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Sex differences in problematic pornography use among adolescents: a network analysis

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Abstract

Background Pornography use is a common practice in adolescents and has been observed to be more prevalent in males. There are different consequences associated with pornography use and problematic use that may present differently among males and females. The interplay between these factors remains underexplored.

Methods Using network analysis (a novel model of growing interest), this study examined the interrelationships between variables linked to PPU (such as victimization, sexual double standards, loneliness, family relationships, and risky sexual behaviors) in a Spanish sample of $N = 650$ adolescents. The analysis focused on identifying central variables and differences between sexes.

Results Males demonstrated higher levels of intentional pornography use and PPU, with sexual pleasure as a central node in their network. PPU in males was associated with more sexist models of sexuality. For females, online victimization and loneliness emerged as key factors, highlighting their vulnerability to digital harm. Both sexes shared a cluster of PPU-related factors, including conflict, mood modification, relapse, and withdrawal, which were more pronounced in males.

Conclusions These findings highlight the potential of network analysis in the study of PPU in adolescents and its possible effects, providing information for an in-depth understanding of the differences between the sexes. Furthermore, they highlight the importance of developing gender-sensitive prevention and intervention strategies to address the unique needs and vulnerabilities of males and females.

Keywords Pornography, Addictive behaviors, Compulsive behaviors, Impulsive behaviors, Sexually explicit materials, Adolescents, Sex, Problematic pornography use, Trauma

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Introduction

Sex differences in adolescent pornography use

Pornography use is a common behavior among adolescents [1, 2], with varying prevalence estimates and ages of onset between sexes. Pornography use is more common among males than females [3]. For example, in Spain there is a significant disparity between sexes regarding weekly pornography use, with 32% of males engaging in this behavior compared to only 6.2% of females [4]. Additionally, in Australia, adolescent females show lower pornography use compared to males (69% vs. 86%) [5]. Other multicultural studies have also found higher pornography use among boys in countries such as China, Belgium, Ecuador, Indonesia, and the Republic of Congo [6]. These differences were also observed in the United States [3]. Furthermore, there are sex differences in the average age of first access to pornography, with males accessing pornography at younger ages [7, 8]. For example, in Spain, Ballester et al. [4] reported average ages of onset for pornography consumption of 14.02 years for males and 16.14 years for females. In other countries, such as the Czech Republic, it was observed that the proportion of adolescents who had accessed for the first time between 11 and 13 years of age was higher among boys than among girls [9].

Sex differences in adolescent problematic pornography use

Problematic pornography use (PPU) involves consumption of sexually explicit material to the extent of disrupting functioning or generating significant distress [10]. For certain adolescents, pornography use can lead to negative consequences related to PPU [11, 12]. Despite numerous studies conducted on the subject, the classification of PPU remains a topic of ongoing debate and scientific scrutiny, highlighting the complexity and evolving understanding of this phenomenon [13–15]. The ICD-11 has included Compulsive Sexual Behavior Disorder (CSBD) under the category of impulse control disorders and has recently recognized Problematic Pornography Use (PPU) as one of its subtypes [16]. Some researchers argue that pornography consumption itself is not inherently problematic, but rather it is the individual's moral interpretation of their consumption that creates issues [17]. Conversely, other studies and experts have suggested that PPU exhibits similarities to behavioral addictions, as indicated by its neurobiological characteristics [14, 18, 19].

Regarding sex differences, PPU may impact males more than females, although females may experience indirect consequences [20, 21]. In a Spanish study assessing online sexual activities, 37.7% of males and 19.3% of females were classified as being at-risk for PPU [22]. Similarly, in another Spanish study focusing on young individuals, 28.7% of males versus 3.6% of females self-reported criteria meeting the threshold for PPU [4]. In other Spanish-speaking countries, such as Mexico, higher levels of PPU were also observed in males compared to females [23]. In Europe, countries such as Italy have also observed a higher prevalence of PPU among males [24].

Sex differences in other factors related to pornography use and PPU

The use of pornography has been linked to various factors [2, 3] that may manifest differently depending on sex, gender, or sexual orientation [9, 21]. Different theoretical models have attempted to explain the possible consequences of pornography consumption [17, 25, 26]. The Differential Susceptibility to Media Effects Model (DSSM) is a widely accepted model for understanding different susceptibilities to media effects [27]. The DSSM is based on three domains (social, dispositional and developmental) that could also explain the different impacts of pornography use on adolescents [3, 27].

According to the DSSM, the possible development of PPU and its consequences is conditioned may be conditioned and affected by these three predictor domains, which may mediate, predispose or moderate effects in dynamic and bidirectional manners [3]. In this sense, the DSMM establishes that sex is one of the sociodemographic dispositional variables with more weight, where male sex is a variable of susceptibility to greater use and greater effects of pornography consumption [2, 3]. Throughout the scientific literature, sex differences have been studied across various dimensions and variables that may be influenced by pornography use and PPU [3, 9, 28, 29].

One of the possible consequences of pornography consumption in adolescents is sexual violence and related trauma (also termed victimization, although the term "victim" may be experienced as stigmatizing by some) [30, 31]. In this regard, within the DSMM framework, victimization may be a social predictor promoting pornography consumption among adolescents [3]. However, other studies interpret victimization as a consequence of pornography consumption [32, 33]. This phenomenon is more commonly observed in females, with alcohol consumption acting as a mediating variable [34]. Overall, both males and females may develop objectifying views of females and endorse myths about rape, although males who use pornography tend to adopt a model of dominance and negative beliefs about females [3, 30, 35–37]. However, longitudinal studies investigating the impact of pornography use on males and females have not reached definitive conclusions, and causal relationships between pornography use and different forms of violence remain debated [30, 38]. One of the few meta-analyses that included an adolescent population, conducted in 2016,

found that both physical and verbal aggression were associated with pornography consumption in seven different countries and across males and females [39]. However, a later meta-analysis criticized this earlier study and found that the longitudinal associations were statistically weak [40]. It is important to note that this later meta-analysis focused on behavioral outcomes related to aggression and did not include violent attitudes and/or other types of violence [40]. In this regard, a recent systematic review emphasized the importance of implementing robust statistical models to better understand the different associations and to specifically categorize the various types of violence rather than treating them in a general way [30]. Additionally, it highlighted the need to use standardized measures to assess violence and variables related to types and patterns of pornography consumption, such as PPU [30].

Other variables of interest studied in relation to pornography consumption and its differences by sex include sexual intercourse and risky sexual behaviors [4, 41, 42]. For example, a Spanish study found that pornography consumption was associated with an increase in sexual risk behaviors in 47.4% of males and 39.6% of females [4]. In the US, inconsistent/irresponsible condom use was linked to pornography use in both males and females [34, 43]. A recent systematic review found that adolescent pornography consumption is associated with sexual risk behaviors, such as early initiation of sexual activity, a greater number of sexual partners, unprotected sex, and engaging in sexual activity under the influence of alcohol or drugs, among others [42]. However, due to the lack of robust studies, they recommended considering possible third variables and using representative samples, as well as valid and reliable instruments to assess pornography use [42]. These conclusions were also raised by the authors of the DSMM, who pointed out the lack of robust studies on the association between pornography use and risky sexual behaviors, as well as the mediating variables of these associations [3].

Finally, loneliness may also be both a consequence and a predisposing factor for pornography use [44, 45]. This is a variable with a broader field of study in adults, serving both as a predictor and as a consequences of consumption in both sexes [46]. However, there is a lack of in-depth studies exploring the gender differences in this area among adolescents.

Although each of these factors has been analyzed in their association with pornography use and PPU, studies that explore the interaction between all of these factors simultaneously and with more robust statistical analyses are needed [3, 30, 42].

Therefore, the present research aimed to explore the relationships between characteristics potentially related to adolescent pornography use and expanding some of the variables proposed by the DSMM, including sexual risk behaviors (sex without condom and sex under the effects of alcohol and other drugs), violent attitudes or behaviors (sexual double standards and sexual victimization), loneliness, and other possible related variables (family relationships, permissiveness, and type of pornography use). This research also aimed to identify key aspects with potential for cluster differentiation associated with PPU and sex differences using recently emerging model with high statistical power, such as network analysis. Network analysis is being studied in relation to other variables associated with problematic pornography use, providing new insights and a better understanding of its possible consequences [47, 48].

Methods

Participants and procedures

The study included Spanish-speaking adolescents who were enrolled in any course of junior high school or high school in Spain. Individuals with mental disorders or cognitive difficulties that could affect their understanding of the assessment battery were excluded. Of 3304 schools contacted online, only three schools agreed to participate. The assessment was conducted using a Google Form because, due to the COVID-19 pandemic (post-lockdown), it was challenging to collect all the information using pencil and paper and to visit the schools. Recruitment began in December of 2020 and concluded in January of 2022. Teachers received training on administering the survey, and whenever possible, a psychology professional (either the school educational psychologist or school counselor) was present. To ensure student privacy and data confidentiality, surveys were completed individually in a quiet classroom, with no identifying information collected. Teachers present oversaw logistics but had no access to responses, and school psychologists, when present, were limited to observing the process. Additionally, various materials were sent to the schools to ensure they were fully informed about the process, including a letter to the families explaining the study, a letter to the school board, and a general information sheet about the study. If further information was needed, a video recorded by one of the researchers explaining the details was provided. In addition, we offered the possibilities of: (1) explaining the results of the study once collected (2), contacting us if any psychological problem were identified and (3) giving a free prevention workshop if any school requested it.

A total of 674 adolescents initially agreed to participate, and after removing incomplete questionnaires, the final consisted of 650 adolescents, evenly distributed between males (50%) and females (50%) with a mean age of 16.0 years (SD = 1.1, age range 12–18).

Instruments

Pornography use and problematic pornography use

Frequency and type of pornography use The frequency of pornography use was measured with a self-designed item with the question: How often do you watch pornography? with 12 response possibilities (*"Never", "Less than once a month", "Once a month", "Twice a month", "Several times a month", "Once a week", "Twice a week", "Several times a week", "Once a day", "Twice a day", "Several times a day", "Five or more times a day").* Three dichotomous items (*yes/no*) were used to explore the exposure of adolescents sexually explicit material on the internet: accidental exposure (*In the last year, when you were doing an online search or surfing the web, did you ever find yourself on a website that showed pictures of naked people or people having sex when you didn't want to be on that type of website?)*, intentional exposure (*"Have you ever accessed a porn website on purpose or downloaded sexual images on purpose?)*, or sexual content received by others (*"In the last year, have you ever opened a message or a link in a message that showed you real pictures of naked people or people having sex that you didn't want to see?).*

Problematic pornography consumption scale (PPCS-18) [49] The PPCS-18 measures PPU with 18 Likert-type items with seven options of responses (*1 = Never; 7 = All the Time*). The scale has 6 sub-factors: salience, emotional modification, conflict, tolerance, relapse, and abstinence. The total score ranges from 18 to 126, with an established cut-off score ≥ 76 indicating high-risk of PPU. Good psychometric properties were observed in the original validation (∝ = 0.93) [49]. In the study sample, internal consistency was α = 0.93 for the total score; α = 0.77 for salience; α = 0.84 for tolerance; α = 0.73 for mood modification; α = 0.82 for relapses; α = 0.80 for withdrawal; and α = 0.77 for conflicts.

Pornography consumption inventory (PCI) [50] The PCI assesses pornography-use motivations. The scale contains four factors (i.e., sexual pleasure, emotional avoidance, arousal seeking and sexual curiosity). The scale includes 13 Likert-type items, with response options going from *1 = Never to 5 = Many times*. The scores range from 15 to 75. There is no established cut-off, with higher scores indicating higher tendencies to use pornography for specific reasons. The Spanish validation was used in the present study. This version demonstrated excellent reliability > 0.90 for all factors and an internal consistency of 0.93 [51]. In the study sample, internal consistency ranged between very good to excellent for the different factor scales (α = 0.88 for emotional avoidance, α = 0.93 for sexual curiosity, α = 0.95 for excitement-pleasure), and α = 0.94 for the total score.

Sexual double standard

An abridged Spanish version of the sexual double standard scale (SDSS) [52] The SDSS is a scale that determines the extent to which people exhibit sexual double standards (SDSs). SDSs involve different criteria and values assessing sexuality of men and women typically giving more sexual freedom to men and rewarding them for engaging in sexual activity [53–55]. The SDSS includes 26 items that range from *Disagree Strongly* (0) to *Agree Strongly* [3] and requires 5 min to complete. Scores range from − 30 (indicating acceptance of greater sexual freedom for women) to 0 (reflecting identical standards for men and women) to 48 (indicating more acceptance of the traditional double standard, suggesting acceptance of greater sexual freedom for men). Some items may be reverse-scored to control for response biases. The authors of the SDSS indicate it has a reliability of 0.73 in women and 0.76 in men [53].

In this study, the Spanish abridged version of the scale was used, with a reliability of 0.84 for the subscale Acceptance for sexual freedom and 0.87 for the subscale Acceptance for sexual shyness [52]. Test-retest reliabilities were good for both subscales, obtaining correlation coefficients over 0.70. In our study sample, internal consistency was α = 0.78.

Online sexual abuse

Brief scale of online sexual abuse (EBASO, for its acronym in Spanish) [56] The EBASO consists of 14 items that correspond to the online sexual victimization factor of the Juvenile Online Victimization Questionnaire (JOV-Q; [57]). This brief version of the questionnaire assesses the frequency of online sexual victimization in the last 12 months. It has four options of responses ranging from *0 (never) to 3 (always).* The total score is a sum of each item's answers. A higher score indicates greater frequency of experiencing sexual abuse online during the prior year. This version of the scale presents a reliability of 0.93 and an adequate internal consistency (α = 0.87) [56]. In our study sample, internal consistency was α = 0.93.

Loneliness

The university of California Los Angeles loneliness scale– version 3 (UCLA-LS version 3) [58] The UCLA-LS version 3 assesses the severity of loneliness with 20 items. Scores range *from 20 to 80*, and higher scores reflect greater loneliness. The response options range from *1 = Never to 4 = Always*. In the present study, the version previously adapted and validated in a Spanish sample

was used with a Cronbach's alpha of 0.91 [59]. In our study sample, internal consistency was α = 0.7 for the total score.

Permissiveness

Permissiveness was assessed with a scale adapted and modified from previous research [60] that assessed instrumental and commitment attitudes towards sexual relations in relation to pornography use. It includes a dichotomous scale (*Yes and No*) with 13 items in relation to these variables. Some examples are *"Sex is mainly physical," "Sex is just a game," or "It is important to accumulate experience with multiple sexual partners*." Higher scores indicate greater levels of permissiveness.

Risky sexual behaviors

Non-use of condoms during sexual intercourse and sexual intercourse under the effects of substances (alcohol and other drugs) were assessed by means of two dichotomous items (yes/no) (e.g., "Have you ever had sexual intercourse without using a condom?"). These items were adapted from constructs studied in previous research [61].

Sociodemographic variables

Sociodemographic variables included age (*12, 13, 14, 15, 16, 17 and 18 years old or more*), sex variable was asked as "indicate your biological sex" (male, female, or other with specification), therefore the terms male and female will be used in this research, specifying that the differences are due to assigned sex not to gender, according to the internacional guidelines. Educational level (*12 to 18 years of education*, adapted to the school system in Spain), and family relationship (*from very bad to excellent*). Each item included the possibility of answer abstention.

Statistical analysis

We applied a network-based analysis (a promising analysis that reveals inter-relationships among elements and analyzes the structures of identified links [62, 63]. The application of network theory in psychopathology research assumes that mental disorders are the clinical expression of the complex and dynamic inter-relationships between symptoms and other features [64, 65]. Therefore, network analysis aims to visualize the structure of these associations and to identify the symptoms and links that contribute to maintain the disorder and/or create "bridges" with other comorbid unhealthy conditions [66]. The network graphs consist of a set of nodes (which are the representation of the symptoms/features, graphically shown as "circles") and edges (which reflect the statistical associations between the nodes, graphically plotted as "lines"). A key component of network analysis is "centrality", which measures the relevance and the linkage capacity of the nodes in the network structure. Identifying the nodes with the highest centrality indexes provides a better understanding of the potential etiologies of psychopathological conditions and provides evidence for targeted prevention and intervention and plans [67].

This study modeled networks with Gephi 9.2 for Windows [68], a software platform specifically developed for the analysis and visualization of networks within datasets with diverse structures (the system is available at http://gephi.org). This software provides a powerful spatializatio n process and the computation of multiple parameters of centrality, density, and modularity-clustering.

Separate networks were obtained for males and females. The nodes analyzed in the study were the PPCS, PCI, SDSS, EBASO and UCLA scores, reasons for pornography use, presence of risky sexual behaviors, permissiveness, and perceived family relationships. The magnitudes and signs of edges were calculated from the partial correlation matrix between nodes to obtain adjusted connectors and avoid the presence of biased relationships due to confounding effects. The initial data structure for the networks resulted in 22 nodes and 231 potential edges, most of which had very low weights (partial correlations around 0). To simplify this initial complex structure, only edges with significant results ($p < 0.10$) were included, resulting in a final structure with 60 edges for the females' network (26.0% of all potential connections) and 93 edges for the males' network (40.3% of all the potential connections).

The prominence and linkage capacity of nodes within a network can be measured through different indexes, with the most frequently used being the centrality and closeness of a node [69]. In this study, node-level relevance within the network was measured with centrality parameters, specifically eigenvector centrality indexes (calculated from the weighted sum of centrality measures of all nodes connected to a node). High centrality indexes evidence that the information contained in a concrete node is highly relevant for the whole graph. The node-level linkage was measured through the closeness indexes (which measure how close the node is to all the other nodes in the graph). High closeness indexes indicate a short average distance between one node and all the other nodes. Therefore, nodes with high closeness values have a high capacity to promote relevant changes in other parts of the network. Conversely, they are also highly vulnerable to modifications by any part of the structure.

Empirical clusters of nodes (called communities or modules in network theory) were automatically identified [70]. The existence of clusters indicates the possibility of grouping variables that are highly interconnected to each other and poorly connected with nodes outside the cluster. The identification of communities in the network

graph suggests the existence of densely connected "subgraphs" that represent groups of nodes based on their similarity in the graph typology.

Other graph distance measures used in the study were the average path length, the diameter, and the density [71]. The average path length is defined as the average number of steps along the shortest paths for all pairs of nodes, and it provides insights into the network overall efficiency for transferring the information. Networks with high average path lengths are less compacted and characterized by distant/disperse nodes, while networks with low average path lengths are compact with close nodes.

The diameter is defined as the greatest distance between the two furthest nodes, and it provides insight into the overall size of the network (this coefficient represents the maximum eccentricity of any vertex in the graph). Diameter is also interpreted as a measure of the robustness of the network and its capacity to connect information over long distances. Low diameters in networks indicate that all nodes are in proximity, and that the whole graph is compact. Networks with high graph diameters are typically characterized by at least two nodes that are very distant (but it is possible that several other nodes are close).

Finally, the density of the graph was also estimated as the number of edges (connections) included in the network divided by the number of total possible edges. This coefficient is in the range 0 to 1, and it provides insight into how close the network is to being complete. A network with 0 edges provides a density equal to 0, while a complete network including all the possible edges achieves a density equal to 1.

Results

Descriptive data for the sample

Table 1 contains the distribution of the study variables and comparisons between sexes. Compared to females, a higher proportion of males were within higher education levels and reported intentional pornography use. Males also achieved higher mean scores in the problematic pornography use (PPCS), frequency of pornography consumption (PCI scales), and SDSS scales; males reported lower scores related to online victimization (EBASO scale) and perceived loneliness (UCLA scale).

Underlying structures obtained in the network analysis

The graphs with the visualization of the networks are shown in Fig. 1 (the complete statistics for the analyses are included in Table S1, S2 and S3 supplementary material).

The network obtained for the females' subsample achieved a diameter equal to 3, the average path length was 1.935 and the density of the graph was 0.260. The first panel of Fig. 2 shows the bar-charts with the nodes ordered by the eigenvector centrality (which provides a measure of the relevance of each variable in the network) and the closeness centrality (a measure of linkage capacity, calculated as the reciprocal of the sum of the length of the shortest paths between the node and all other nodes). For females the node with the greatest influence and the highest linkage was the online victimization level (EBASO score), closely followed by using pornography for sexual pleasure (measured with the PCI) and PPU aspects of tolerance and mood modification (measured with the PPCS).

The network obtained for males achieved a diameter equal to 3, the average path length was 1.623 and the density of the graph was 0.403. The node with the greatest relevance (the most central variable) was the use of pornography for sexual pleasure, followed by PPU-related withdrawal (PPCS scale). The PCI sexual pleasure and online victimization (EBASO score) achieved the highest linkage.

Figure S1 (supplementary material) shows the main linkages for the node frequency of pornography use. Among females, the activation of this node had the greatest major impact on the PPCS scales of salience, tolerance and relapses, the PCI scales of pleasure and avoidance, and the EBASO scale. Among males, the highest impact associated with the activation of this node were on the PPCS scales, the PCI avoidance and pleasure scales, the SDSS sexual restraint scale, the permissibility score, the EBASO scale and the UCLA scale.

The clustering analysis (Fig. 3) for the nodes identified four latent modularities for the females subsample and five latent modularities for the males subsample. A common cluster was found for males and females, grouping four PPCS scales: conflict, mood modification, relapse, and withdrawal.

Discussion

Despite the growing prevalence of adolescent exposure to pornography, significant gaps persist in the scientific literature regarding sex differences in usage patterns and PPU among adolescents, as well as their associations with various variables and potential effects. One notable gap is the lack of studies with robust statistical models to better understand these relationships in adolescents. This research aimed to examine key aspects of adolescent pornography consumption, incorporating and expanding variables from the DSMM framework. Specifically, we focused on PPU, risky sexual behaviors, sexual double standards, loneliness, online sexual victimization, and other factors like family relationships, permissiveness, and types of pornography consumption.

In the study, males reported higher intentional pornography use and had higher mean pornography use and

Table 1 Sample characteristics and between-sex differences

	Total (*n* = 650)		**Females (*n* = 325)**		**Males (*n* = 325)**			
Sociodemographics	*n*	*%*	*n*	*%*	*n*	*%*	*p*	*C-V*
Education								
High school / Level1	7	1.1%	2	0.6%	5	1.5%	**0.003***	**0.166†**
High school / Level 2	14	2.2%	1	0.3%	13	4.0%		
High school / Level 3	20	3.1%	9	2.8%	11	3.4%		
High school / Level 4	190	29.2%	91	28.0%	99	30.5%		
Senior school / Level1	184	28.3%	108	33.2%	76	23.4%		
Senior school / Level2	235	36.2%	114	35.1%	121	37.2%		
Family relationships								
Very bad	5	0.8%	2	0.6%	3	0.9%	0.270	0.099
Bad	4	0.6%	3	0.9%	1	0.3%		
Mild	45	6.9%	28	8.6%	17	5.2%		
Good	152	23.4%	79	24.3%	73	22.5%		
Very good	266	40.9%	134	41.2%	132	40.6%		
Excellent	178	27.4%	79	24.3%	99	30.5%		
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	*p*	η^2
Age (yrs-old)	15.99	1.08	16.07	1.00	15.91	1.16	0.064	0.005
Pornography use (prevalence)	*n*	*%*	*n*	*%*	*n*	*%*	*p*	*C-V*
Accidental	451	69.4%	236	72.6%	215	66.2%	0.074	0.070
Received	285	43.8%	154	47.4%	131	40.3%	0.069	0.071
Intentional	326	50.2%	88	27.1%	238	73.2%	**0.001***	**0.462†**
Problematic pornography use	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*p*	η^2
PPCS: salience	4.46	2.86	3.50	1.66	5.43	3.42	**< 0.001***	0.115
PPCS: tolerance	5.19	3.70	3.66	2.24	6.72	4.20	**< 0.001***	**0.172**
PPCS: mood modification	4.20	2.87	3.36	1.54	5.04	3.56	**< 0.001***	0.086
PPCS: relapse	4.36	3.17	3.49	1.90	5.23	3.87	**< 0.001***	0.075
PPCS: withdrawal	5.36	4.26	3.44	1.59	7.29	5.14	**< 0.001***	**0.204**
PPCS: conflict	4.07	2.84	3.38	1.83	4.77	3.45	**< 0.001***	0.060
PPCS: total	27.65	16.79	20.83	8.93	34.47	19.79	**< 0.001***	**0.165**
Pornography consumption	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*p*	η^2
PCI: emotional avoidance	7.12	3.82	5.64	2.30	8.61	4.42	**< 0.001***	**0.151**
PCI: sexual curiosity	6.41	3.70	5.44	3.06	7.38	4.02	**< 0.001***	0.068
PCI: excitement	9.16	5.80	6.09	4.12	12.22	5.62	**< 0.001***	**0.280**
PCI: total score	22.69	11.28	17.18	7.96	28.21	11.42	**< 0.001***	**0.239**
Pornography frequency	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*p*	η^2
Pornography use (hours/month)	2.47	9.43	0.53	5.10	4.42	12.02	**< 0.001***	0.043
Online victimization	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*p*	η^2
EBASO: total score	3.16	5.67	4.46	6.33	1.86	4.58	**< 0.001***	0.053
Permissiveness	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*p*	η^2
Total score	2.85	2.45	2.75	2.37	2.94	2.53	0.329	0.001
Doble standard scale	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*p*	η^2
SDSS-F1: sexual freedom	6.83	3.78	6.23	3.32	7.43	4.10	**< 0.001***	0.025
SDSS-F2: sexual restraint	7.15	3.74 h	6.62	3.32	7.69	4.04	**< 0.001***	0.021
SDSS: global index	-2.05	4.92	-2.70	4.83	-1.40	4.93	**0.001***	0.018
Loneliness	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*p*	η^2
UCLA: loneliness total	38.39	10.10	39.70	10.74	37.08	9.25	**0.001***	0.017
Risk sexual relationships (prev.)	*n*	*%*	*n*	*%*	*n*	*%*	*p*	*C-V*
Sex without condom	133	20.5%	65	20.0%	68	20.9%	0.771	0.011
Sex with alcohol-drugs	119	18.3%	63	19.4%	56	17.2%	0.478	0.028

Note. SD: standard deviation. *Bold: significant comparison

†Bold: effect size within the ranges moderate-mild to large-high.z

Chi-square tests used for the comparison between the groups for categorical variables and analysis of variance for quantitative variables

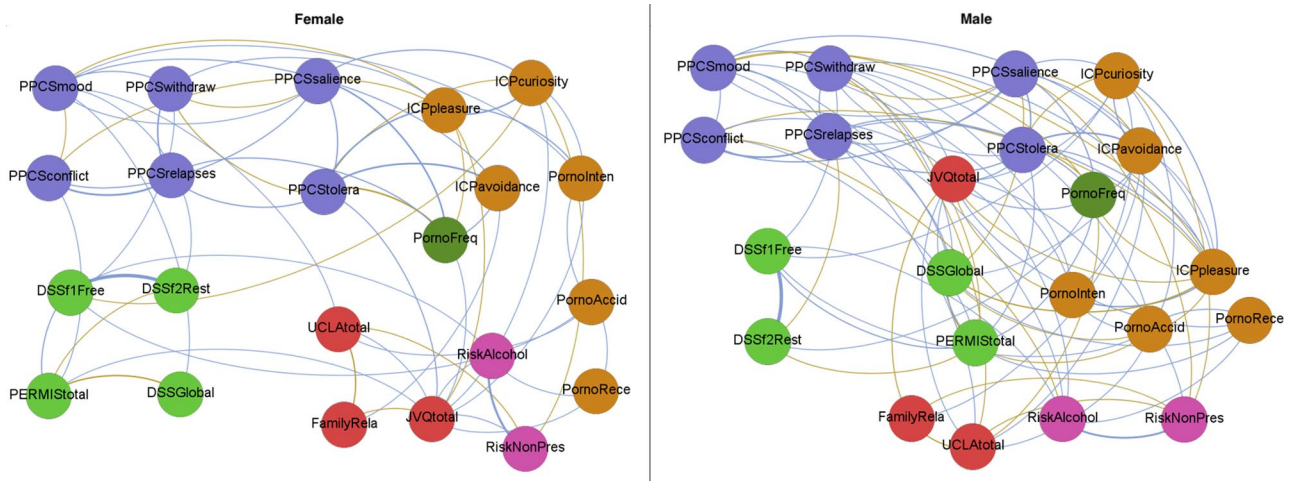

Fig. 1 Visualization of the networks. *Note.* Positive edges are represented by blue color lines, and negative edges are plotted in brown-ochre color lines. As thicker the edge as stronger the connection weight. Nodes are plotted in colors depending on the dimension: problematic porno use (blue), reason for porno use (brown), perceptions about sex (light green), frequency of porno user (green), contextual variables (red), risk sexual behaviors (magenta). **PPCSmood**: Mood modification of PPCS-18; **PPCSconflict**: Conflcit of PPCS-18; **PPCSwithdraw**: withdrawal of PPCS-18; **PPCStolera**: tolerance of PPCS-18; **PPCSsalience**: salience of PPCS-18; **PPCSrelapses**: relapse of PPCS-18; **PClavoidance**: avoidance dimension of PCI; **PClcuriosity**: curiosity dimension of PCI; **PClpleasure**: pleasure dimension of PCI; **PornoFreq**: Frequency of pornography use; **PornoInten**: intentional pornography use; **PornoAccid**: accidental pornography use; **EBASO**: total of score of sexual online victimization; **RiskAlcohol**: sexual relationship under the effects of substances (alcohol and other drugs); **RiskNonPres**: sexual relationships without condom.; **FamilyRela**: family relationship quality; **UCLAtotal**: total score of loneliness; **DSSGlobal**: total score of double sexual standard; **DSSf1Free**: sexual freedom index; **DSSf2Rest**: sexual restriction index; **PERMIStotal**: total score of permissiveness

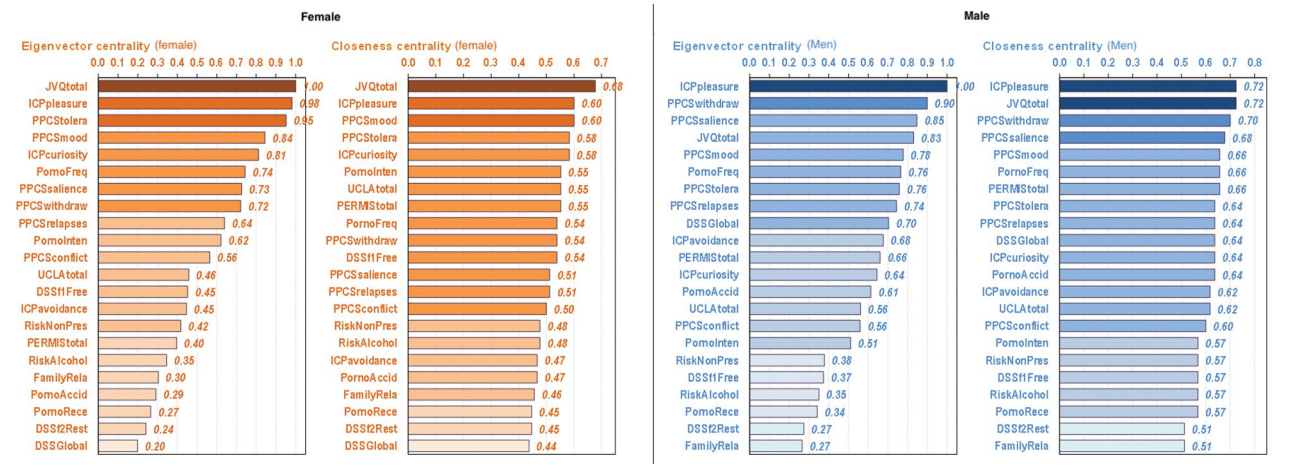

Fig. 2 Relevance of centrality and linkage of the nodes **PPCSmood**: Mood modification of PPCS-18; **PPCSconflict**: Conflcit of PPCS-18; **PPCSwithdraw**: withdrawal of PPCS-18; **PPCStolera**: tolerance of PPCS-18; **PPCSsalience**: salience of PPCS-18; **PPCSrelapses**: relapse of PPCS-18; **PClavoidance**: avoidance dimension of PCI; **PClcuriosity**: curiosity dimension of PCI; **PClpleasure**: pleasure dimension of PCI; **PornoFreq**: Frequency of pornography use; **PornoInten**: intentional pornography use; **PornoAccid**: accidental pornography use; **EBASO**: total of score of sexual online victimization; **RiskAlcohol**: sexual relationship under the effects of substances (alcohol and other drugs); **RiskNonPres**: sexual relationships without condom.; **FamilyRela**: family relationship quality; **UCLAtotal**: total score of loneliness; **DSSGlobal**: total score of double sexual standard; **DSSf1Free**: sexual freedom index; **DSSf2Rest**: sexual restriction index; **PERMIStotal**: total score of permissiveness

PPU. These findings align with previous research that has also observed higher rates of pornography use and PPU among males versus females [2, 4, 7, 72]. According to the DSMM, male sex functions as a dispositional predictor of higher pornography consumption, a finding that has been corroborated in our study with a sample of Spanish adolescents [3].

In our sample, males showed slightly higher levels of SDDs, suggesting a potential tendency towards a more conservative view of sexuality concerning girls. This observed SDS may be influenced by PPU in males, as evidenced by the positive associations between the total score of the SDS scale and four of the PPCS sub-scales (mood modification, relapse, withdrawal, and conflict) in

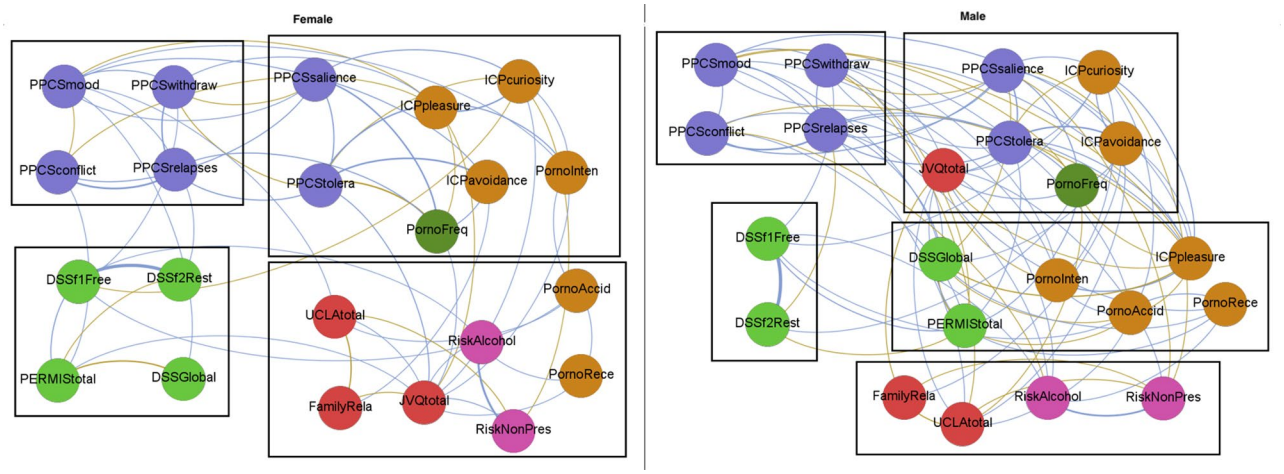

Fig. 3 Network grouping the nodes within module-class-clusters *Note*. Positive edges are represented by blue color lines, and negative edges are plotted in brown-ochre color lines. As thicker the edge as stronger the connection weight. Nodes are plotted in colors depending on the dimension: problematic porno use (blue), reason for porno use (brown), perceptions about sex (light green), frequency of porno user (green), contextual variables (red), risk sexual behaviors (magenta). **PPCSmood**: Mood modification of PPCS-18; **PPCSconflict**: Conflcit of PPCS-18; **PPCSwithdraw**: withdrawal of PPCS-18; **PPCStolera**: tolerance of PPCS-18; **PPCSsalience**: salience of PPCS-18; **PPCSrelapses**: relapse of PPCS-18; **PClavoidance**: avoidance dimension of PCI; **PClcuriosity**: curiosity dimension of PCI; **PClpleasure**: pleasure dimension of PCI; **PornoFreq**: Frequency of pornography use; **PornoInten**: intentional pornography use; **PornoAccid**: accidental pornography use; **EBASO**: total of score of sexual online victimization; **RiskAlcohol**: sexual relationship under the effects of substances (alcohol and other drugs); **RiskNonPres**: sexual relationships without condom.; **FamilyRela**: family relationship quality; **UCLAtotal**: total score of loneliness; **DSSGlobal**: total score of double sexual standard; **DSSf1Free**: sexual freedom index; **DSSf2Rest**: sexual restriction index; **PERMIStotal**: total score of permissiveness

the network analysis. These results provide new findings addressing a prior literature gap involving understanding relationships between PPU and female objectification in adolescents [30].

Females in our sample exhibited higher levels of online victimization and reported experiencing greater feelings of loneliness. Notably, these two variables showed a positive relationship in the network analysis, indicating a potential link between online victimization and loneliness among females. This finding reinforces the existing evidence from other studies that suggest females are at a higher risk of online victimization compared to males [73]. Moreover, it suggests how victimization may lead to more detrimental consequences [73]. In addition, network analysis indicated a link between levels of victimization and frequency of pornography use, which is consistent with previous findings and the DSMM [3, 30]. In this sense, in the case of females, the variables of loneliness and victimization could serve as predictors of increased use and PPU, but at the same time, in bidirectional and dynamic manners, as proposed by the DSMM, moderating some potentially harmful effects [3].

Regarding females, the network analysis also revealed that online victimization had the greatest influence and highest linkage, closely followed by using pornography for sexual pleasure and PPU aspects of tolerance and mood modification. These findings highlight the significance of online victimization in females and its potential association with PPU. It is possible that females who experience sexual victimization may turn to pornography to seek sexual pleasure, which, in turn, could lead to PPU due to increased tolerance levels and using pornography as a mood regulator. Furthermore, these results underscore the higher risk that females may face when navigating the internet, consistent with findings from other studies, which identified being a female as a potential vulnerability factor for experiencing various types of online violence [30, 36, 74].

However, in males it seems that the node with the greatest relevance (the most central variable) was the use of pornography for sexual pleasure, which could relate to a gender-stereotyped model, where males feel greater freedom for sexual pleasure than girls, as has been seen in other studies where males' online sexual practices are more recreational and females are more likely to experience abuse [22].

The common cluster observed in both males and females comprises the PPCS scales evaluating conflict, mood modification, relapse, and withdrawal. These results suggest that these variables play a central role in understanding PPU among adolescents, while the PPCS scales tolerance and salience form a separate cluster. Tolerance and salience, while potentially leading to certain consequences, may also indicate adolescents' curiosity and progressive exploration of their sexuality, which is a typical aspect of adolescence [11, 75]. These findings suggest the importance of establishing specific criteria for

PPU in adolescents, distinct from those for adults, as they are in a different stage of general and sexual maturity.

Clinical implications

The current findings have clinical implications. First, it may be particularly important to consider males when addressing PPU clinically, and for psychoeducation on pornography use and gender stereotypes when they present a more negative view of female sexuality. Second, it will be important to consider potential risks that females have of experiencing sexual trauma online and therefore assess and address these concerns and related emotional harms and loneliness. In general, it will be important to consider how the results may help develop gender-informed prevention strategies for risk behaviors such as PPU and online sexual trauma and victimization. Third, parents should focus on providing sex education and information at home to help adolescents develop critical thinking about pornography and understand its potential effects on gender stereotypes. Finally, policymakers should prioritize the development and implementation of comprehensive educational programs that address pornography consumption, promote critical media literacy, and raise awareness about pornography's potential impact on gender stereotypes. Such programs should be incorporated into school curricula and community initiatives to ensure consistent access to accurate and age-appropriate information for adolescents and their families.

Strengths, limitations, and future studies

The present study has several limitations that should be considered when interpreting the findings.

Limitations may be consider from methodological, contextual, and interpretative perspectives.

From a methodological perspective, the study sample of Spanish adolescents may not generalize to the overall adolescent population of the country or other jurisdictions, especially given cultural differences. This limitation is further exacerbated by the large number of schools that did not respond, possibly due to pandemic-related saturation, resulting in a sample that is not representative of the diverse cultural or socioeconomic profiles of Spanish adolescents. Additionally, the cross-sectional nature of the study prevents causal inferences, limiting the understanding of temporal relationships between the variables analyzed. Another methodological limitation relates to the measurement tools, as some of the scales and items, such as the permissiveness scale, were self-designed and have not been systematically validated in the Spanish language or adolescent populations. This could lead to reduced reliability, increased measurement error, and smaller effect sizes. Furthermore, the use of self-reported questionnaires is inherently subject to biases, such as desirability and recall biases, particularly among adolescents. The lack of a clear definition of what was considered "pornography" in the study may have also led to subjective interpretations by participants, potentially influencing the results.

Contextually, the limited number of schools that agreed to participate, along with the differences between mixed-sex and single-sex schools (due to possible differences in peer socialization and the way information about sexuality is received in schools) poses challenges for the generalizability of the findings. Moreover, although school staff received thorough instructions regarding administration of the survey, the absence of direct researcher control over the data collection process may have influenced the consistency of responses, further limiting the reliability of the dataset. From an interpretative standpoint, the absence of a precise definition of "pornography" may have influenced participants' understanding of the term and, consequently, the study results. Additionally, while the findings provide novel insights, they are specific to a Spanish adolescent population, necessitating caution when applying these results to other contexts or populations.

To address these limitations, future research should aim to include larger and more representative samples and adopt longitudinal designs to explore the evolution of these variables over time. Furthermore, the use of standardized and validated instruments is recommended to ensure greater reliability and comparability of results. If deemed appropriate, it would also be advisable to develop self-help materials for PPU to distribute to adolescents after the evaluation. This should be done under the supervision of a psychology professional, adapting the content to their age and context. These steps would not only strengthen the generalizability of future studies but also contribute to advancing the understanding of adolescent pornography use and its associated factors.

Conclusion

The study highlights notable sex differences in the use and problematic consumption of pornography among adolescents, offering new insights into this complex phenomena. Males were found to consume pornography more frequently and in a more problematic manner, potentially reinforcing gender stereotypes about female sexuality. In contrast, while females reported lower levels of pornography use, they experienced significant associated concerns, such as increased likelihood of experiencing online sexual abuse or victimization and heightened feelings of loneliness. The application of network analysis in this study represents a major methodological advancement, offering a robust and innovative approach to examining the intricate interrelations between variables associated with pornography use and PPU in

adolescents. This method has allowed for the identification of key variables and their centrality within the network, providing a clearer understanding of the dynamic interactions involving sex differences and their underlying factors. The findings underscore the importance of using advanced statistical models like network analysis to explore complex phenomena, as they enable the identification of patterns and interconnections that might otherwise remain obscured in traditional analyses. This study thus contributes to a deeper and more nuanced understanding of adolescent pornography use and PPU, having implications for clinical and preventive interventions.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s40359-025-02624-0.

Supplementary Material 1

Supplementary Material 2

Supplementary Material 3

Supplementary Material 4

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Not applicable.

Author contributions
AVM: Conceptualization, Methodology, Investigation, Writing - Original Draft, Review & Editing; MNP: Supervision, Validation, Writing - Review & Editing; RG: Data Analysis, Visualization, Writing - Review & Editing; UP: Investigation, Data Collection, Writing - Review & Editing; GA: Data Analysis, Interpretation of Results, Writing - Review & Editing; CCA: Conceptualization, Supervision, Writing - Review & Editing; FFA: Supervision and Writing; SJM: Supervision, Conceptualization, Writing - Review & Editing; EN: Critical Manuscript Review, Writing - Review & Editing; LB: Critical Manuscript Review, Interpretation of Results, Writing - Review & Editing; GMB: Project Administration, Conceptualization, Writing - Review & Editing, Overall Supervision.

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Data availability
For further information on the data used for the study, please contact the corresponding author at the e-mail address indicated at the head of the article.

Declarations

Ethics approval and consent to participate
The study, approved by the Clinical Research Ethics Committee of the International University of La Rioja (reference PI: 018/2020), was conducted in accordance with the latest version of the Declaration of Helsinki. Students were informed that participation was voluntary, responses were anonymous, and non-participation carried no consequences. All participants completed the informed consent form. For underage students, parental or legal guardian authorization was also required. School management boards provided permission for their institutions to participate, and all participants were informed about the study.

Consent for publication
Not applicable.

Competing interests
F.F.-A. and S.J.-M. received consultancy and speakers honoraria from Novo Nordisk. M.N.P discloses that he has consulted for and advised Game Day Data, Addiction Policy Forum, AXA, Idorsia, Baria-Tek, and Opiant Therapeutics; been involved in a patent application with Yale University and Novartis; received research support from the Mohegan Sun Casino, Children and Screens and the Connecticut Council on Problem Gambling; consulted for or advised legal and gambling entities on issues related to impulse control, internet use and addictive behaviors; provided clinical care related to impulse-control and addictive behaviors; performed grant reviews; edited journals/journal sections; given academic lectures in grand rounds, CME events, and other clinical/scientific venues; and generated books or chapters for publishers of mental health texts. The other authors report no disclosures.

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