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Symptom Clusters and Network Structure of Symptom Distress in Middle-Aged and Older Adults Receiving Maintenance Haemodialysis: Associations With Health-Related Quality of Life

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Tables 1 to 8 are available in the Supplementary Files section.

Symptom Clusters and Network Structure of Symptom Distress in Middle-Aged and Older Adults Receiving Maintenance Haemodialysis: Associations With Health-Related Quality of Life

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Abstract

Introduction Patients undergoing maintenance hemodialysis (MHD) frequently experience multiple co-occurring symptoms that adversely affect health-related quality of life (HRQoL). However, the multidimensional structure of symptom burden and its underlying interrelationships remain insufficiently understood.

Methods A total of 261 patients aged ⩾45 years receiving MHD were included. Symptom burden was assessed using the Modified Dialysis Symptom Index, and HRQoL was measured using the Kidney Disease Quality of Life Short Form (KDQOL-SF™). Exploratory factor analysis was used to identify symptom clusters. A Gaussian graphical model with EBICglasso regularization based on Spearman correlation matrices was used to estimate the symptom network. Associations between symptom clusters, HRQoL, and hematological parameters were examined using Spearman correlation and multivariable regression analyses.

Results The most prevalent symptoms were itching (33.3%), fatigue (29.5%), and dry skin (27.6%). Six symptom clusters were identified, explaining 48.9% of the total variance. Network analysis revealed a complex system of interrelated symptoms with acceptable stability (CS = 0.36 for expected influence). Higher symptom cluster scores were associated with poorer HRQoL, particularly in sleep, general health, and disease burden domains. The strongest association was observed between the skin-sleep-fatigue-pain cluster and kidney disease burden ($r = -0.344$, $P < 0.001$). In adjusted analyses, one cluster remained independently associated with physical functioning ($\beta = 0.070$, $P = 0.033$) and emotional well-being ($\beta = -0.114$, $P = 0.019$). Associations with hematological parameters were limited.

Conclusions Symptom burden in middle-aged and older MHD patients is substantial and structured as interconnected clusters associated with impaired HRQoL. These findings support symptom cluster–based management strategies to improve patient outcomes.

Key Words

Renal Dialysis, Symptom Clusters, Quality of Life, Middle Aged, Aged.

Introduction

Maintenance hemodialysis (MHD) is the primary renal replacement therapy for patients with end-stage renal disease (ESRD). It is estimated that by 2030, the global population of patients receiving dialysis will reach 5.4 million [1,2].Although MHD prolongs survival and partially replaces kidney function, it does not fully restore renal function or eliminate dialysis-related symptom burden. Long-term MHD is frequently accompanied by various physical and psychological symptoms, which significantly diminish the health-related quality of life (HRQoL) of MHD patients[3,4]. Patients receiving MHD experience an average of 13 discomfort symptoms after dialysis, while other studies have indicated that MHD patients typically experience between 6 and 20 different symptoms[5,6].These symptoms frequently co-occur and are interrelated, manifesting as symptom clusters (SCs) [7,8].

Symptom clusters have been reported in 26.63% of patients undergoing maintenance hemodialysis (MHD)[9]. Middle-aged and older patients often experience more numerous and severe symptoms because of age-related physiological and cognitive decline[10]. Gastrointestinal, sleep, skin-related, and emotional symptom clusters are particularly prominent in older patients[6], and their combined effects may worsen disease burden, impair health-related quality of life (HRQoL), reduce treatment effectiveness, and increase mortality risk. Accordingly, clarifying symptom clusters and their associations with HRQoL and clinical indicators is essential for evaluating treatment and nursing outcomes.

However, previous studies have focused mainly on depressive symptoms and their relationships with symptom burden, alexithymia, or HRQoL[11-13].Although exploratory factor analysis and network analysis have been

used to identify symptom clusters and core symptoms[14-18], evidence on the associations between symptom clusters, HRQoL, and blood parameters in older MHD patients remains limited[19]. In particular, few studies have defined symptom clusters according to symptom distress while simultaneously examining their relationships with HRQoL and hematological indicators.

Because physiological indicators alone may not fully explain symptom experiences in patients undergoing maintenance hemodialysis (MHD)[20], the Social Ecological Model(SEM) guided variable selection and the interpretation of relationships between symptom burden and health-related quality of life (HRQoL).

This study aimed to identify symptom clusters using exploratory factor analysis, examine symptom interrelationships through network analysis, and assess their associations with HRQoL and blood parameters in middle-aged and older patients receiving MHD. These integrated analyses were intended to support targeted symptom cluster–based management.

Methods

Study design and participants

This observational study was conducted in the hemodialysis unit of a tertiary hospital in Fujian Province, China, from December 2024 to October 2025. A total of 261 middle-aged and elderly patients receiving MHD were recruited using a convenience sampling method.

Eligible participants were aged ≥45 years, had received regular MHD for at least 3 months (two or three 3–4-hour sessions per week), had adequate cognitive and reading abilities to complete the questionnaires, and provided written informed consent. Patients with severe illness that prevented participation were excluded.

Eligible patients were approached during scheduled dialysis sessions by trained research staff, who provided standardized study information and obtained written informed consent. Participants then completed the paper-based questionnaire independently in a quiet area of the dialysis unit, with assistance available when required. Completed questionnaires were reviewed on site for missing or inconsistent responses, which were verified with participants to ensure data completeness and accuracy.

Measures

The demographic and clinical questionnaire

Informed by the SEM, the demographic and clinical characteristics questionnaire was designed to capture individual-level and selected interpersonal-level characteristics potentially related to symptom experiences and HRQoL in MHD patients. Variables included in the present analysis were sex, age, marital status, educational level, dialysis duration, cardiovascular disease, renal anemia, renal osteodystrophy, hypertension, and number of comorbidities. Sociodemographic information was self-reported, whereas dialysis-related and clinical data were obtained or verified using electronic medical records.

Modified Dialysis Symptom Index (MDSI)

Symptom burden was assessed using the Modified Dialysis Symptom Index (MDSI), which was adapted from the Dialysis Symptom Index (DSI) originally developed by Weisbord et al[21]. The Chinese version developed by Hao Y [22]expanded the DSI by incorporating two additional dimensions—symptom frequency and severity—according to the theory of unpleasant symptoms, to better reflect the symptom experiences of Chinese dialysis patients. The MDSI consists of 30 items: 25 physical and 5 psychological symptoms. Each

symptom's *presence* is scored 1 if present and 0 if absent. For symptoms that occur, patients further rate the *degree of distress* on a 5-point Likert scale (1 = "not at all" to 5 = "very much"), *frequency* on a 4-point scale (1 = "rarely" to 4 = "almost always"), and *severity* on a 4-point scale (1 = "mild" to 4 = "very severe"). Higher total scores indicate heavier symptom burden. An open-ended item allows participants to report additional symptoms not included in the scale. In the present study, the MDSI demonstrated excellent internal consistency (Cronbach's $\alpha = 0.983$).

Kidney Disease Quality of Life Short Form (KDQOL-SF™)

HRQoL was measured using the Kidney Disease Quality of Life Short Form (KDQOL-SF™), developed by Hays RD et al[23]. The Mandarin Chinese version was translated and authorized by Amgen Inc. and the MAPI Research Institute, and it is available for non-commercial use from the RAND Corporation website[24]. The KDQOL-SF™ integrates two components: (1) the kidney-disease-targeted areas (KDTA) and (2) the generic health-related component, the SF-36. The SF-36 includes 36 items across eight domains—physical functioning, role-physical, bodily pain, general health, vitality, social functioning, emotional role, and mental health—reflecting general HRQoL. The KDTA component encompasses 11 domains: symptoms, effects of kidney disease, burden of kidney disease, work status, quality of social interaction, sexual function, cognitive function, sleep, social support, patient satisfaction, and encouragement/support from medical staff. Scoring followed the standard algorithm proposed by Hays et al[25]. in which raw item scores are linearly transformed to a 0–100 scale. Higher scores denote better functional status or less negative impact of kidney disease. The Cronbach's α of the KDQOL-SF™ was 0.80 in the original development [25]and 0.87 in the study by Shim HY, et al[19].

Statistical analysis

All statistical analyses were conducted using R (version 4.4.3; R Foundation for Statistical Computing, Vienna, Austria). A two-tailed P value < 0.05 was considered statistically significant. Categorical variables were reported as frequencies and percentages, and continuous variables were reported as means and standard deviations (SD) or medians with interquartile ranges (IQR).

Exploratory factor analysis(EFA) using principal axis factoring and varimax rotation was performed to identify symptom clusters. Data suitability was assessed using the KMO measure and Bartlett's test[26]. Factor retention was guided by eigenvalues >1, scree plots, and parallel analysis; items with loadings ≥0.40 were interpreted[27]. Because factor-score directions are arbitrary, higher scores did not consistently indicate greater symptom burden.

A symptom network was estimated using a Gaussian graphical model with Extended Bayesian Information Criterion graphical least absolute shrinkage and selection operator (EBICglasso) regularization based on Spearman correlation matrices. , given the ordinal, non-normal, and zero-inflated symptom scores. The EBIC hyperparameter γ was set at 0.25 to obtain a parsimonious and stable network structure. No additional thresholding procedure was applied beyond the regularization performed by EBICglasso. Missing data were handled using pairwise complete observations. In this network, nodes represented symptoms and edges represented regularized partial correlations, reflecting conditional dependence relationships between symptoms. The network was visualized using the qgraph's spring layout, in which nodes with stronger

connections were positioned closer together[28,29]. Edge thickness indicated the strength of associations, with green and red edges denoting positive and negative associations, respectively.

Centrality indices, including strength, closeness, betweenness, and expected influence, were calculated to identify the most influential symptoms within the network. Bridge centrality (bridge strength) was further estimated using the networktools package to identify symptoms that connect different symptom communities, which were defined according to the exploratory factor analysis results and clinical interpretability. Higher bridge strength values indicated a greater potential for cross-cluster activation[30].

The accuracy and stability of the network were evaluated using nonparametric bootstrap procedures implemented in the bootnet package (nBoots = 1,500)[31]. Edge-weight accuracy was assessed via bootstrapped confidence intervals, while differences between edge weights were examined using bootstrapped difference tests. The stability of centrality indices was quantified using the correlation stability (CS) coefficient. A CS coefficient >0.25 was considered acceptable, and values >0.50 indicated good stability[31].

Given the non-normal distribution of symptom cluster scores, nonparametric tests were used to examine differences across demographic and clinical characteristics. The Mann–Whitney U test was applied for comparisons between two groups, and the Kruskal–Wallis H test was used for comparisons among multiple groups. Variables with $P < 0.10$ in univariate analyses were considered as candidate covariates for subsequent multivariable analyses. Factor-specific multivariable linear regression models were constructed to examine the associations between blood parameters and symptom cluster scores after adjustment for relevant sociodemographic and clinical covariates, where applicable. Multicollinearity among independent variables was assessed using variance inflation factors (VIFs), with VIF values <5 considered to indicate no serious multicollinearity.

Results

Participant characteristics

A total of 261 middle-aged and older patients undergoing maintenance hemodialysis (MHD; age ≥45 years) were included in the final analysis, comprising 105 females (40.2%) and 156 males (59.8%).

Symptom prevalence and burden

The prevalence, frequency, severity, and distress of symptoms are presented in (**Table 1**). Among the 30 symptoms assessed, the most prevalent symptoms were itching (33.33%), fatigue (29.50%), and dry skin (27.59%), followed by trouble falling asleep (21.07%), dry mouth (20.31%), and trouble staying asleep (19.16%).

Although the median scores for symptom frequency, severity, and distress were generally 0, several symptoms showed relatively high mean distress scores, including itching (0.923), fatigue (0.759), dry skin (0.693), trouble falling asleep (0.651), and trouble staying asleep (0.598), suggesting a substantial burden among affected individuals.

Identification of symptom clusters

The scree plot from exploratory factor analysis is shown in (**Figure 1**). The data were suitable for factor analysis (KMO = 0.851; Bartlett's test $\chi^2 = 3935.244$, df = 435, $P < 0.001$). Parallel analysis supported a six-factor solution.

As shown in (**Table 2**), six symptom clusters extracted via principal axis factoring with varimax rotation, explaining 48.9% of the total variance. The eigenvalues ranged from 1.834 to 3.638. Based on factor loadings and clinical interpretability, the six factors were labelled as: Factor 1, the skin–sleep–fatigue–pain cluster; Factor 2, the cardiopulmonary–affective cluster; Factor 3, the gastrointestinal cluster; Factor 4, the neuromuscular–cognitive cluster; Factor 5, the mixed affective–sexual–gastrointestinal cluster; and Factor 6, the neurovascular cluster.

The skin–sleep–fatigue–pain cluster (Factor 1) was characterized by dermatological, fatigue, sleep-related, and pain-related symptoms, including itching (loading = 0.646), dry skin (0.545), fatigue (0.569), dry mouth (0.525), muscle cramp (0.418), bone or joint pain (0.426), trouble falling asleep (0.624), and trouble staying asleep (0.617). The cardiopulmonary–affective cluster (Factor 2) included shortness of breath (0.598), chest pain (0.435), feeling nervous (0.699), and feeling sad (0.576). The gastrointestinal cluster (Factor 3) included nausea (0.741), vomiting (0.787), decreased appetite (0.439), and constipation (0.442). The neuromuscular–cognitive cluster (Factor 4) included swelling in legs (0.413), restless legs (0.588), muscle soreness (0.549), and difficulty concentrating (0.422). The mixed affective–sexual–gastrointestinal cluster (Factor 5) included diarrhea (0.523), feeling anxious (0.493), decreased interest in sex (0.558), and difficulty becoming sexually aroused (0.555). The neurovascular cluster (Factor 6) included dizziness (0.623) and headache (0.709).

Symptom network structure and stability

The symptom network (Figure 2) and centrality indices (Figure 3) revealed complex conditional dependencies. Expected influence and strength were the most reliable centrality indicators. Trouble falling asleep within Factor 1 showed the highest expected influence and strength centrality (rs = 1.24), followed by fatigue (rs = 1.21) and dry skin (rs = 1.10), indicating their central network positions.

Bootstrap analyses of edge-weight accuracy and differences are shown in (Figure 4 and Figure 5), while correlation stability results are presented in (Figure 6). The correlation stability coefficients were 0.36 for expected influence and 0.284 for strength, indicating acceptable stability, whereas betweenness and closeness showed low stability (CS = 0.05).

Determinants of symptom clusters

Associations between symptom cluster scores and sociodemographic and clinical variables are presented in (**Table 3**). Education level was significantly associated with Factor 1 ($H = 16.471$, $P < 0.001$) and Factor 5 ($H = 9.145$, $P = 0.027$). Hypertension was associated with Factor 1 ($Z = 2.255$, $P = 0.024$) and Factor 3 ($Z = 2.728$, $P = 0.006$), while the number of comorbidities was associated with Factor 2 ($Z = 2.407$, $P = 0.016$).

Health-related quality of life (HRQoL)

Descriptive statistics of HRQoL domains are summarized in (**Table 4**). Among KDQOL-SF™ domains, the mean scores were 73.08 ± 24.56 for symptom/problem list, 58.20 ± 22.85 for effects of kidney disease, and 43.97 ± 22.16 for burden of kidney disease. The sleep domain score was 60.14 ± 16.49.

General HRQoL assessed by KDQOL-SF™ showed mean physical and mental composite scores of 39.56 ± 8.22 and 44.20 ± 8.42, respectively.

Associations between symptom clusters and HRQoL

The correlations between symptom clusters and HRQoL domains are shown in (**Table 5**) and (**Figure 7**).

Correlations are shown in Table 5 and Figure 7. Greater symptom burden generally correlated with poorer HRQoL across domains.

Significant negative correlations with the symptom/problem list were observed for Factor 1 (r = −0.152, P = 0.014), Factor 2 (r = −0.169, P = 0.006), Factor 4 (r = −0.146, P = 0.018), and Factor 5 (r = −0.167, P = 0.007). The burden of kidney disease showed the strongest association with Factor 1 (r = −0.344, P < 0.001), followed by Factor 6 (r = −0.262, P < 0.001).

Sleep was negatively correlated with all symptom clusters (r range: −0.168 to −0.252; all P < 0.05). Similarly, overall health was negatively associated with all clusters, with the strongest correlation observed for Factor 1 (r = −0.333, P < 0.001).

The physical health score was negatively correlated with Factor 1 (r = −0.306, P < 0.001), Factor 2 (r = −0.166, P = 0.007), Factor 3 (r = −0.217, P < 0.001), Factor 5 (r = −0.152, P = 0.014), and Factor 6 (r = −0.126, P = 0.042), whereas the mental health score showed no significant correlations with these factors (all P > 0.05).

Multivariable analysis of HRQoL

Multivariable regression results are presented in (**Table 6**). After adjustment, most associations between symptom clusters and HRQoL domains were attenuated.

Factor 6 showed a statistically significant association with physical functioning(β = 0.070, 95% CI: 0.006 to 0.133; P = 0.033) and emotional well-being (β = −0.114, 95% CI: −0.206 to −0.022; P = 0.019) after adjustment, however, the direction of the association should be interpreted cautiously given the arbitrary orientation of exploratory factor scores.

Blood parameters and symptom clusters

Correlations between symptom clusters and blood parameters are shown in (**Table 7**) and (**Figure 8**). Most correlations were weak and not statistically significant. Multivariable linear regression results are presented in (**Table 8**). In these models, blood parameters were entered simultaneously, and the regression coefficients therefore represent the mutually adjusted independent associations between each blood parameter and the corresponding symptom cluster score. White blood cell count was negatively associated with Factor 1 (β = −0.376, 95% CI: −0.744 to −0.007; P = 0.046). Red blood cell count was positively associated with Factor 2 (β = 1.192, 95% CI: 0.590 to 1.794; P < 0.001) and Factor 4 (β = 0.756, 95% CI: 0.097 to 1.414; P = 0.025), whereas hemoglobin was negatively associated with Factor 2 (β = −0.036, 95% CI: −0.059 to −0.013; P = 0.003). Variance inflation factors for red blood cell count and hemoglobin were both 3.95 (below threshold), thus both were retained.

Discussion

Rather than occurring as isolated complaints, symptoms aggregated into clinically meaningful clusters that were broadly associated with impaired health-related quality of life (HRQoL). Network analyses further revealed interconnected systems with conditional dependencies, reinforcing the conceptualization of symptom experiences in chronic illness as dynamic and interrelated[15,32]. Taken together, these findings underscore the importance of moving beyond single-symptom assessment toward a multidimensional, symptom cluster–based approach to symptom management in this population.

The skin–sleep–fatigue–pain cluster, characterized by pruritus, dry skin, fatigue, and sleep disturbances,

emerged as a core component of the symptom experience in MHD patients. This aligns with prior research identifying pruritus and fatigue as highly distressing symptoms in dialysis populations[10,33].

Mechanistically, pruritus and dry skin may disrupt sleep initiation and maintenance, while sleep disturbance may exacerbate fatigue and reduce physiological resilience. However, due to the cross-sectional design, these associations should be interpreted as interrelationships rather than causal pathways. Clinically, these findings support integrated interventions targeting co-occurring symptoms—e.g., combining skin care and sleep management may offer broader benefits than addressing fatigue alone[16]—though their efficacy requires longitudinal or interventional evaluation.

Beyond this core cluster, we identified multiple additional clusters, including a neuromuscular–cog nitive cluster and a mixed affective–sexual–gastrointestinal cluster, highlighting under-recognized yet clinically relevant domains[34]. Notably, the inclusion of sexual health underscores an often-overlook ed aspect of dialysis care; sexual dysfunction is closely tied to psychological well-being, interperson al relationships, and overall quality of life, yet remains insufficiently addressed in routine practice[3 5]. Incorporating such domains into symptom assessment can therefore enhance care comprehensiven ess and patient-centeredness.

The HRQoL sleep domain was negatively associated with all symptom clusters, suggesting that sleep-related quality of life may represent a cross-cutting outcome affected by multiple symptom domains. This indicates that sleep may function as a clinically relevant pathway through which symptom burden influences daily functioning and health perceptions. This finding aligns with previous research emphasizing the central role of sleep in determining quality of life in chronic illness[6]. Clinically, sleep may represent a strategic intervention target, as improvements here could yield multi-domain benefits.

Consistent with prior research[36], greater symptom cluster burden was associated with poorer HRQoL across multiple domains. However, the attenuation in multivariable analyses uggests these relationships are partly influenced by shared sociodemographic and clinical factors. In the adjusted models, the neurovascular cluster, showed independent associations with physical functioning and emotional well-being. though these results require cautious interpretation given the cross-sectional design and arbitrary factor-score orientation. This supports precision symptom management, wherein interventions target clusters most relevant to specific HRQoL aspects. In this context, some clusters may primarily affect physical functioning, whereas others may be more closely related to emotional well-being or perceived disease burden[14].

Symptom clusters were also associated with individual and clinical characteristics. Sociodemographic factors, particularly educational level, were linked to specific symptom clusters, which may reflect differences in health literacy, symptom recognition, and self-management capacity. For clinical factors such as hypertension and comorbidity burden were also associated with certain clusters, suggesting that symptom distress arises not only from the dialysis state itself but also from the broader context of multimorbidity[5]. Although most blood indicators showed weak associations with symptom clusters, several factor-specific associations emerged after adjustment, hinting at a potential but unclear link between hematological status and symptom domains.

When interpreted within the socioecological model, these findings highlight the multilevel determinants of

symptom burden. While many influencing factors operate at the individual level, such as education and comorbidities, their effects extend to interpersonal and organizational levels[37]. Patients with lower educational attainment may require more tailored communication and support from family members and healthcare providers, whereas those with multiple comorbidities may benefit from coordinated multidisciplinary care. This perspective emphasizes that effective symptom management should integrate biological treatment with social and healthcare system–level interventions, thereby promoting a more comprehensive and patient-centered approach.

This study integrated symptom-cluster identification, network analysis, HRQoL assessment, and clinical correlates to assess symptom burden in middle-aged and older MHD patients. Nevertheless, several limitations should be acknowledged. First, although the observational design allowed us to examine associations,causal inference cannot be made, and longitudinal studies are needed to clarify temporal relationships. Second the single-center design and convenience sampling may limit generalizability; multicenter studies with larger, more diverse samples are warranted. Third, although symptom distress was assessed using a standardized self-reported instrument, the data may still be subject to recall and response bias. Given the ordinal and skewed distribution of scores with a high proportion of zeros, the precision of estimated associations may have been affected, despite the use of Spearman correlation matrices. Fourth, although several sociodemographic, clinical, and hematological variables were included, some potentially relevant biological and dialysis-related factors, such as dialysis adequacy, inflammatory markers, nutritional indicators, and medication use, were not assessed, and residual confounding cannot be excluded. Finally, although internal stability analyses were performed, the identified symptom clusters and network structure were not externally validated in an independent cohort; therefore, these findings should be interpreted as exploratory and should be confirmed in future studies.

In conclusion, symptom burden in middle-aged and older MHD patients is substantial, structured, and multidimensional. These findings support shifting from isolated single-symptom treatment toward integrated, cluster-based approaches embedded within a socioecological framework. Future research should focus on longitudinal designs and intervention studies to identify key symptom targets and evaluate whether prioritizing high-impact symptom clusters can effectively reduce symptom burden and improve quality of life in this vulnerable population.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Author contributions

Wan Ye conceived and designed the study, carried out the study, performed data analysis, and prepared the first draft of the manuscript. Yining Tao and Xinxin Ye contributed to study design, data analysis, and manuscript preparation.Jie Chen, Qiaoli Lin, Qijun Chen, Liqing Chen, Chenxi Lei, HongHui Ruan, Qijia Cui, assisted in data collection and data analysis, and helped prepare the first draft of the manuscript. Xiulan Guo and Yang Fan conceived and designed the study and revised the manuscript. All authors contributed to the article and

approved the submitted version.

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Data availability

The authors will provide the raw data underpinning the findings of this article to any qualified researcher upon reasonable request.

Clinical trial number

This study is a cross-sectional survey and does not meet the definition of a clinical trial. Therefore, clinical trial registration is not applicable. Clinical trial number: not applicable.

Declarations

Ethics approval and consent to participate

This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the ethics committee at the The Second Affiliated Hospital of Xiamen Medical College (2024230), and all participants signed informed consent.

Consent for publication

Not applicable.

Competing interests

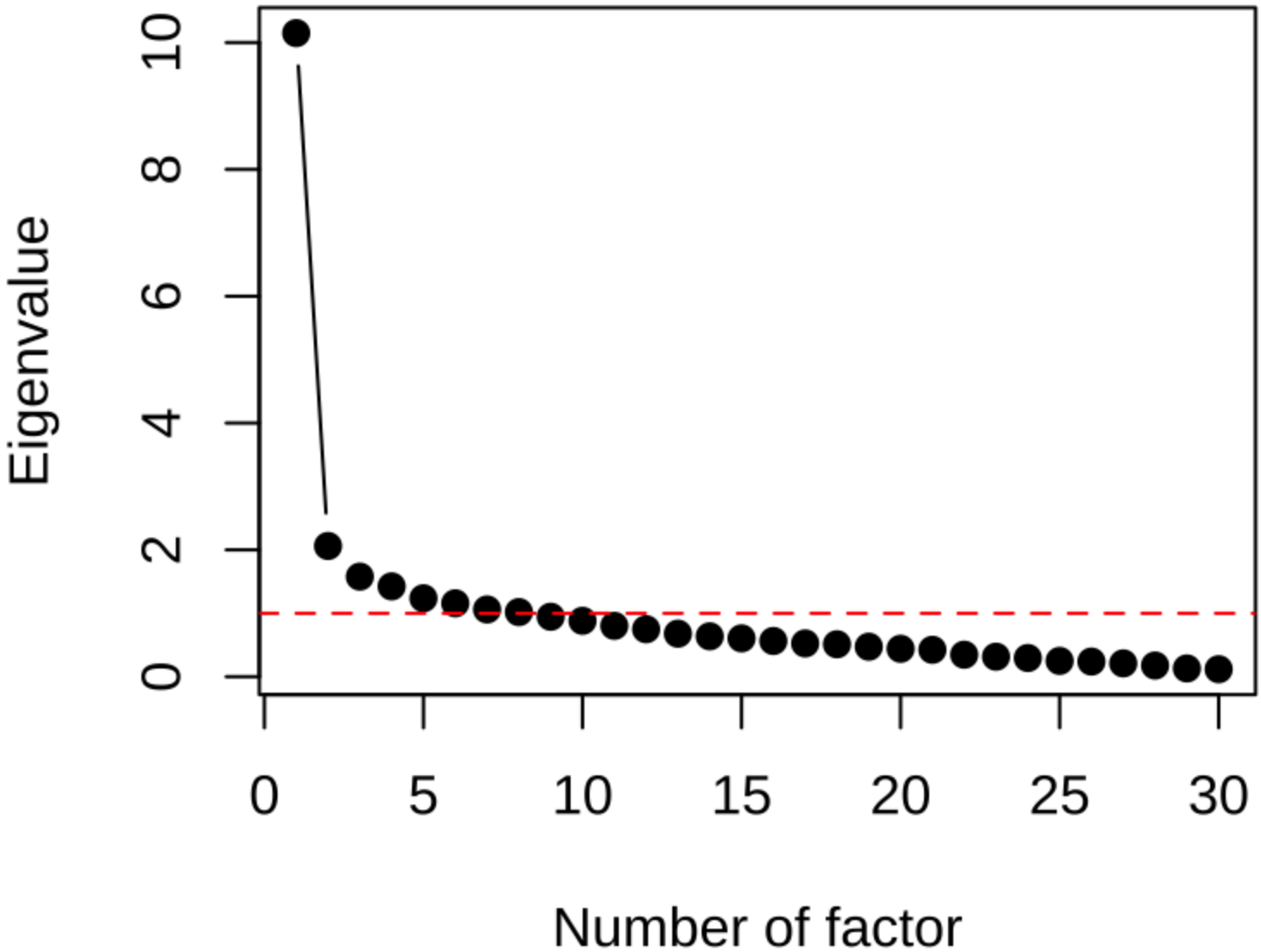
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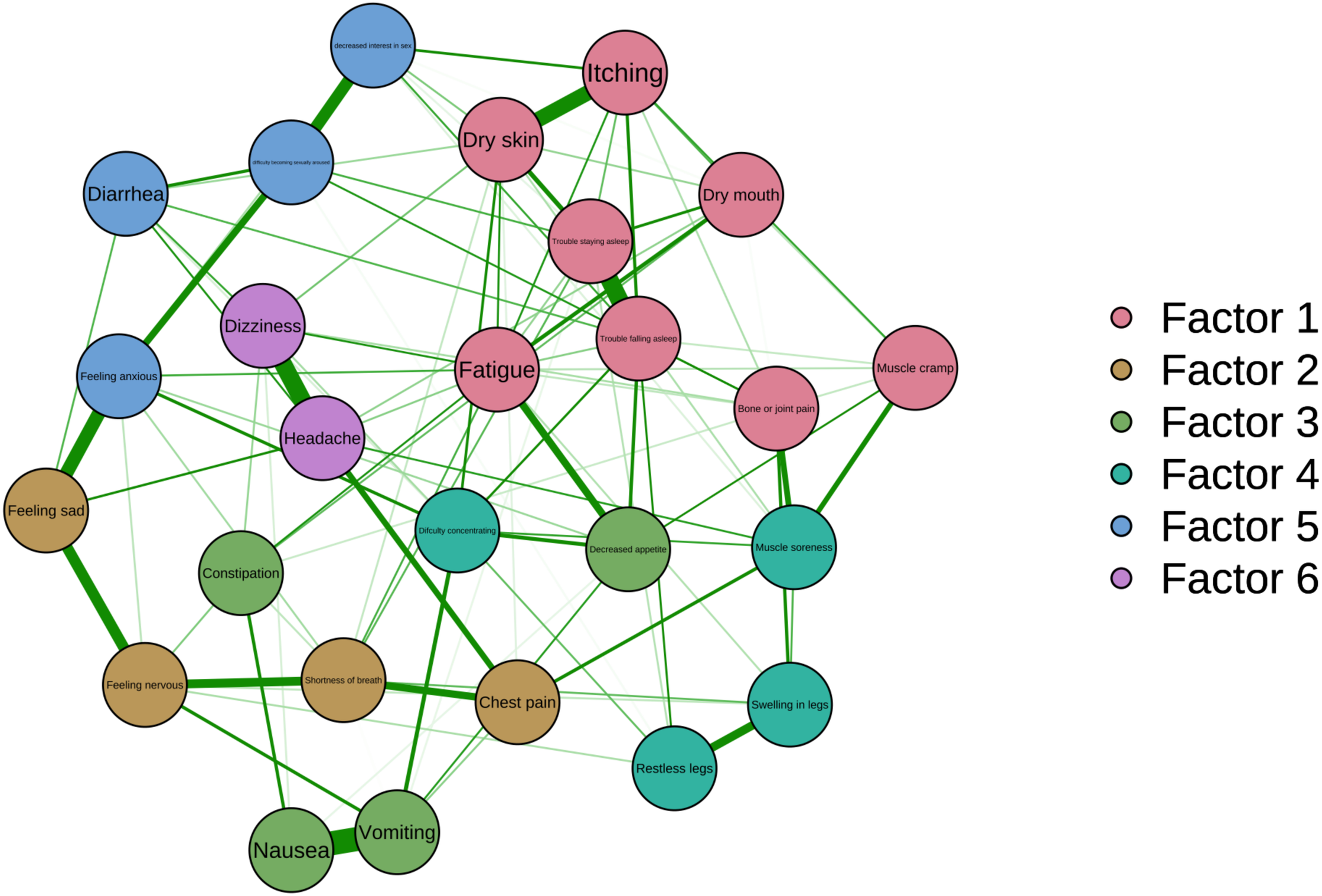
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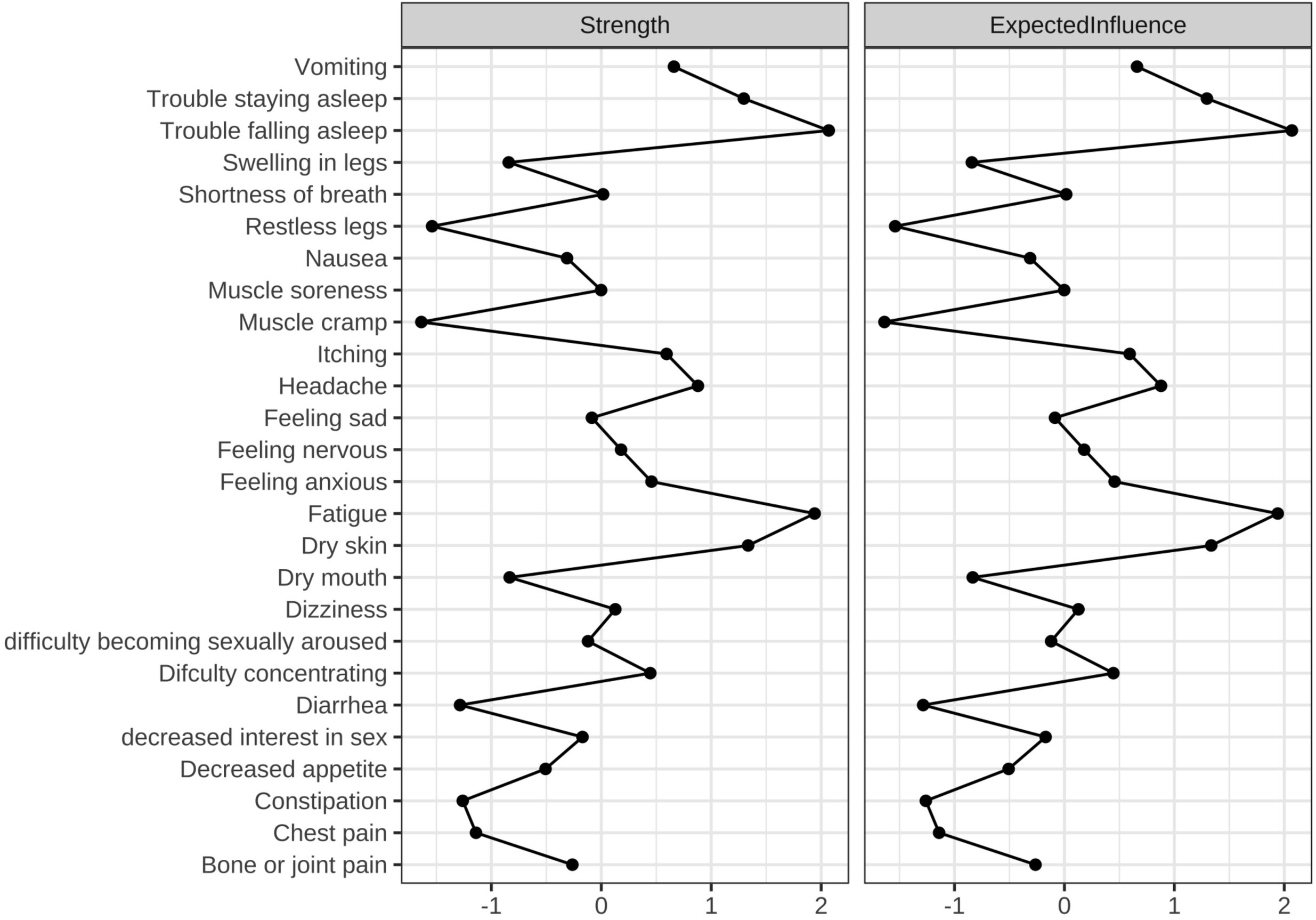
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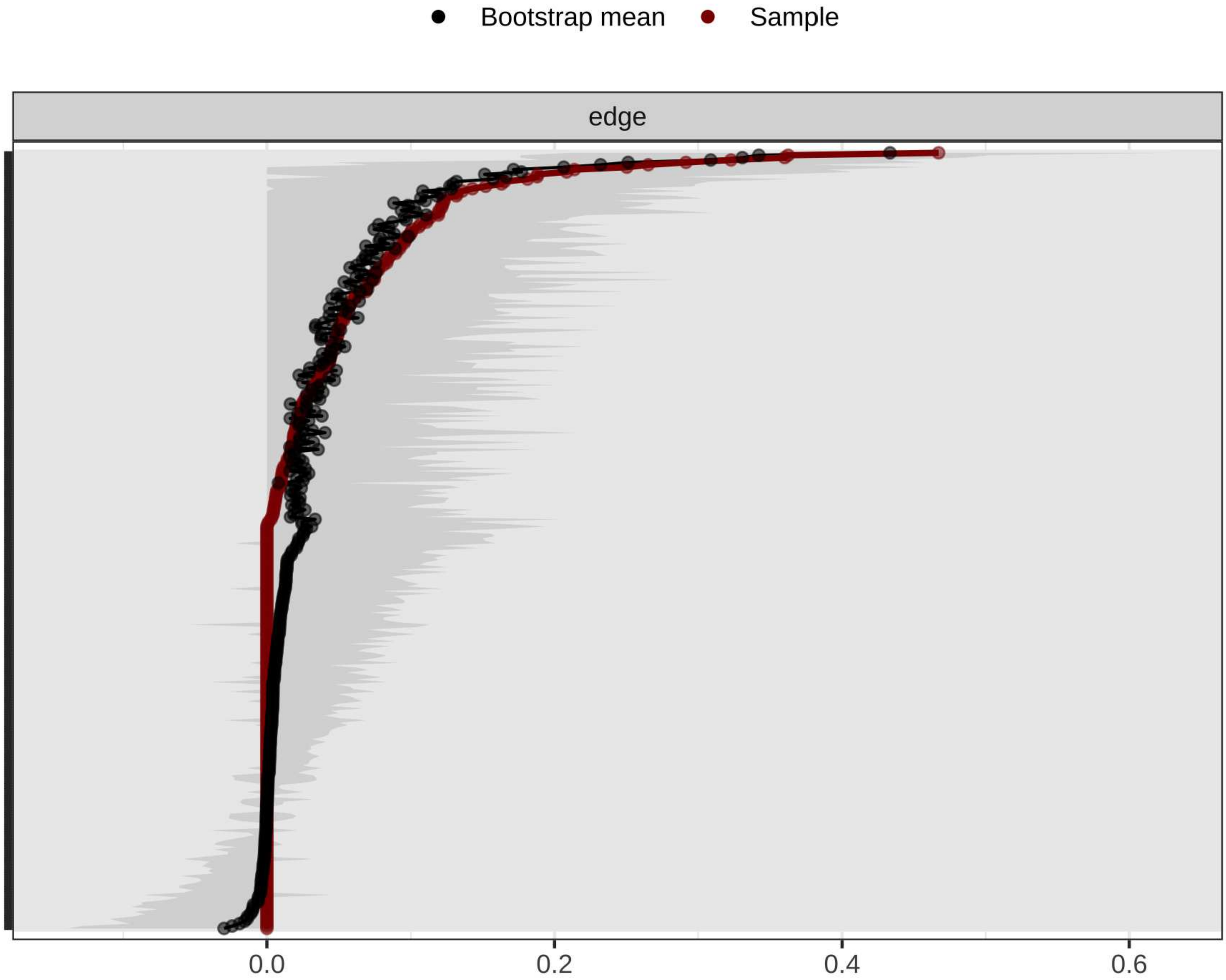
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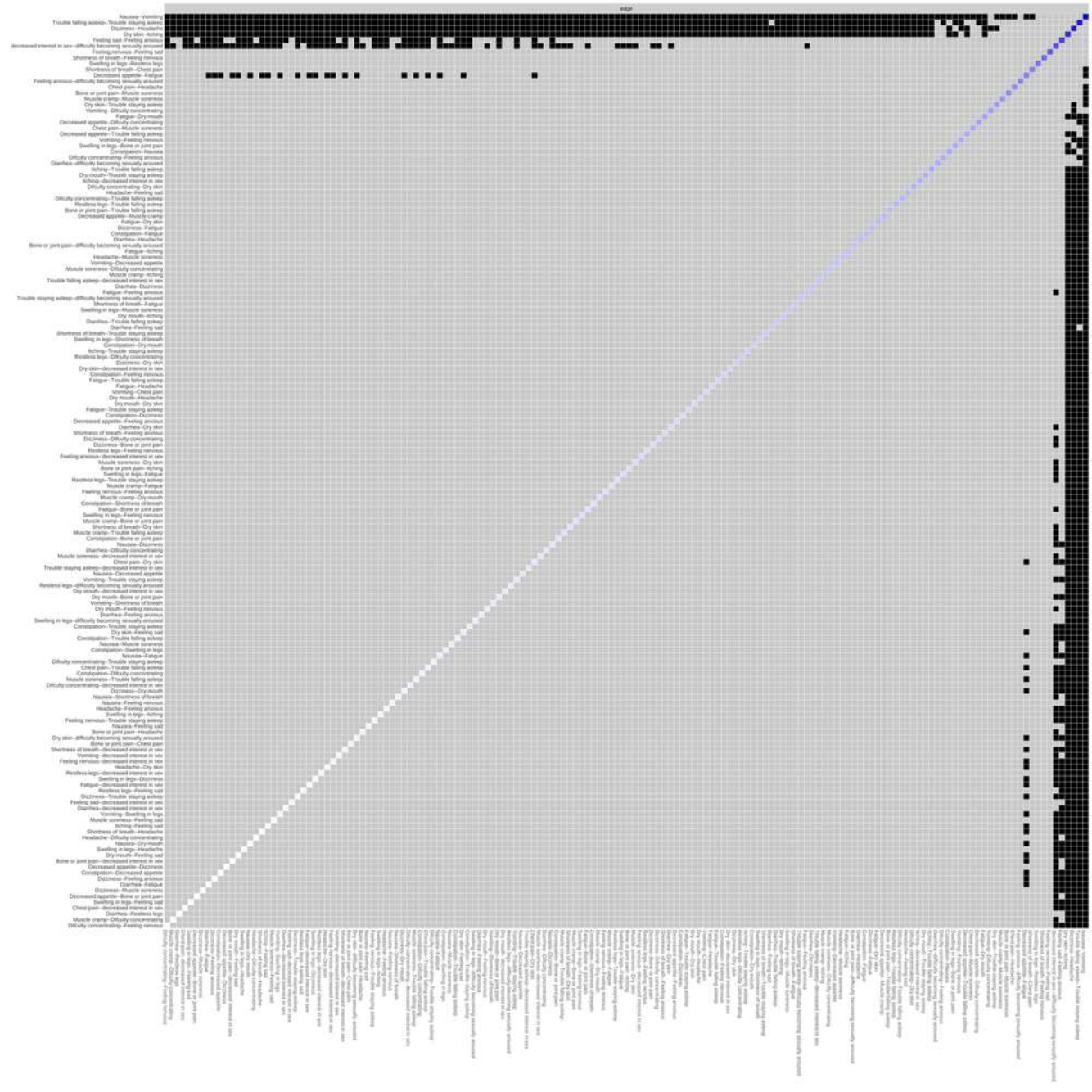
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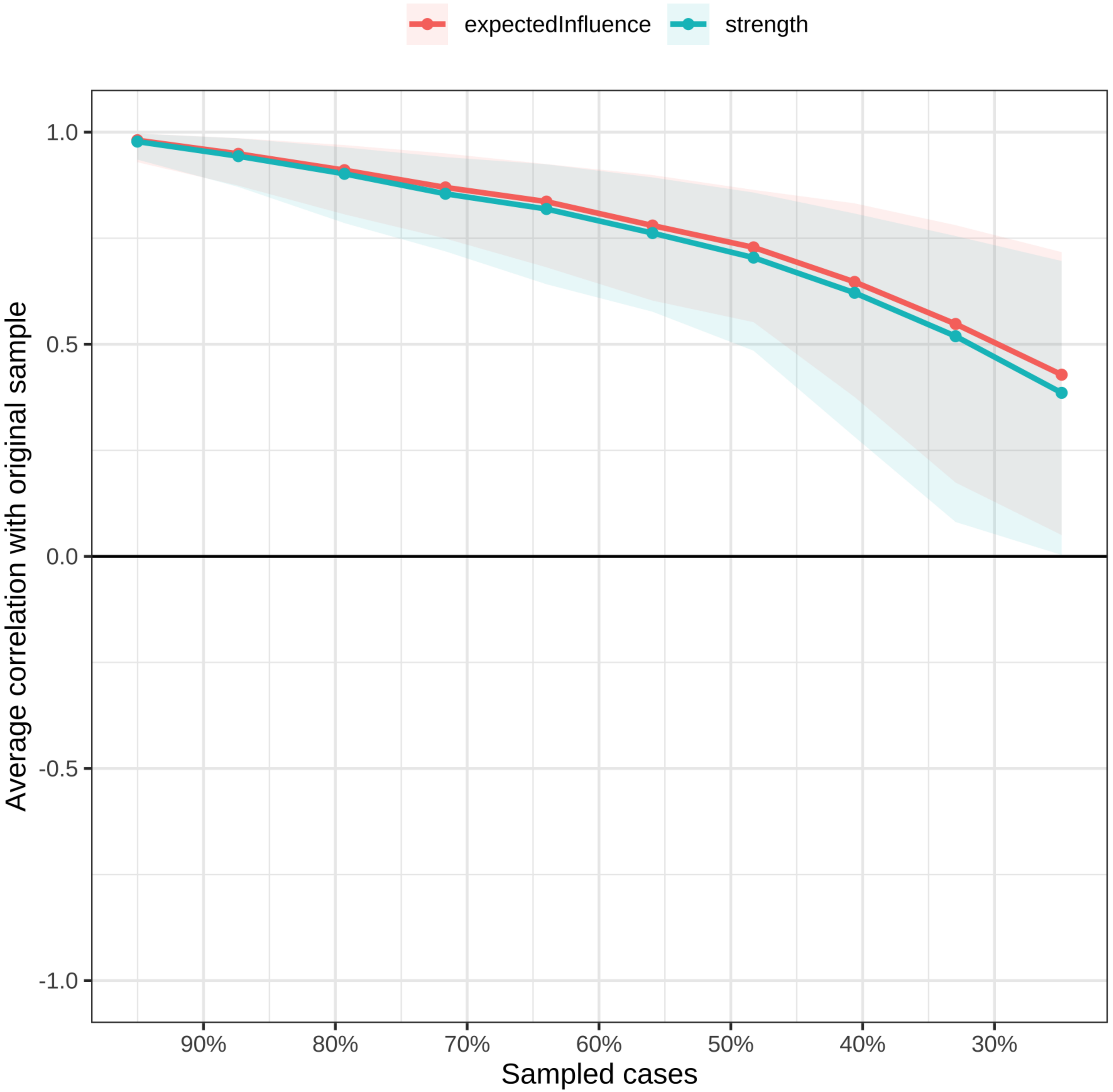

Eigenvalue
0
2
4
6
8
10
0
5
10
15
20
25
30
Number of factor

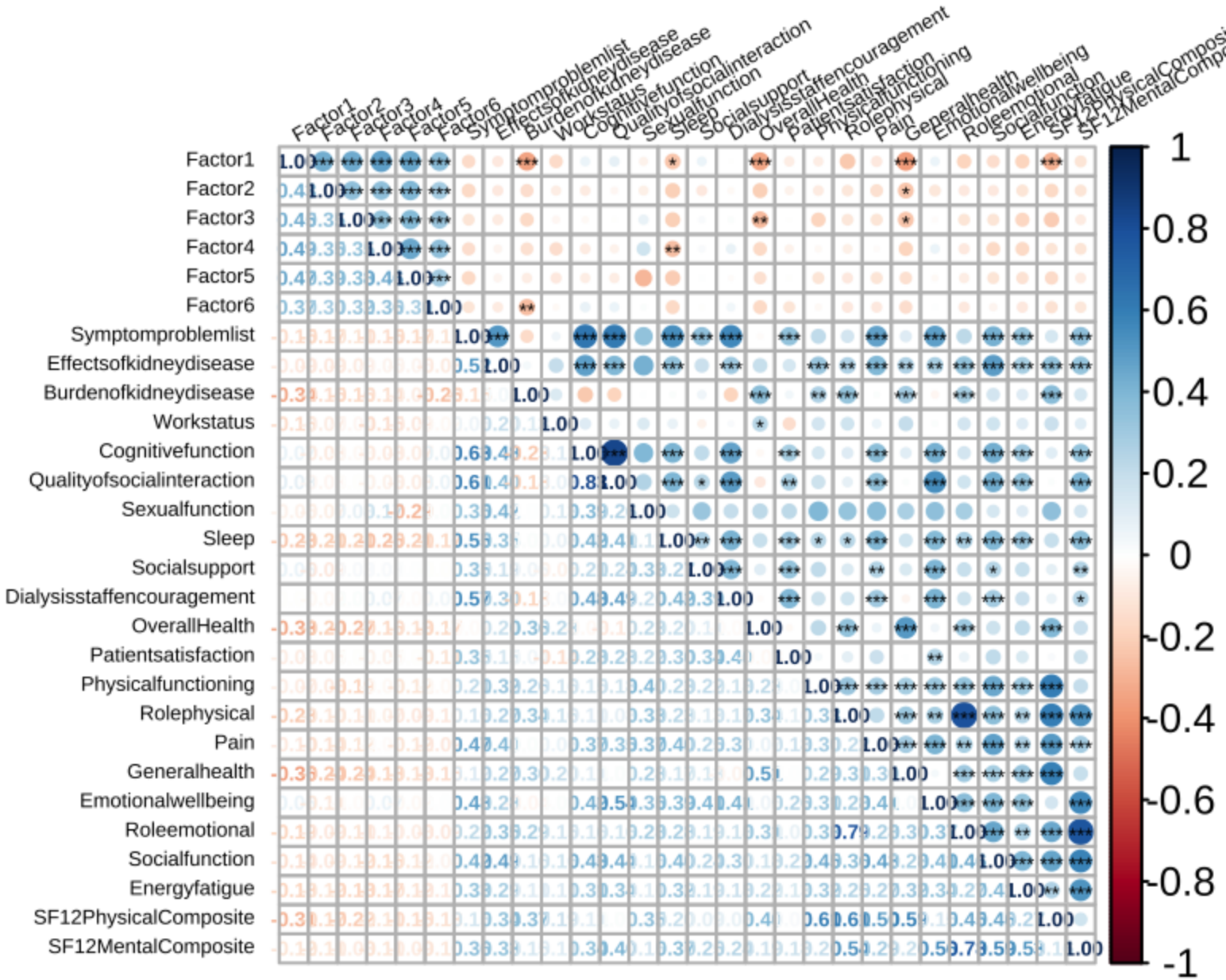

decreased interest in sex
Itching
Dry skin
difficulty becoming sexually aroused
Diarrhea
Dry mouth
Trouble staying asleep
Dizziness
Trouble falling asleep
Fatigue
Muscle cramp
Feeling anxious
Bone or joint pain
Headache
Feeling sad
Difculty concentrating
Decreased appetite
Muscle soreness
Constipation
Feeling nervous
Shortness of breath
Chest pain
Swelling in legs
Restless legs
Nausea
Vomiting
Factor 1
Factor 2
Factor 3
Factor 4
Factor 5
Factor 6

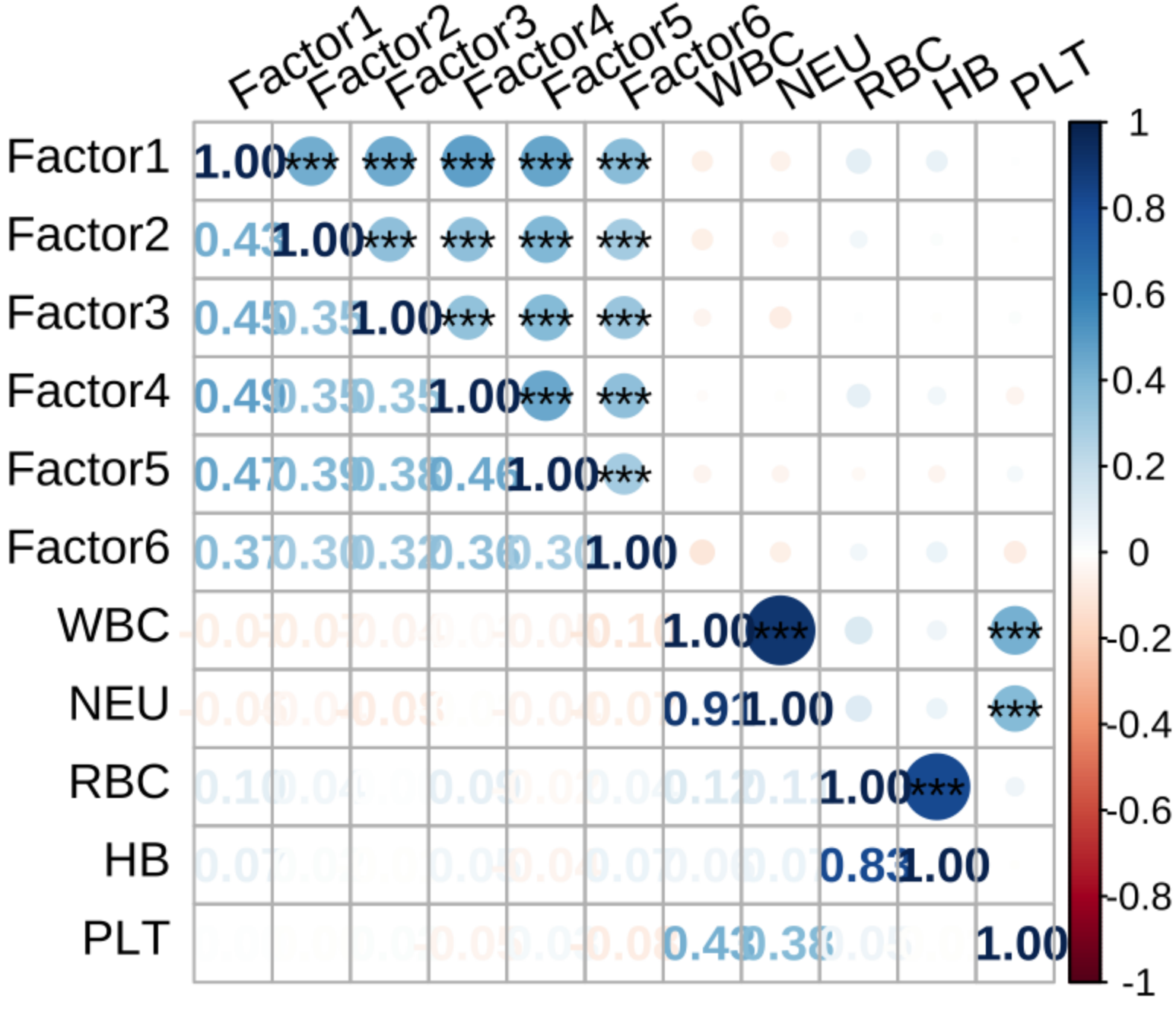

Strength
ExpectedInfluence
Vomiting
Trouble staying asleep
Trouble falling asleep
Swelling in legs
Shortness of breath
Restless legs
Nausea
Muscle soreness
Muscle cramp
Itching
Headache
Feeling sad
Feeling nervous
Feeling anxious
Fatigue
Dry skin
Dry mouth
Dizziness
difficulty becoming sexually aroused
Difculty concentrating
Diarrhea
decreased interest in sex
Decreased appetite
Constipation
Chest pain
Bone or joint pain
-1
0
1
2


Bootstrap mean
Sample
edge
0.0
0.2
0.4
0.6


edge
Nausea--Vomiting
Trouble falling asleep--Trouble staying asleep
Dizziness--Headache
Dry skin--Itching
Feeling sad--Feeling anxious
decreased interest in sex--difficulty becoming sexually aroused
Feeling nervous--Feeling sad
Shortness of breath--Feeling nervous
Swelling in legs--Restless legs
Shortness of breath--Chest pain
Decreased appetite--Fatigue
Feeling anxious--difficulty becoming sexually aroused
Chest pain--Headache
Bone or joint pain--Muscle soreness
Muscle cramp--Muscle soreness
Dry skin--Trouble staying asleep
Vomiting--Difficulty concentrating
Fatigue--Dry mouth
Decreased appetite--Difficulty concentrating
Chest pain--Muscle soreness
Decreased appetite--Trouble falling asleep
Vomiting--Feeling nervous
Swelling in legs--Bone or joint pain
Constipation--Nausea
Difficulty concentrating--Feeling anxious
Diarrhea--difficulty becoming sexually aroused
Itching--Trouble falling asleep
Dry mouth--Trouble staying asleep
Itching--decreased interest in sex
Difficulty concentrating--Dry skin
Headache--Feeling sad
Difficulty concentrating--Trouble falling asleep
Restless legs--Trouble falling asleep
Bone or joint pain--Trouble falling asleep
Decreased appetite--Muscle cramp
Fatigue--Dry skin
Dizziness--Fatigue
Constipation--Fatigue
Diarrhea--Headache
Bone or joint pain--difficulty becoming sexually aroused
Fatigue--Itching
Headache--Muscle soreness
Vomiting--Decreased appetite
Muscle soreness--Difficulty concentrating
Muscle cramp--Itching
Trouble falling asleep--decreased interest in sex
Diarrhea--Dizziness
Fatigue--Feeling anxious
Trouble staying asleep--difficulty becoming sexually aroused
Shortness of breath--Fatigue
Swelling in legs--Muscle soreness
Dry mouth--Itching
Diarrhea--Trouble falling asleep
Diarrhea--Feeling sad
Shortness of breath--Trouble staying asleep
Swelling in legs--Shortness of breath
Constipation--Dry mouth
Itching--Trouble staying asleep
Restless legs--Difficulty concentrating
Dizziness--Dry skin
Dry skin--decreased interest in sex
Constipation--Feeling nervous
Fatigue--Trouble falling asleep
Fatigue--Headache
Vomiting--Chest pain
Dry mouth--Headache
Dry mouth--Dry skin
Fatigue--Trouble staying asleep
Constipation--Dizziness
Decreased appetite--Feeling anxious
Diarrhea--Dry skin
Shortness of breath--Feeling anxious
Dizziness--Difficulty concentrating
Dizziness--Bone or joint pain
Restless legs--Feeling nervous
Feeling anxious--decreased interest in sex
Muscle soreness--Dry skin
Bone or joint pain--Itching
Swelling in legs--Fatigue
Restless legs--Trouble staying asleep
Muscle cramp--Fatigue
Feeling nervous--Feeling anxious
Muscle cramp--Dry mouth
Constipation--Shortness of breath
Fatigue--Bone or joint pain
Swelling in legs--Feeling nervous
Muscle cramp--Bone or joint pain
Shortness of breath--Dry skin
Muscle cramp--Trouble falling asleep
Constipation--Bone or joint pain
Nausea--Dizziness
Diarrhea--Difficulty concentrating
Muscle soreness--decreased interest in sex
Chest pain--Dry skin
Trouble staying asleep--decreased interest in sex
Nausea--Decreased appetite
Vomiting--Trouble staying asleep
Restless legs--difficulty becoming sexually aroused
Dry mouth--decreased interest in sex
Dry mouth--Bone or joint pain
Vomiting--Shortness of breath
Dry mouth--Feeling nervous
Diarrhea--Feeling anxious
Swelling in legs--difficulty becoming sexually aroused
Constipation--Trouble staying asleep
Dry skin--Feeling sad
Constipation--Trouble falling asleep
Nausea--Muscle soreness
Constipation--Swelling in legs
Nausea--Fatigue
Difficulty concentrating--Trouble staying asleep
Chest pain--Trouble falling asleep
Constipation--Difficulty concentrating
Muscle soreness--Trouble falling asleep
Difficulty concentrating--decreased interest in sex
Dizziness--Dry mouth
Nausea--Shortness of breath
Nausea--Feeling nervous
Headache--Feeling anxious
Swelling in legs--Itching
Feeling nervous--Trouble staying asleep
Nausea--Feeling sad
Bone or joint pain--Headache
Dry skin--difficulty becoming sexually aroused
Bone or joint pain--Chest pain
Shortness of breath--decreased interest in sex
Vomiting--decreased interest in sex
Feeling nervous--decreased interest in sex
Headache--Dry skin
Restless legs--decreased interest in sex
Swelling in legs--Dizziness
Fatigue--decreased interest in sex
Restless legs--Feeling sad
Dizziness--Trouble staying asleep
Feeling sad--decreased interest in sex
Diarrhea--decreased interest in sex
Vomiting--Swelling in legs
Muscle soreness--Feeling sad
Itching--Feeling sad
Shortness of breath--Headache
Headache--Difficulty concentrating
Nausea--Dry mouth
Swelling in legs--Headache
Dry mouth--Feeling sad
Bone or joint pain--decreased interest in sex
Decreased appetite--Dizziness
Constipation--Decreased appetite
Dizziness--Feeling anxious
Diarrhea--Fatigue
Dizziness--Muscle soreness
Decreased appetite--Bone or joint pain
Swelling in legs--Feeling sad
Chest pain--decreased interest in sex
Diarrhea--Restless legs
Muscle cramp--Difficulty concentrating
Difficulty concentrating--Feeling nervous
Nausea--Vomiting
Trouble falling asleep--Trouble staying asleep
Dizziness--Headache
Dry skin--Itching
Feeling sad--Feeling anxious
decreased interest in sex--difficulty becoming sexually aroused
Feeling nervous--Feeling sad
Shortness of breath--Feeling nervous
Swelling in legs--Restless legs
Shortness of breath--Chest pain
Decreased appetite--Fatigue
Feeling anxious--difficulty becoming sexually aroused
Chest pain--Headache
Bone or joint pain--Muscle soreness
Muscle cramp--Muscle soreness
Dry skin--Trouble staying asleep
Vomiting--Difficulty concentrating
Fatigue--Dry mouth
Decreased appetite--Difficulty concentrating
Chest pain--Muscle soreness
Decreased appetite--Trouble falling asleep
Vomiting--Feeling nervous
Swelling in legs--Bone or joint pain
Constipation--Nausea
Difficulty concentrating--Feeling anxious
Diarrhea--difficulty becoming sexually aroused
Itching--Trouble falling asleep
Dry mouth--Trouble staying asleep
Itching--decreased interest in sex
Difficulty concentrating--Dry skin
Headache--Feeling sad
Difficulty concentrating--Trouble falling asleep
Restless legs--Trouble falling asleep
Bone or joint pain--Trouble falling asleep
Decreased appetite--Muscle cramp
Fatigue--Dry skin
Dizziness--Fatigue
Constipation--Fatigue
Diarrhea--Headache
Bone or joint pain--difficulty becoming sexually aroused
Fatigue--Itching
Headache--Muscle soreness
Vomiting--Decreased appetite
Muscle soreness--Difficulty concentrating
Muscle cramp--Itching
Trouble falling asleep--decreased interest in sex
Diarrhea--Dizziness
Fatigue--Feeling anxious
Trouble staying asleep--difficulty becoming sexually aroused
Shortness of breath--Fatigue
Swelling in legs--Muscle soreness
Dry mouth--Itching
Diarrhea--Trouble falling asleep
Diarrhea--Feeling sad
Shortness of breath--Trouble staying asleep
Swelling in legs--Shortness of breath
Constipation--Dry mouth
Itching--Trouble staying asleep
Restless legs--Difficulty concentrating
Dizziness--Dry skin
Dry skin--decreased interest in sex
Constipation--Feeling nervous
Fatigue--Trouble falling asleep
Fatigue--Headache
Vomiting--Chest pain
Dry mouth--Headache
Dry mouth--Dry skin
Fatigue--Trouble staying asleep
Constipation--Dizziness
Decreased appetite--Feeling anxious
Diarrhea--Dry skin
Shortness of breath--Feeling anxious
Dizziness--Difficulty concentrating
Dizziness--Bone or joint pain
Restless legs--Feeling nervous
Feeling anxious--decreased interest in sex
Muscle soreness--Dry skin
Bone or joint pain--Itching
Swelling in legs--Fatigue
Restless legs--Trouble staying asleep
Muscle cramp--Fatigue
Feeling nervous--Feeling anxious
Muscle cramp--Dry mouth
Constipation--Shortness of breath
Fatigue--Bone or joint pain
Swelling in legs--Feeling nervous
Muscle cramp--Bone or joint pain
Shortness of breath--Dry skin
Muscle cramp--Trouble falling asleep
Constipation--Bone or joint pain
Nausea--Dizziness
Diarrhea--Difficulty concentrating
Muscle soreness--decreased interest in sex
Chest pain--Dry skin
Trouble staying asleep--decreased interest in sex
Nausea--Decreased appetite
Vomiting--Trouble staying asleep
Restless legs--difficulty becoming sexually aroused
Dry mouth--decreased interest in sex
Dry mouth--Bone or joint pain
Vomiting--Shortness of breath
Dry mouth--Feeling nervous
Diarrhea--Feeling anxious
Swelling in legs--difficulty becoming sexually aroused
Constipation--Trouble staying asleep
Dry skin--Feeling sad
Constipation--Trouble falling asleep
Nausea--Muscle soreness
Constipation--Swelling in legs
Nausea--Fatigue
Difficulty concentrating--Trouble staying asleep
Chest pain--Trouble falling asleep
Constipation--Difficulty concentrating
Muscle soreness--Trouble falling asleep
Difficulty concentrating--decreased interest in sex
Dizziness--Dry mouth
Nausea--Shortness of breath
Nausea--Feeling nervous
Headache--Feeling anxious
Swelling in legs--Itching
Feeling nervous--Trouble staying asleep
Nausea--Feeling sad
Bone or joint pain--Headache
Dry skin--difficulty becoming sexually aroused
Bone or joint pain--Chest pain
Shortness of breath--decreased interest in sex
Vomiting--decreased interest in sex
Feeling nervous--decreased interest in sex
Headache--Dry skin
Restless legs--decreased interest in sex
Swelling in legs--Dizziness
Fatigue--decreased interest in sex
Restless legs--Feeling sad
Dizziness--Trouble staying asleep
Feeling sad--decreased interest in sex
Diarrhea--decreased interest in sex
Vomiting--Swelling in legs
Muscle soreness--Feeling sad
Itching--Feeling sad
Shortness of breath--Headache
Headache--Difficulty concentrating
Nausea--Dry mouth
Swelling in legs--Headache
Dry mouth--Feeling sad
Bone or joint pain--decreased interest in sex
Decreased appetite--Dizziness
Constipation--Decreased appetite
Dizziness--Feeling anxious
Diarrhea--Fatigue
Dizziness--Muscle soreness
Decreased appetite--Bone or joint pain
Swelling in legs--Feeling sad
Chest pain--decreased interest in sex
Diarrhea--Restless legs
Muscle cramp--Difficulty concentrating
Difficulty concentrating--Feeling nervous


expectedInfluence
strength
1.0
0.5
0.0
-0.5
-1.0
Average correlation with original sample
90%
80%
70%
60%
50%
40%
30%
Sampled cases


Factor1
Factor2
Factor3
Factor4
Factor5
Factor6
Symptomproblemlist
Effectsofkidneydisease
Burdenofkidneydisease
Workstatus
Cognitivefunction
Qualityofsocialinteraction
Sexualfunction
Sleep
Socialsupport
Dialysisstaffencouragement
OverallHealth
Patientsatisfaction
Physicalfunctioning
Rolephysical
Pain
Generalhealth
Emotionalwellbeing
Roleemotional
Socialfunction
Energyfatigue
SF12PhysicalComposite
SF12MentalComposite
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1


Factor1
Factor2
Factor3
Factor4
Factor5
Factor6
WBC
NEU
RBC
HB
PLT
1.00
0.43
0.45
0.49
0.47
0.37
0.91
0.10
0.83
0.43
0.38
***
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1

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