Calvo et al., 2021; Starcevic, 2016), the validity of these implications depends on the results of much needed future replication employing rigorous research methodologies with diverse populations (Griffin, Way, & Kraus, 2021).

Limitations and future research

The cross-sectional design of the current study is suboptimal when investigating directional hypotheses. Future studies

using longitudinal designs are needed to examine withdrawal symptoms and tolerance in CSBD and/or PPU. The current study did not investigate the temporal characteristics of each of the withdrawal symptoms (the appearance and dissipation may differ between them) or their possible impacts on functioning. Methods providing more fine-grained assessments (e.g., ecological momentary assessment [EMA]) may be used to investigate these issues (e.g., track the possible appearance of withdrawal symptoms daily, in an ecological and more reliable manner; Lewczuk, Gorowska, Li, & Gola, 2020). In our study, we also did not gather information on whether participants were in a period of sexual abstinence or regulated/limited their sexual behavior at the time the study was conducted, which would be a useful supplement to the presented results. Multiple possible factors (e.g., insufficient professional training, limited insight of participants) may influence findings reported in the current study as compared to assessments involving experienced mental health professionals. An important future step for reliable assessment of the features predicted by the addiction model of CSBD is to investigate the presence of withdrawal symptoms and tolerance in clinical groups, based on clinician-administered assessments. Moreover, although we investigated multiple possible withdrawal symptoms (compared to previous studies of behavioral addictions), it is possible that some other important types of withdrawal symptoms were not included in the study. The precise structure and features of withdrawal symptoms in CSBD and PPU should be examined further, including in focus groups involving treatment seeking clients with CSBD and PPU. As elaborated on in the Discussion section, measurement of PPU in the current study (using the Brief Pornography Screen) resulted in probable overdiagnosis of these symptoms in the studied population – this should be considered a limitation of the study, and the current results should be replicated using a more conservative measure of PPU. As the study was conducted during the COVID-19 pandemic, additional studies following the pandemic are needed. Our analysis was based only on Polish participants. As differences in sexual behavior may relate to culture, race, ethnicity, religion and other factors (Agocha, Asencio, & Decena, 2013; Grubbs & Perry, 2019; Perry & Schleifer, 2019), generalizability of the current results should be investigated in other cultural environments and geographic locations, particularly further work should examine possible differences attributed to gender, racial/ethnic, religious, and sexual identities. Lastly, additional, important factors potentially influencing the relations of CSBD/PPU to withdrawal symptoms and tolerance which are not a part of the current analysis (including sexual drive, sexual health and dysfunctions) should be investigated in future work.

CONCLUSIONS

The current work provides initial evidence of the possible presence of withdrawal symptoms and tolerance in the domain of sexual activity, and its significant relation to CSBD and PPU symptoms. Most frequently reported symptoms not only involved sexual domain (more frequent sexual thoughts which were difficult to stop, difficulty controlling sexual desire), but also emotional (irritability, mood swings) and functional ones (trouble sleeping). Thus, sexual activity withdrawal symptoms shared similarities with those observed for behavioral addictions like gambling and internet gaming disorders. At the same time, the current study provides only initial evidence and its limitations outlined in the Discussion section should not be understated when interpreting study findings. Further research, especially involving clinical samples and clinician-assessed diagnoses, as well as longitudinal designs, should be conducted to investigate the detailed characteristics, the overall importance (a critical vs. only a peripheral role in the symptom picture and disorder development) as well as diagnostic and clinical utility of withdrawal symptoms and tolerance in CSBD and PPU.

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Appendix

Sample characteristics Education: Many participants completed secondary education (39.5%, $n = 609$), 30.0% received basic and vocational education ($n = 463$) and 30.4% higher education ($n = 469$). *Size of the place of residence:* Many respondents indicated villages as their place of residence (39.5%, $n = 609$), followed by towns/cities with less than 100,000 inhabitants (31.9%, $n = 492$), towns/cities with 100,000–499,999 inhabitants (16.5%, $n = 254$), and towns/cities with more than 500,000 inhabitants (12.1%, $n = 186$).

Withdrawal symptoms assessment: Participants were instructed to answer questions as follows: When I have cut down on sexual activity in which I usually engage, or have not engaged in the sexual activity at all for some time: (1) I am restless; (2) I am depressed; (3) I am stressed; (4) I am irritable; (5) I am drowsy; (6) I am aroused; (7) I have frequent mood changes; (8) I feel guilt or embarrassment; (9) I have problems with concentration; (10) I find making decisions more difficult; (11) I have difficulties solving difficult tasks and problems; (12) I experience more frequent thoughts of sexual content, which I find difficult to stop; (13) I feel sexual desire that is difficult to control; (14) I have sleep problems; (15) I have a headache; (16) I have a stomach ache; (17) I feel pain, muscle rigidity or spasms; (18) I feel pain in the other parts of the body (e.g., arms, legs, chest, back); (19) I have nausea; (20) I feel strong heartbeats (21) I experience other symptoms [please indicate].

Tolerance assessment: The items were as follows: (1) I currently need sexual activities to be more stimulating to reach the same level of arousal as in the past. (2) I watch more extreme and diverse types of pornography than in the past because they are more stimulating. (3) I spend more time engaging in sexual activities than in the past. (4) With time, I have noticed that I need to engage in more and more new types of sexual behavior in order to experience the same sexual arousal or to reach an orgasm. (5) In general, sexual activity is often less satisfying to me than it used to be in the past.