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An Exploratory Network Analysis of Sexual and Relationship Satisfaction Comparing Partnered Cisgendered Men and Women

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An exploratory network analysis of sexual and relationship satisfaction comparing partnered cisgendered men and women

Background: Sexual and relationship satisfaction are intimately connected and share many predictors.

Aim: The aim of the present study is to disentangle the relationship between sexual and relationship satisfaction, by exploring the connections to other relevant correlates.

Methods: Regularized mixed graphical model networks were estimated separately for men and women, which were compared using the network comparison test. In addition, strength centrality and community structure was explored.

Main outcome: The associations between variables measuring sexual and relationship satisfaction and related constructs did not differ significantly between partnered, cisgendered men and women.

Results: Sexual and relationship satisfaction were associated with sexual pleasure, sexual distress, and sexual communication for both men and women. Sexual satisfaction was the most central variable in the network for men (strength = 1.1), while sexual desire was the most central variable for women (strength = 1.1). Frequency of sexual activity was a central variable for both men and women (strength men = 1.0, strength women = 1.1). The community analysis showed similar communities of variables for men and women, except that frequency of sexual activity belonged to the same community as sexual and relationship satisfaction for men, but not for women.

Clinical translation: The results have clinical implication in sex and couples therapy, as they increase the knowledge on sexual and relationship satisfaction.

Strengths & limitation: A strength of the study is the population-based dataset, and a limitation is that inferences of causality cannot be made due to the cross-sectional study design.

Conclusion: The present study suggests that men and women are largely similar when comparing constructs related to sexual and relationship satisfaction.

Keywords: sexual satisfaction; relationship satisfaction; network analysis; sex difference

Introduction

Sexual satisfaction is closely linked to relationship satisfaction, and people who are satisfied with their sex lives tend to be more satisfied with their romantic relationships as well, and vice versa^{1,2}. The connection between sexual and relationship satisfaction is well established in the literature, and they share many predictors, such as sexual desire³, frequency of sexual activities⁴, sexual communication⁴, relationship duration⁵, and parenthood⁶. Additionally, concepts such as jealousy⁷ and mate value discrepancy⁸ (i.e., differences in estimated attractiveness as partners) are associated to relationship satisfaction. Intrasexual competition (i.e., the tendency to compete for the attention of members of the opposite gender with members of the same gender) is linked to body image issues⁹, which in turn been shown to influence sexual satisfaction^{10,11}.

The present study aimed to explore connections between constructs associated to sexual and relationship satisfaction using network analysis, comparing men and women. Sexual and relationship satisfaction have many known correlates; however, most studies have only included a few correlates at a time. Network analysis allows for exploring and comparing many correlates at once, while using regularization techniques to limit the risk of type I errors. Visualizing the correlates as networks allows for creating clear and approachable figures of the results.

Meta-analyses reveal that while men and women are mostly similar in terms of sexual and relationship satisfaction and their correlates, some small differences likely exist between men and women^{12,13}. The present study is, to our knowledge, the first to apply a cross-sectional network analysis to this topic using population-based data. The study was mainly exploratory, and the following questions were formulated beforehand and elucidated in the study:

- (1) Are there sex differences in the structure of the networks? Based on existing literature, we expected that the general structure and global strength of the networks would be similar, but that the roles of certain variables (e.g., sociosexual orientation) might differ between networks estimated for men and women.
- (2) How are variables measuring sexual and relationship satisfaction connected to other variables in the networks?
- (3) Which variables are the most central in the networks?
- (4) Are there communities in the networks, and do these differ between men and women?

Materials and Method

Data from a Finnish population-based sample was used to conduct the analyses. The data is part of a three-wave data collection known internationally as the Genetics of Sex and Aggression sample (GSA; see Tybur et al.¹⁴). The study was carried out in accordance with the Helsinki Declaration and all participants gave their informed written consent prior to the study. A total of 3,214 men and 6,105 women answered the questionnaire, yielding a response rate of 29%. Participants who were single, non-binary or had missing data were excluded. Additionally, only one participant per family was included to control for familial dependency and the groups were made equal in size by using a computer program¹⁵ to extract random samples, to allow for statistical comparison of the results of the network comparison test. The final sample consisted of 1,434 men and 1,434 women.

The participants were divided into groups (men and women) based on their sex in the central population registry. The following sexuality-related variables were included in the networks: sexual satisfaction, sexual pleasure, sexual desire, sexual inhibition, sexual excitation, sexual distress, frequency of sexual behavior, and experience of having less sex than one would like. The following relationship-related variables were included: relationship satisfaction, sexual communication, relationship duration and whether the participants had children or not. Lastly, the following variables were added: intrasexual competition, sociosexual orientation, jealousy, tendency to engage in extrapair sexual activity, own mate value, partner's mate value, body dissatisfaction and genital dissatisfaction. More information about the measures can be found in the supplementary material.

IBM SPSS statistics 26.0 was used for data preparation and the analyses were conducted in the free programming language R version 4.1.1¹⁵. Separate networks for men and women were estimated using the mixed graphical model package in R (*mgm*)¹⁶. The networks consist of nodes (i.e., variables) and edges (i.e., connections between variables). An edge between two nodes indicates a partial correlation between the variables and the edge weight is represented by the magnitude of the partial correlation, and a stronger, more saturated edge therefore represents a higher partial correlation. The EBIC¹⁷ model selection was used and the hyperparameter gamma was set to 0.5 according to recommendations in the literature (the higher the hyperparameter is the fewer edges you get¹⁸). The networks were then visualized using the *qgraph*-package¹⁹ and the Fruchterman-Reingold algorithm was used to create the layout of the networks. The explained variance was visualized as a pie chart around the nodes¹⁶.

The networks were statistically compared using the Network Comparison Test (NCT)^{20,21}. The NCT tests three hypotheses: 1) if there are differences in the global

strength (i.e., absolute sum of all edge weights) of the networks, 2) if there are structural differences between the networks, and 3) if individual edges differ between the networks. The NCT can also detect differences in the strength centrality of the nodes between the networks.

Strength centrality (the sum of the absolute edge weights) was calculated for the nodes. Network stability and accuracy were assessed using the *bootnet*-package²² (see supplementary material). A community detection analysis was made as an additional way of exploring the structure of the networks. Connectivity between nodes was explored using the *ComDet*-function²³, which is an extension to the *igraph*-package²⁴ that allows for running many iterations.

Results

Descriptive statistics for men and women can be found in Table 1.

Table 1

Descriptive Statistics and Difference between Variable Sum Scores for Men and Women

	Men	Women		
	<i>M (SD)</i>	<i>M (SD)</i>	<i>p-value</i>	<i>Cohen's d</i>
Age (years)	32 (7.7)	32 (7.9)	.036	0.08
Relationship duration	7.3 (6.7)	7.4 (7.0)	.593	0.02
Intrasexual competition	29 (9.7)	27 (11)	< .001	0.21
Having children or not	0.4 (0.5)	0.5 (0.5)	.090	0.06
Sexual distress	13 (5.1)	15 (5.9)	< .001	0.35
Sexual activity	15 (3.9)	14 (3.9)	.099	0.06
Too little sex	3.8 (3.3)	2.5 (2.9)	< .001	0.39
Sexual desire	31 (7.5)	26 (8.5)	< .001	0.64
Sexual excitation	15 (2.9)	14 (3.1)	< .001	0.59

Sexual inhibition performance	8.0 (2.2)	10 (2.3)	< .001	0.88
Sexual inhibition consequence	10 (2.4)	12 (2.6)	< .001	0.67
Relationship satisfaction	35 (5.7)	36 (5.7)	.081	0.07
Sexual pleasure	18 (3.7)	17 (4.2)	< .001	0.21
Sexual communication	16 (4.6)	16 (4.9)	.410	0.03
Sexual satisfaction	12 (2.1)	11 (2.9)	< .001	0.44
Extrapair activity	33 (15)	33 (17)	.865	0.01
Jealousy	54 (10)	60 (10)	< .001	0.57
Body dissatisfaction	23 (5.9)	27 (7.1)	< .001	0.54
Genital dissatisfaction	4.5 (2.2)	5.2 (2.0)	< .001	0.32
Mate value own	13 (2.7)	12 (3.1)	.029	0.08
Mate value partner	14 (2.8)	14 (2.7)	.184	0.05
Sociosexual orientation	40 (12)	33 (12)	< .001	0.61

Note. M = mean, SD = standard deviation, *Cohen's d* = effect size of difference. * = $p < .05$, ** = $p < .01$, *** = $p < .001$. See range for sum scores in supplementary material.

Research question 1: Network comparison

The networks of men and women can be found in Figure 1. The network models did not differ significantly between men and women regarding the structure of the networks (maximum edge difference = 0.12, $p = .539$), and neither regarding the global strength (difference in global strength = 0.08, $p = .840$). Women had slightly higher global strength than men (8.16 vs. 8.08). Both networks had 52 edges each and many of the same edges could be found in both networks. The mean predicted variance was higher for women ($M = 0.38$, $SD = 0.17$) than for men ($M = 0.36$, $SD = 0.17$). See supplementary material for the stability plots of the bootstrapped edge weights. The mean of the bootstrapped edge weights followed the estimated edge weights closely, which therefore appeared accurate. Five edges remained significantly different between men and women after controlling for multiple tests (see supplementary material).

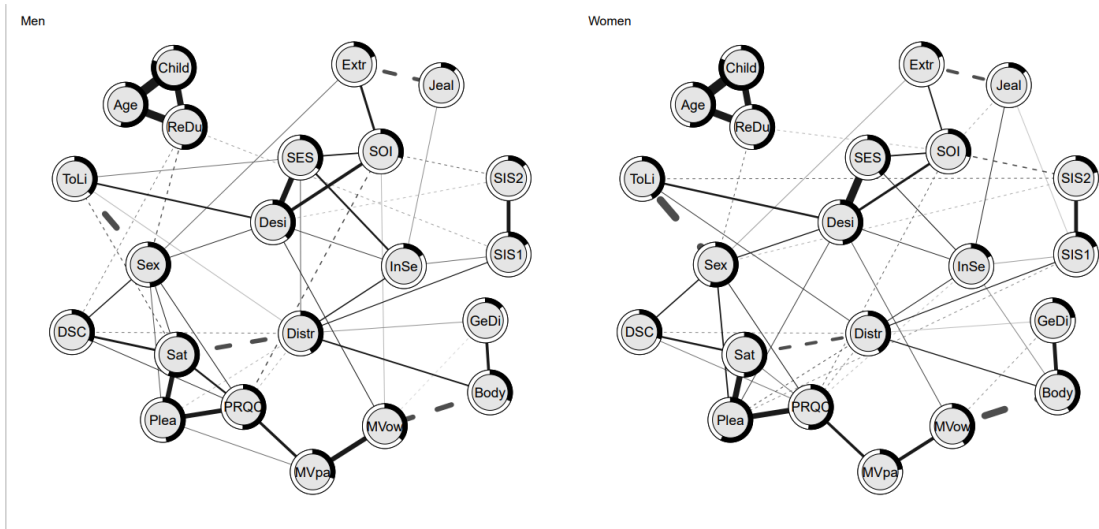


Figure 1. Mixed graphical model networks for men and women. The grey circles represent variables and the pie chart surrounding the circles represent predictability. A fully filled pie chart (black) would indicate perfect predictability and an empty pie chart (white) would indicate that relevant predictors are missing from the model. Solid lines represent positive partial correlations, and dashed lines represent negative partial correlations. Child is a dichotomous variable and the solid edges can be interpreted as, for example, having children is associated with being older. ReDu = relationship duration, child = having children or not, Sat = sexual satisfaction, SDI = sexual desire, SDS = sexual distress, SPS = sexual pleasure, Sex = frequency of sexual activity, ToLi = too little sexual activity, SES = sexual excitation, SIS1 = sexual inhibition, performance, SIS2 = sexual inhibition, consequence, PRQC = relationship quality, DSC = sexual communication, SOI = sociosexual orientation, Extr = extrapair activity, ASJS = jealousy, ICS = intrasexual competition, GeDi = genital dissatisfaction, Body = body dissatisfaction, MVS = own estimated mate value, MVpa = estimated mate value of partner. The network layout is an average of the Fruchterman-Rheingold layout for both networks, and the maximum saturation of the edges in both networks was set to 0.57, which is the highest edge weight in either network.

Research question 2: Sexual and relationship satisfaction

Sexual satisfaction had positive connections to sexual pleasure (edge weight men = .30, women = .36), sexual communication (edge weight men = .17, women = .16), and

relationship satisfaction (edge weight men = .16, women = .07) and a negative connection to sexual distress for both men and women (edge weight men = -.29, women = -.23). The men had two additional edges: a positive edge between sexual satisfaction and frequency of sexual activity (edge weight = .10), and a negative edge between sexual satisfaction and too little sexual activity (edge weight = -.10).

Relationship satisfaction had positive associations with sexual pleasure (edge weight men = .29, women = .34), sexual satisfaction, self-perceived mate value of partner (edge weight men = .20, women = .20), sexual communication (edge weight men = .09, women = .06), and frequency of sexual activity for both women and men (edge weight men = .10, women = .10). Negative associations to sociosexual orientation (edge weight men = -.12, women = -.09) and sexual distress (edge weight men = -.04, women = -.23) were also found in both networks. Women had an additional negative edge between relationship satisfaction and intrasexual competition (edge weight = -.04). No edges connected to neither sexual nor relationship satisfaction differed significantly between men and women according to the NCT after controlling for multiple tests.

Research question 3: Central variables

The centrality estimates can be seen in Figure 2. The centrality in men's and women's networks generally followed the same pattern, but with some slight differences. Sexual satisfaction (strength 1.12) followed by relationship duration (strength 1.07) and frequency of sexual activity (strength 1.03) had the highest strength centrality for men. Sexual desire (strength 1.17) had the highest strength centrality for women, followed by frequency of sexual activity (strength 1.10) and sexual pleasure (strength 1.07). Significant differences between men and women could be found only in sexual satisfaction, which was significantly more central in the men's network (women = 0.81, men = 1.12, $p < .001$). The strength centrality of body dissatisfaction (women = 0.34,

men = 0.27, $p = .081$) and sexual pleasure (women = 1.08, men = 0.77, $p = .081$) was higher in the women's network, but the difference was not significant. The strength centrality measure appeared stable and reliable for both men and women (CS-coefficient = .75)

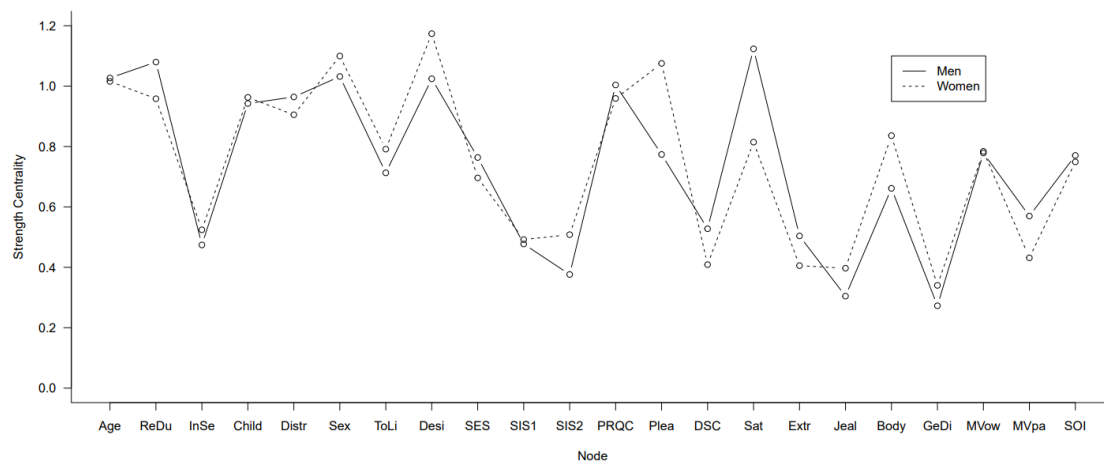


Figure 2. Strength centrality (i.e., the sum of the absolute edge weight for the variables) for men and women. ReDu = relationship duration, child = having children or not, Sat = sexual satisfaction, SDI = sexual desire, SDS = sexual distress, SPS = sexual pleasure, Sex = frequency of sexual activity, ToLi = too little sexual activity, SES = sexual excitation, SIS1 = sexual inhibition, performance, SIS2 = sexual inhibition, consequence, PRQC = relationship quality, DSC = sexual communication, SOI = sociosexual orientation, Extr = extrapair activity, ASJS = jealousy, ICS = intrasexual competition, GeDi = genital dissatisfaction, Body = body dissatisfaction, MVS = own estimated mate value, MVpa = estimated mate value of partner

Research question 4: Community analysis

Six communities were formed for men and seven for women (see Figure 3). The six-community solution emerged in 89% of the iterations for men and the seven-community solution emerged in 40% of the iterations for women (see supplementary material for second most frequent community solutions). Most of the communities were similar in

both groups. Too little sex and sexual frequency belonged to the satisfaction community for men, while they formed a separate community for women.

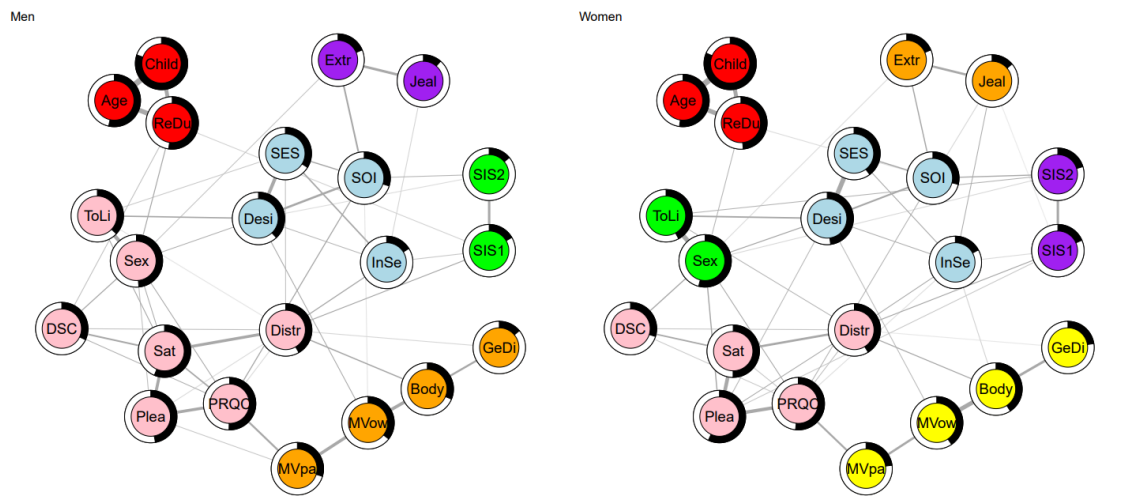


Figure 3. Most frequent community structure solution for men and women using the spinglass algorithm. The colored circles represent variables, and different colors represent different communities. The pie chart surrounding the circles represent predictability. A fully filled pie chart (black) would indicate perfect predictability and an empty pie chart (white) would indicate that relevant predictors are missing from the model. Blue lines represent positive partial correlations, and red lines represent negative partial correlations. Child is a dichotomous variable and the blue edges can be interpreted as, for example, having children is associated with being older. ReDu = relationship duration, child = having children or not, Sat = sexual satisfaction, SDI = sexual desire, SDS = sexual distress, SPS = sexual pleasure, Sex = frequency of sexual activity, ToLi = too little sexual activity, SES = sexual excitation, SIS1 = sexual inhibition, performance, SIS2 = sexual inhibition, consequence, PRQC = relationship quality, DSC = sexual communication, SOI = sociosexual orientation, Extr = extrapair activity, ASJS = jealousy, ICS = intrasexual competition, GeDi = genital dissatisfaction, Body = body dissatisfaction, MVS = own estimated mate value, MVpa = estimated mate value of partner

Discussion

The networks were quite similar with 52 edges in each, and no significant differences were found neither regarding global strength nor structure. This supports our hypothesis and is in agreement with the gender similarity hypothesis, which states that men and women are largely similar for most psychological traits. The results are also in line with a meta-analysis of sex differences in sexuality by Petersen and Hyde¹², in which they concluded that with regards to sexuality, there is greater variance within sex than between sexes. This is also supported by an earlier meta-analysis on sex differences in sexuality-related concepts¹³.

Both sexual and relationship satisfaction had similar connections to sexual distress, sexual communication, and sexual pleasure in both networks, indicating that sexual and relationship satisfaction are in fact closely related concepts with shared correlates. Sexual pleasure was almost as strongly connected to relationship satisfaction as it was to sexual satisfaction, further confirming the importance of pleasurable partnered sex in relationships. The link between sexual and relationship satisfaction (0.16 for men and 0.07 for women) was weaker in the present study than one might expect based on previous findings¹. This was especially true for women. The relatively low partial correlation between sexual and relationship satisfaction implies that the (usually strong) association between the two variables is explained to a quite high degree by the other variables in the networks. This in turn confirms that future research should continue exploring this connection in a way that accounts for more variables and a more complex web of associations.

One of the notable similarities between men and women were that longer relationships were negatively associated with frequency of sexual activity, confirming results from numerous previous studies^{25,26}. Longer relationships were, however, not related to sexual desire for neither women nor men, contradicting previous research,

which has shown a decline in desire for women as the relationship progresses^{25,27}.

Relationship duration was not connected to sexual or relationship satisfaction, contradicting previous studies^{5,28}. The reason that some expected associations were lacking might be that they were explained by some other included variable, as all other variables were controlled for in the networks.

Another similarity that could be found was that sexual distress was positively associated with body dissatisfaction for both men and women, highlighting the need to address body image in sex therapy. A previous meta-analysis has found that body image can affect all domains of female sexual functioning²⁹, and the present study suggests that a similar association can be found in men. Sexual desire was positively associated to own mate value and intrasexual competition after controlling for all other variables in the network, for both men and women. The link between intrasexual competition and sexual desire confirms results from a previous study that has linked intrasexual competition with higher sex drive in men³⁰, and expands upon it to show a similar connection for women. The link between sexual desire and own mate value could possibly be explained by a mediator or a common cause such as self-esteem and self-confidence. Being comfortable with oneself could hypothetically expand to not only affect one's self-evaluated mate value but also to how open and responsive one is to sexual stimuli and how comfortable one is in reacting to stimuli which may awaken sexual desire.

Sexual satisfaction was the most central variable for men, and sexual desire was most central for women. This could mean that satisfaction and desire influence the connected variables, or that the variables are causal endpoints in the network (or that there is a reciprocal relationship between the two). Research using time-series analysis could determine the direction of causality for the association(s), which would help

conclude whether sexual satisfaction and sexual desire are useful as specific targets for treatment in couples or sex therapy. Frequency of sexual activity was also central for both men and women (as it was connected to e.g., desire, sexual communication, and sexual pleasure), which is in line with previous research where sexual frequency is positively associated with sexual satisfaction¹ and relationship maintenance³¹.

The results from the community analysis revealed similar results for men and women. Sexual and relationship satisfaction formed a community with sexual pleasure, sexual distress, and sexual communication in both groups, indicating that these variables are the most relevant for sexual and relationship satisfaction. For men, too little sexual activity and frequency of sexual activity belonged to the same community as sexual and relationship satisfaction, while the two nodes formed a separate community for women. This again reinforces that frequency of sex is more relevant for sexual and relationship satisfaction for men than for women. Intrasexual competition did not belong to the same community as jealousy, as one might expect, but rather to the same community as sexual excitation, sociosexual orientation, and sexual desire. This further confirms previous studies linking intrasexual competition to sex drive³⁰.

The present study had some limitations that should be mentioned. The response rate was low; however, it is expected to be lower in surveys measuring sensitive topics (such as sex), and nonetheless, the sample was large and population-based. The participants in the present study were limited to those who identified with the sex they were assigned in the central population registry (the population registry of Finland recognizes only male and female sexes), as non-binary participants were too few ($n = 69$) to form a separate group for statistical comparison. It would be important to have greater gender diversity in future research regarding sexual and relationship satisfaction.

The analysis is limited by the fact that the variable “discrepancy between desired and actual sexual frequency” was calculated as a function from the variable “sexual frequency”, meaning that the variables are conditionally dependent, which could lead to estimation issues. In future data collections, the concepts could preferably be measured as independent constructs. The R-package ComDet²³ used in the community analysis is still in developmental stages and the applicability of the spinglass function to psychological networks need further investigation. However, as the package runs the spinglass algorithm many times and shows the most frequent solution, it allows for checking that the results are reliable. Furthermore, the glasso regularization might not be optimal in large samples as it might create too sparse networks, which is why we included networks estimated with the ggmModSelect function in the supplementary material. The ggmModSelect networks were similar to the mgm networks, but the ggmModSelect included additional weaker edges. As we are mostly interested in the stronger edges, we chose the glasso-regulated network as the main result of the article.

Inferences about causality cannot be made in cross-sectional networks under most conditions, as they are based on a single measurement point where participants retrospectively report symptoms, attitudes or behaviors. Drawing conclusions regarding centrality in cross-sectional networks has been criticized as these may differ from conclusions made from time-series networks, meaning that cross-sectional networks might not accurately reflect how symptoms trigger each other over time³². However, it has been suggested that cross-sectional networks are useful for estimating co-occurrence among symptoms and finding patterns of current co-existing symptoms³². Future research could estimate time-series network models containing similar variables (e.g., sexual and relationship satisfaction, sexual distress, sexual pleasure, sexual

communication, too little sex, and frequency of sexual activity) to allow for comparison with the models of this cross-sectional sample.

Conclusions

The present study was exploratory with the goal to extract findings to be further investigated and confirmed in later studies. Separate network models were estimated for men and women, including variables related to sex and romantic relationships. Some differences and many similarities could be found, such as the importance of sexual desire and pleasurable partnered sex to satisfying relationships for both men and women. The overall connectivity and structure of the networks did not differ between men and women, offering support for the gender similarity hypothesis.

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