European Psychiatry

www.cambridge.org/epa

A network approach to lifestyle behaviors and health outcomes in people with mental illness: the MULTI+ study III

Natascha M. den Bleijker[1,2], Myrthe M. E. van Schothorst[1,3], Tessa F. Blanken[4,5], Ingrid J. M. Hendriksen[6], Wiepke Cahn[2,7] and Jeroen Deenik[1,2,3]

[1]Scientific Research Department, GGz Centraal, Amersfoort, the Netherlands; [2]Department of Psychiatry, UMC Utrecht Brain Center, University Medical Center Utrecht, Utrecht University, Utrecht, the Netherlands; [3]School for Mental Health and Neuroscience, Faculty of Health, Medicine and Life Sciences, Maastricht University, Maastricht, the Netherlands; [4]Department of Psychological Methods, University of Amsterdam, Amsterdam, the Netherlands; [5]Department of Clinical Psychology, University of Amsterdam, Amsterdam, the Netherlands; [6]LivIng Active, Santpoort-Zuid, the Netherlands and [7]Altrecht, General Menthal Health Care, Utrecht, the Netherlands

Research Article

Cite this article: den Bleijker NM, van Schothorst MME, Blanken TF, Hendriksen IJM, Cahn W, Deenik J (2025). A network approach to lifestyle behaviors and health outcomes in people with mental illness: the MULTI+ study III. *European Psychiatry*, **68**(1), e53, 1–10
https://doi.org/10.1192/j.eurpsy.2025.2442

Received: 04 April 2024
Revised: 08 October 2024
Accepted: 12 March 2025

Keywords:
lifestyle behavior; physical health; mental health; network approach; sleep

Corresponding author:
Natascha M. den Bleijker;
Email: n.denbleijker@ggzcentraal.nl

Abstract

Background. Unhealthy lifestyle behaviors are prevalent among people with mental illness (MI), affecting their physical and mental health. Most research has focused on the isolated effects of lifestyle behaviors, leaving the interconnectedness between these behaviors and health outcomes unexplored. This study aimed to examine these relationships and identify the most strongly connected lifestyle behavior or health outcome within a network.

Methods. We conducted a cross-sectional study with 423 inpatients with MI, receiving care as usual. Lifestyle behaviors, physical and mental health outcomes were assessed through questionnaires and routine data. A Gaussian Graphical Model was estimated, and strength centrality was calculated to identify the most influential nodes.

Results. Mean age was 55.5 years, 42% were female, and 41% were diagnosed with schizophrenia. Psychological and physical quality of life (QoL), nighttime sleep problems, and overall sleep quality were the most strongly connected nodes. Sleep was strongly associated with physical QoL. Furthermore, there were negative associations between healthy food intake and cholesterol ratio, and positive associations between daily doses of antipsychotics and length of hospital stay. Node strength was stable (CS(cor = 0.7) = 0.75). No clear pattern emerged among other lifestyle behaviors and health outcomes.

Conclusions. This study offers insights into the interrelatedness of lifestyle behaviors and health outcomes. Addressing sleep problems could enhance QoL and potentially influence other health outcomes. Psychological and physical QoL were also strongly associated, emphasizing the importance of perceived well-being in health outcomes. Future research could explore causal pathways to identify treatment targets to improve care.

Introduction

Unhealthy lifestyle behaviors, such as physical inactivity, unhealthy diet, a poor sleep pattern, and substance use, are prevalent among people with mental illness (MI) [1,2]. In recent years, these behaviors have gained more attention in mental health care due to their substantial role in the development of physical conditions, such as cardiovascular disease, obesity, and diabetes mellitus [1,3,4]. These physical conditions contribute significantly to the disability and mortality of people with MI, leading to a reduced life expectancy of up to 20 years compared to the general population [5,6]. Despite extensive evidence and calls for action [7,8], the mortality gap persists. Moreover, the proportion of physical conditions appears to be increasing in people with MI, so promoting a healthier lifestyle is necessary and warrants additional investment [9].

Lifestyle behaviors not only impact physical health but are also linked to the onset and persistence of mental disorders. Growing evidence supports the efficacy of lifestyle interventions in improving both physical and mental health [2,10–14]. Furthermore, a comprehensive meta-review investigated how various lifestyle behaviors individually affect the onset and treatment of mental disorders [2]. However, it also highlights the predominant focus on the isolated effects of individual lifestyle behaviors. Since lifestyle behaviors do not occur in isolation, it is crucial to gain more understanding of their interrelations.

Research into lifestyle behaviors has primarily focused on physical activity (PA), which is strongly linked to other lifestyle behaviors [2]. Regular PA has been shown to improve sleep quality [15], while sleep deprivation can reduce motivation for exercise and lower overall activity levels

EUROPEAN PSYCHIATRIC ASSOCIATION

[16]. Poor sleep quality can also lead to lowered mood and reduced impulse control, making it more difficult to maintain healthy behaviors [17]. Additionally, PA also plays a role in cognitive functioning and executive planning, which can help with better meal planning and healthier food choices [18]. Conversely, sleep problems can increase dietary intake due to extended wakefulness and disrupted hormonal regulation, increasing cravings for unhealthy foods [19]. Furthermore, lifestyle behaviors such as smoking complicate these relationships. While nicotine has a stimulant effect which reduces the quality of sleep [20], smoking cessation may increase appetite, which may lead to weight gain. These examples illustrate the interconnected nature of lifestyle behaviors, influencing each other in ways that can either support or hinder mental and physical health outcomes. It is therefore crucial that we gain an understanding of how these behaviors are interrelated, to address multiple lifestyle behaviors simultaneously.

The network approach offers a powerful method for exploring these complex relationships [21,22]. A psychological network consists of nodes representing observed variables, connected by edges representing statistical relationships [23]. For example, the Gaussian Graphical Model (GGM) estimates a network of partial correlation coefficients. These coefficients represent the strength of a relation between two variables after controlling for the other variables in the model [24]. Furthermore, by assessing network parameters like node strength, we can gain insight into which nodes are more strongly connected than others. Strongly connected nodes may signal symptoms that could potentially play an important role in stabilizing the network and may be investigated as treatment targets [16].

This study aims to explore the relationships among lifestyle behaviors and health outcomes and to identify the most central lifestyle behavior or health outcome in this network. In line with the exploratory nature of this study, there were no specific predictions about which behavior or health outcome was most central. Nevertheless, given the associations between lifestyle behaviors and mental and physical health, we hypothesized that these behaviors were interconnected rather than independent. Understanding these interconnections could inform treatment and guide future research to address the challenges people with MI face in improving their health.

Methods

Study design and setting

This study is based on cross-sectional data, collected as part of a larger trial evaluating the effectiveness and implementation of a lifestyle-focused approach for inpatients with MI (MULTI+) [20]. The overarching trial was conducted at GGz Centraal, a mental healthcare facility in the Netherlands, comprising 45 inpatient wards grouped into three clusters with approximately 800 places of residence. During the trial, all clusters initially delivered care as usual (CAU), and every six months one cluster transitioned to MULTI+ until all clusters had switched. Measurements were collected at the start of the trial, and subsequently at a six-month interval (after 6, 12, and 18 months) across all clusters. For the present study, we used data collected prior to each cluster´s transition from CAU to MULTI+, thereby providing insights into lifestyle behavior and health outcomes of people with MI receiving CAU.

Study population

People were included if they were aged ≥16 years and had a treatment duration exceeding 10 days within one of the psychiatric wards. This time frame was pragmatically chosen to ensure that patients had sufficient exposure to treatment conditions. People were excluded if they had a limited understanding of the Dutch language or their (mental) health condition hindered informed consent.

Procedure

Data were collected during CAU, which includes pharmacological and psychological treatment, without structured lifestyle interventions. Instead, lifestyle-related activities varied between individuals or teams, depending on specific needs and available resources. Data were collected from routine screening and questionnaires. These questionnaires were administered as semi-structured interviews by trained research assistants (RAs), allowing for additional clarification when needed. We collaborated with staff across 45 wards to determine the optimal conditions for conducting the semi-structured interviews, including the best time of day and location. RAs were present for several days, approaching potential participants with support from staff. RAs received training and followed a standardized interview protocol, while weekly consensus meetings were held to ensure data quality. Participants provided verbal informed consent. This procedure was employed to visually communicate the study's objectives and methodologies, enhancing comprehension for participants. A full description of the procedures can be found in den Bleijker et al. (2020) [25].

Outcomes

Demographic characteristics were obtained from the electronic patient file. Study measures and psychometric properties are outlined in Table 1, with a comprehensive description available in den Bleijker et al. (2020) [25]. Since lifestyle behaviors are central to our study, we included multiple nodes to capture their nuances, whereas for other variables, we used composite scores to reduce complexity while ensuring robust estimation.

Lifestyle behaviors

Physical activity was measured with the Simple Physical Activity Questionnaire (SIMPAQ; [26]), a reliable and valid tool for assessing physical activity in people with severe MI. Sleep problems were measured with the validated Scales for Outcomes in Parkinson's disease Sleep (SCOPA SLEEP; [27]). We categorized smoking behavior according to the categorization of the QRISK3 algorithm [28], in line with the primary outcome measure of the MULTI+ trial. We used the 24-hour recall (24HR) method to measure dietary intake quality, in which foods and beverages consumed over the past 24 hours are assessed. We evaluated this according to the National Food-based Dietary Guidelines (FBDG). The "Wheel of Five" (WoF) is part of the FBDG and includes food groups associated with a reduced risk for chronic diseases [29]. Each recalled food item was classified within or outside the WoF and ranked on a 1–3 scale (1 = below guideline, 2 = meets guideline, 3 = exceeds guideline). This (classification) method is not validated, but was reviewed by a dietitian and consensus meetings were held to improve consistency.

Physical health

We used body mass index (BMI), cholesterol ratio, and mean arterial pressure (MAP) to assess physical health. Additionally, we incorporated the Physical Quality of Life (QoL) scale from the validated World Health Organization Quality of Life-BREF

https://doi.org/10.1192/j.eurpsy.2025.2442 Published online by Cambridge University Press

Table 1. Description of outcome measures and their psychometric properties

Domain	Instrument and properties	Measure/domain	Calculation of item
Lifestyle behaviors	**SIMPAQ**: Reliability assessments show acceptable to good consistency, with Spearman correlation coefficients ranging from $\rho = 0.63$ to $\rho = 0.76$. The validity for moderate-to-vigorous physical activity is $\rho = 0.25$ across the full sample, aligning with findings from studies in the general population. Due to insufficient evidence supporting the validity of self-reported sedentary behavior, an alternative calculation method is recommended, which we used [53].	Sedentary behavior	Subtraction of the total self-reported time spent in various forms of non-sedentary behavior (time spent in bed, walking, exercising, and engaging in incidental activities) from the total duration of 24 hours (hours/day).
		Walking	Self-reported time spent walking (hours/week).
		Moderate to vigorous physical activity	Self-reported time spent exercising (hours/week).
	SCOPA SLEEP Demonstrated strong reliability for both nighttime sleep problems ($\alpha = 0.88$) and daytime sleep problems ($\alpha = 0.91$), as well as good construct validity in a Dutch sample of individuals with Parkinson's disease. Scores on all domains showed high correlations with established, validated instruments assessing the same constructs [54].	Overall sleep quality	1 item to evaluate overall quality of sleep, scored on a 7-point ranging from slept very well to slept very badly.
		Daytime sleep problems	Sum score of 6 items evaluating problems with falling asleep during the day. Items are scored on a 4-point Likert scale ranging from 0 (not at all/never) to three (a lot/often).
		Nighttime sleep problems	Sum score of 5 items evaluating insomnia. Items are scored on a 4-point Likert scale ranging from 0 (not at all/never) to 3 (a lot/often).
	Routine screening Data is routinely collected by healthcare professionals as part of standard care. In line with the primary outcome measure of the overarching trial, we categorized smoking behavior according to the QRISK3 algorithm [55].	Smoking behavior	1 non-smoker 2 ex-smoker 3 light smoker (less than 10) 4 moderate smoker (10 to 19) 5 heavy smoker (20 or over)
	24-hour recall A retrospective method used to quickly assess an individual's food intake. For this study, a 24-hours recall was designed using the five-pass method. This method is commonly used and reduces bias [56]. The method is not validated, but consensus meetings were held to discuss uncertainties regarding food items, and a dietician reviewed decisions.	Percentage of healthy food intake	The percentage of healthy food intake as a proportion of the total food intake. Food intake is evaluated to determine whether it belongs within or outside the food groups outlined in the Wheel of Five. Within each food group, rankings "1", "2", or "3" were assigned to each consumed food item (1 = below guideline, 2 = meets guideline, 3 = exceeds guideline). Rankings are aggregated and the percentage of healthy food intake is calculated by dividing the ranking assigned to healthy food intake by the total ranking assigned to all types of food intake.
Physical health	**Routine screening** Data is routinely collected by healthcare professionals as part of standard care	Body Mass Index	Weight (kg) divided by the square of height (cm)
		Cholesterol ratio	Total cholesterol level (HDL + LDL) divided by HDL cholesterol level
		Mean Arterial Pressure	DP + 1/3(SP – DP)
	WHOQOL-BREF Shows acceptable to good internal consistency ($\alpha = 0.66$ to $\alpha = 0.80$), and has also been validated in people with schizophrenia, showing strong content and construct validity [57].	Physical QoL	Item scores have various options but always range from one to five, such as very poor to very good, or not at all to extremely, and are converted to domain scores (range from four to 20) [58]. Mean score of 7 items, ranging from 0 to 5[a]
Mental health	**BSI** Internal consistency ranges from $\alpha = 0.71$ to $\alpha = 0.85$, and the BSI is considered a reliable measure over time [59]. In a Dutch sample, it showed acceptable validity, sufficient test-retest reliability, and strong internal consistency, with $\alpha > 0.80$ on eight of the nine scales [60].	Global Severity Index	The BSI consists of 53 items that reflect 9 symptom domains; each item is rated on a 5-point scale from 0 (not at all) to 4 (extremely). The GSI combines information about the number of symptoms and the intensity of distress. It is calculated by summing the 9 symptom dimensions, divided by the total number of items to which the individual responded [59].
	WHOQOL-BREF See psychometric properties in the physical health domain	Environmental QoL	Mean score of 8 items[a]
		Psychological QoL	Mean score of 6 items[a]
		Social QoL	Mean score of 3 items[a]
Medication	Information on medication use is obtained from the pharmacy's electronic system.	Dose of antipsychotics	DDD of ATC classification N05A
		Dose of antidepressants	DDD of ATC classification N06A

Abbreviations: SIMPAQ, Simple Physical Activity Questionnaire; SCOPA, SLEEP Scales for Outcomes in Parkinson's disease Sleep; DP, Diastolic blood pressure; SP, Systolic blood pressure; BSI, Brief Symptom Inventory; WHOQoL-BREF, World Health Organization Quality of Life; DDD, Daily Defined Dose; ATC, Anatomical Therapeutic Chemical Classification System.
[a]Answering options differ between questions, such as from very poor to very good, or from not at all to extremely.

(WHOQoL-BREF; [30]) to include a subjective perspective to our assessment of physical health.

Mental health

We used the Global Severity Index (GSI) from the Brief Symptom Inventory (BSI; [31]) to measure symptom severity. The BSI is a validated and shorter questionnaire, which measures symptoms of psychopathology[31]. To measure different domains of quality of life (QoL), the Environmental, Psychological and Social scales of the WHOQoL-BREF were included [30].

Medication

Medication use was obtained from the pharmacy's electronic system. Prescriptions are converted into Daily Defined Dose (DDD) according to the Anatomical Therapeutic Chemical Classification System (ATC) from the World Health Organization (WHO). The DDD is a standardized unit for statistical purposes and represents the presumed average daily maintenance dosage of a drug when prescribed for its main indication [32]. For this study, we calculated the DDD for ATC codes N05A (antipsychotics) and N06A (antidepressants).

Statistical analysis

Questionnaires were processed according to their manuals. Routine screening data were checked for entry errors, which were removed. Any extreme values that were not due to errors were retained to maintain a representative view of the population.

Network construction

We estimated a Gaussian Graphical Model (GGM) incorporating all measures outlined in Table 1 as continuous variables [33]. We used LASSO regularization because the number of included variables was relatively high compared to the number of observations. We opted for a hyper-tuning parameter of 0, resulting in a more lenient inclusion of edges, as our study aim is exploratory [34]. Since many variables were skewed, we used Spearman's rank-correlation and pairwise complete observations to handle missing data [33].

Visualization We used the Fruchterman–Reingold algorithm for the layout of our network [35]. This algorithm positions nodes with high strength and/or more connections closer to each other, and closer to the center of the network. The thickness and saturation of edges are proportional to the strength of the conditional association. Blue edges indicate a positive conditional association, while red edges indicate a negative conditional association [36].

Centrality analysis

We calculated strength centrality to quantify how strongly nodes were connected to other nodes in the network. Node strength is calculated by summing the absolute weighted number and strength of all edges of a node and comparing it to those of all other nodes in the network [37].

Network accuracy

Before interpreting the network, we evaluated the accuracy and stability of the estimated network. We followed the bootstrap procedures as described in Epskamp et al. (2018) [24]. First, we examined the stability of strength centrality using a case-dropping bootstrap based on 1000 samples (re-estimating the network with a different number of observations). This method quantifies the stability of the order of strength centrality with the correlation stability coefficient (CS-coefficient). A CS coefficient of 0.7 is considered reliable. Second, we evaluated the accuracy of the edge weights. We used non-parametric bootstrapping based on 1000 samples (observations are resampled with replacement, creating new datasets). Third, we performed bootstrapped difference tests between the edge weights and the strength indices to test if these differed significantly from each other.

Statistical packages

The analyses were performed in R Statistical Software [38]. For network estimation, we used the *estimateNetwork* function in the *bootnet R* package version 1.5.3 [23]. Furthermore, methods for accuracy analyses are implemented in this package [24]. We used the *qgraph R* package version 1.9.5 to visualize our network [39].

Results

Patient characteristics

The study included 423 patients, of whom 42% were female and 41% had a diagnosis of schizophrenia or another psychotic disorder. The mean age was 55.5 (SD = 17.6, range=19-91), and more than half of the participants were hospitalized for more than a year. Demographic characteristics are described in Table 2. Analyses were conducted with and without extreme values. Because the results showed no substantial differences, the results including extreme values are presented.

Table 2. Patient characteristics

	N[a]		Min–Max
Sex, *n (%) female*	423	179 (42.3)	
Age in years, *m* (sd)	423	55.5 (17.6)	19–91
Diagnosis, *n* (%)	418		
• Schizophrenia and other psychotic disorders		175 (41.4)	
• Substance abuse disorder		70 (16.5)	
• Bipolar disorder		49 (11.6)	
• Depressive disorder		38 (9)	
• Neurodevelopmental disorder		30 (7.1)	
• Other diagnoses[b]		61 (14.4)	
Days of hospitalization, *m* (sd)	423	605 (602)	12 – 2370
• >5 years, *n* (%)		28 (6.6)	
• 1–5 years, *n* (%)		192 (45.4)	
• <1 year, *n* (%)		203 (48)	
• <1 month, *n* (%)		20 (4.7)	
Lifestyle behavior			
Sleep, *m* (sd)			
• Overall sleep quality (0–6)	412	2.3 (1.8)	0 – 6
• Daytime sleep problems (0–18)	400	1.7 (2.7)	0 – 18
• Nighttime sleep problems (0–15)	408	4.1 (4.3)	0 – 15
Smoking behavior: yes, n (%)	262	162 (59.6)	
• Non-smoker		58 (13.7)	
• Ex-smoker		50 (11.8)	
• Light smoker (<10 cigarettes)		40 (9.5)	

Continued

https://doi.org/10.1192/j.eurpsy.2025.2442 Published online by Cambridge University Press

Table 2. *Continued*

	N^a		Min–Max
• Moderate smoker (10–19 cigarettes)		57 (13.5)	
• Heavy smoker (>20 cigarettes)		57 (13.5)	
Percentage healthy food intake, *m* (sd)	146	47.7 (15.5)	7–90
Physical Activity, *m* (sd)			
• Sedentary behavior (hours/day)	366	13.4 (2.1)	6.5–19.7
• Walking (min/week)	389	142.4 (157.4)	0–840
• Moderate-to-vigorous physical activity (min/week), *m* (sd)	385	49.3 (71.8)	0 – 323
Physical health			
Body mass index (BMI), *m* (sd)	304	26.8 (5.8)	11.5–44.9
Cholesterol ratio (mmol/l), *m* (sd)	162	4.3 (1.7)	1.4–10.2
Mean arterial pressure (mmHg), *m* (sd)	372	97.5 (10.5)	70–123.3
Physical quality of life (7–35)	299	14.1 (3.2)	5.1–20
Mental health			
Global severity index (0–4)	276	2 (0.6)	1–3.6
Environmental quality of life (8–40)	300	14.4 (2.7)	5.5–19.5
Psychological quality of life (6–30)	298	13 (3.5)	4.7–19.3
Social quality of life (3–15)	297	13.6 (3.7)	4–20
Medication[c]	423		
• Antipsychotic medication use: yes, *n* (%)		295 (69.7)	
◦ Antipsychotic medication (DDD)	295	.92 (1.2)	0–7.8
▪ Olanzapine	95	1.25 (0.99)	0.25–6
▪ Clozapine	68	0.75 (0.65)	0.04–3
▪ Quetiapine[d]	66	0.34 (0.4)	0.03–2.25
• Antidepressant medication use: yes, *n (%)*		142 (33.6)	
◦ Antidepressant medication (DDD)		.51 (1.2)	0–12
▪ Citalopram	23	0.05 (0.28)	0–2
▪ Nortriptyline	20	0.03 (0.17)	0–1.33
▪ Escitalopram[e]	17	0.05 (0.30)	0–3

[a]Item frequency varies across variables due to missing values resulting from low screening rates, and because not all patients could complete all questionnaires due to illness severity or cognitive deficits.
[b]Diagnoses in this category are: personality disorder, *n* = 22; neurocognitive disorder, *n* = 11; anxiety disorder, n = 7; trauma and stressor-related disorder, *n* = 7; somatic symptom disorder, *n* = 4; other, *n* = 5; missing, *n* = 5.
[c]The defined daily doses (DDDs) of the three most frequently prescribed antipsychotics and antidepressants are noted.
[d]Other antipsychotics prescribed, in order of prevalence, are: haloperidol, *n* = 38; aripiprazole, *n* = 32; risperidone, *n* = 28; zuclopenthixol, *n* = 20; amisulpride, *n* = 14; flupentixol, *n* = 12; pipamperone, *n* = 9; penfluridol, *n* = 8, paliperidone, *n* = 5, chlorpromazine, *n* = 4; pimozide, *n* = 4; sulpiride, *n* = 2.
[e]Other antidepressants prescribed, in order of prevalence, are: clomipramine, *n* = 14; paroxetine, *n* = 14; venlafaxine, *n* = 12; mirtazapine, *n* = 11; tranylcypromine, *n* = 11; fluoxetine, *n* = 9; sertraline, *n* = 8; bupropion, *n* = 8; fluvoxamine, *n* = 7; amitriptyline, *n* = 3; imipramine, *n* = 1; dusolepin, *n* = 1; trazodone, *n* = 1.

Network analysis

The network structure in Figure 1 illustrates the conditional associations among lifestyle behaviors, physical health, and mental health outcomes. Each node represents a symptom or behavior, while each edge depicts a bidirectional partial correlation between the nodes, considering all other associations in the network. The accompanying strength centrality indices are presented in Figure 2.

Generally, we observe a network structure in which all nodes are connected to at least one other node in the network. The nodes with the highest strength centrality are psychological QoL (15), physical QoL (12), nighttime sleep problems (2), and overall sleep quality (1). Supplementary Figure 3 in the supplement provides an overview of the (non)significant differences between strength centrality indices.

When investigating the strength of the nodes related to lifestyle behavior, nighttime sleep problems (2) were stronger than almost half of the nodes in the network. Overall sleep quality (1) cannot be shown to be significantly different from many other nodes (see Supplementary Figure 3). A strong positive connection existed between overall sleep quality and nighttime sleep problems (1–2). Furthermore, sleep was strongly associated with physical QoL, with associations between both overall sleep quality and physical QoL (1–12) and nighttime sleep problems and physical QoL (2–12). In terms of strength, psychological QoL (15) and physical QoL (12) were statistically stronger than most of the other nodes (see Supplementary Figure 3). All QoL nodes (12, 14, 15, 16) are positively associated, indicating that higher QoL in one domain is associated with higher QoL in other domains.

Additionally, we observed strong negative associations between psychological QoL and both the daily dose of antidepressants (15–18) and Global Severity Index (15–13). This suggests that psychological QoL is probably lower when people take higher doses of antidepressants or when they experience more severe symptoms (and vice versa). Other strong associations in the network include the negative association between the percentage of healthy food intake and cholesterol ratio (5–10) and the positive association between daily doses of antipsychotics and length of hospital stay (17–20). No clear pattern of relationships emerged among other lifestyle behaviors or physical health outcomes.

Network accuracy

Results of the accuracy analyses are available in the supplement. We quantified the stability of node strength with the CS–coefficient, which indicated that node strength stability is good and that 75% of the sample can be dropped to still maintain a correlation of 0.7 with the original strength metrics as computed on the entire sample (S (cor = 0.7) = 0.75; Supplementary Figure 1). Thus, the order of the variables as indexed by strength can be interpreted. Supplementary Figure 2 shows that the edges between the strongest nodes (e.g., 1–2, 12–15, 1–12, and 2–12) were present in all of the bootstrapped samples, and differed from approximately half of the other edge weights (Supplementary Figure 4).

Sensitivity analyses

We estimated a post-hoc network excluding antipsychotic medication use (given its impact on lifestyle behavior and health outcomes) and conducted subgroup analyses for individuals aged 65 and younger, and those with schizophrenia and other psychotic disorders. Visualizations show that most of the links are similar across networks. Additionally, the correlation between edge-weight matrices is high (r = 0.81–0.93), indicating that results remain consistent across subgroups. Results are provided in Appendix 2 of the supplement. These findings support the robustness of our original findings.

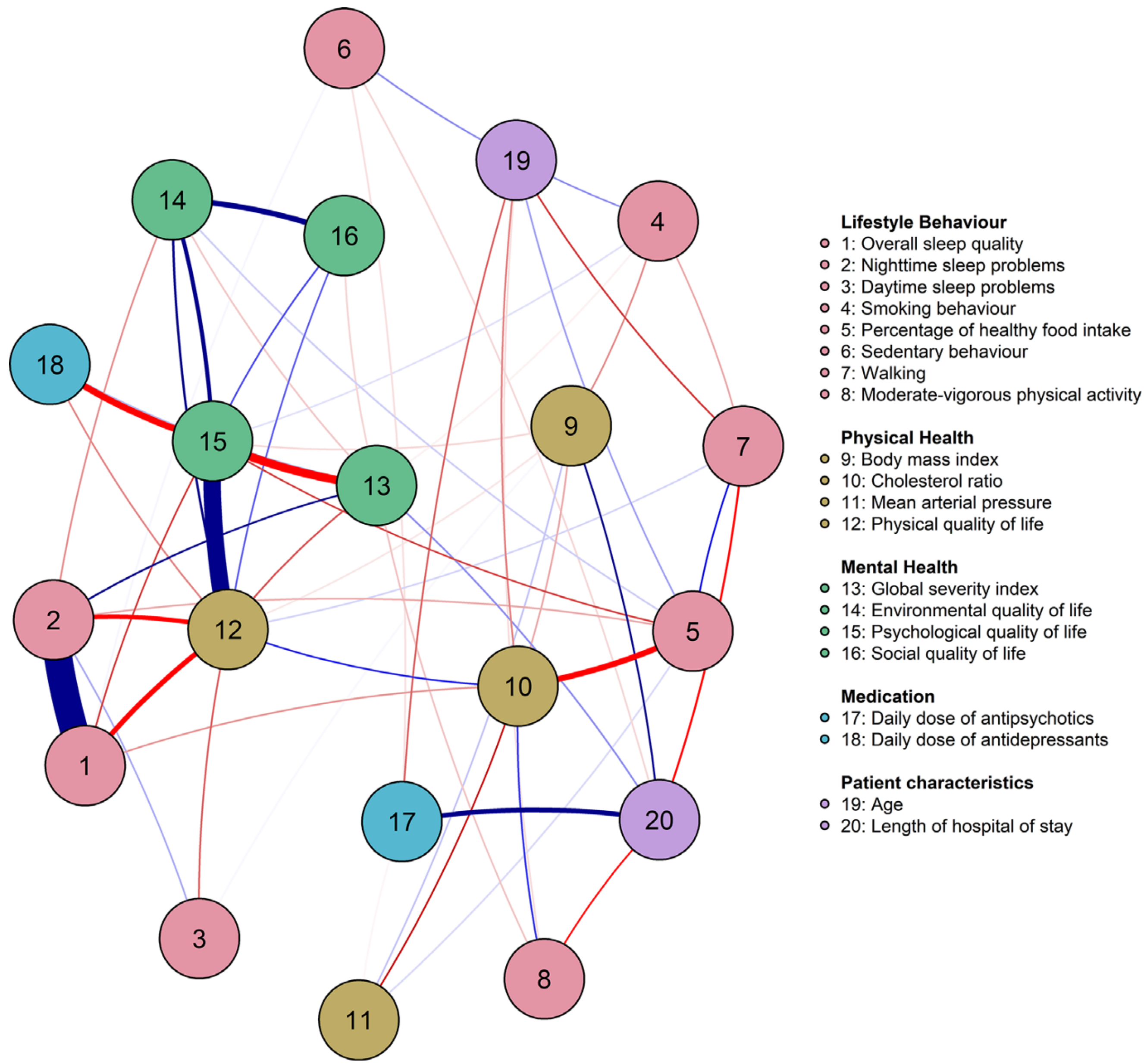

Figure 1. Graphical representation of the estimated network model, including lifestyle behaviors, physical health, and mental health, differentiated by colors. Blue edges indicate a positive conditional association, and red edges indicate a negative conditional association. The thickness and saturation of edges are proportional to the strength of the conditional association. Higher scores on overall sleep quality mean more overall sleep problems.

Discussion

This study applied a network approach to explore the complex interrelations among lifestyle behaviors and physical and mental health outcomes in people with MI. Sleep and QoL emerged as the most central nodes, based on strength centrality. Constructing this exploratory network provides valuable insights into the importance of lifestyle behaviors, health outcomes, and their interconnectedness. This complements current evidence in which such relationships were mainly analyzed in isolation.

Sleep emerged as the most strongly connected lifestyle behavior, and results indicate that sleep and QoL are related (i.e., people with more sleep problems may have a lower QoL and vice versa). The well-established association between sleep disturbances and reduced QoL is particularly relevant for people with MI, who often experience sleep problems, affecting their physical and mental health [40]. Furthermore, evidence is increasing for the causal role of sleep in both the onset and treatment of various mental disorders [11]. Despite this, sleep is often perceived as a consequence of MI, rather than as a symptom to address. Sleep problems are often treated pharmacologically, which helps with sleep duration but negatively affects sleep quality and hinders daytime activity in the long term due to its sedative nature [41]. Our findings underscore the importance of addressing sleep problems because improving sleep quality has the potential to impact other health-related outcomes in people with MI, especially QoL [42].

QoL was another central node, particularly the psychological and physical domains. These domains address the intrinsic experiences of individuals, unlike the social and environmental

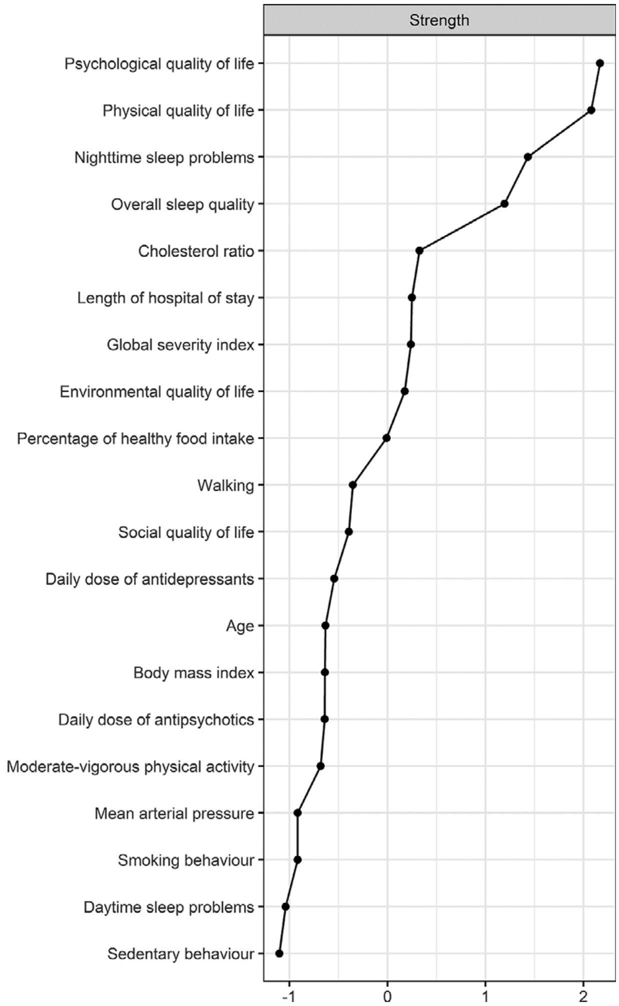

Figure 2. Centrality plot illustrating the strength of the nodes in the network depicted in Figure 1. Nodes are ordered from the node with the highest strength to the node with the lowest strength. Node strength quantifies how strongly a node is directly connected to other nodes (summing the absolute value of the edges to each node). All values are standardized, with higher values indicating more centrality.

dimensions of QoL. The strength of these nodes emphasizes the importance of internal experiences of well-being. This aligns with research recognizing the value of such patient-reported outcomes, as they provide direct insights into individuals' perceptions of their own health and quality of life [43]. Furthermore, the strong association between psychological and physical QoL aligns with the well-documented comorbidity between physical and mental health, yet physical health is often neglected in treatment [4]. While clinical guidelines emphasize monitoring and managing physical health risks of people with MI, adherence in clinical practice remains poor [44]. Our results highlight the importance of perceived psychological and physical health and its potential impact on other health-related outcomes.

Contrary to prior research on the relationship between lifestyle behaviors and health outcomes, physical activity, nutrition, and smoking did not emerge as central nodes in our network. One possible explanation lies in methodological factors: the distribution of physical activity was highly skewed, potentially limiting its role in the network; smoking was categorized as a five-level variable, reducing variability; and nutrition was measured using a non-validated method, which may have introduced measurement errors. However, another relevant possibility is that sleep simply plays a more dominant role in this network than other lifestyle behaviors. Sleep is known to affect mood, cognition, and self-regulation, all of which are crucial for maintaining other healthy behaviors [45–47]. This suggests that sleep may be a key factor in improving other lifestyle behaviors, rather than these behaviors independently driving health outcomes. In the context of network analysis, this does not necessarily imply that physical activity, nutrition, or smoking are unimportant, but rather that sleep plays a more central role.

Beyond the centrality of sleep and QoL, several other noteworthy associations were observed. A positive association was found between the percentage of healthy food intake and cholesterol ratio, aligning with existing research in the general population [48]. However, research on this relation remains limited in people with MI, and disrupted cholesterol levels can also be influenced by hereditary factors and psychotropic medication [49]. While our findings suggest a potential link between healthier dietary intake and cholesterol ratio, this estimate was unstable, and more research is needed to investigate this link. Further, the association between the use of antipsychotics and the duration of admission may be explained by the higher illness severity in people with psychotic disorders, who are more frequently and longer hospitalized compared to other psychiatric populations [50]. However, medication effects are complex, and more in-depth analyses of the underlying mechanisms of medication effects were beyond the scope of this analysis. It would be a valuable direction for future research to further explore these interdependencies, providing a more comprehensive understanding of the role of medication in an interconnected network of health behaviors.

Limitations

Several limitations affect the interpretation of our results. First, when two nodes are strongly connected, they may measure the same underlying construct (topological overlap), with the risk of misinterpretation of the network structure [51]. In our network, this concern arises in the association between psychological QoL and physical QoL, as well as between quality of sleep and nighttime sleepiness, as they originate from the same questionnaire. However, these constructs represent distinct domains within a validated questionnaire. Furthermore, results showed that the association between these domains was stable. Another limitation is missing data. The use of routine screening data helped reduce participant burden but also resulted in missing values due to low screening rates. Additionally, not all participants could complete all questionnaires due to illness severity or cognitive deficits. To account for missing values, we used the pairwise complete observations integrated in the *Bootnet package* to estimate a GGM. Finally, skewed variables could have affected the stability of our results.

Clinical implications

Given the central role of sleep, addressing sleep disturbances in treatment may not only improve sleep quality but also positively impact QoL. This can be done through Cognitive Behavioral Therapy for Insomnia, an effective first-line treatment for people with MI that has demonstrated beneficial effects [52]. Furthermore, the centrality of physical QoL underscores the need for better physical health management, especially given the health disparities of people with MI. Likewise, the central role of psychological and physical QoL emphasizes their importance in the health status of people

https://doi.org/10.1192/j.eurpsy.2025.2442 Published online by Cambridge University Press

with MI. While this study is cross-sectional, it underscores the need to prioritize sleep and QoL in both clinical practice and research.

Conclusion and future research

This study provides a novel perspective on the interplay between lifestyle behaviors and physical and mental health outcomes in people with MI. Our findings highlight the central role of sleep and QoL in this network, suggesting that sleep disturbances are important to address in treatment. Building on these results, future research could focus on testing specific (causal) pathways through methods such as mediation analysis or network intervention analysis. For instance, by exploring whether improving sleep as a key lifestyle behavior could enhance quality of life and activate other health outcomes. These approaches would offer a deeper understanding of the mechanisms at play, which was beyond the scope of the current study. Additionally, our findings show the importance of internal experiences of QoL. Given their interconnected nature, we advocate for a holistic therapeutic approach, taking the reciprocal influence of lifestyle behavior and physical and mental health into account to improve the treatment of people with MI.

Abbreviations

24HR	24-hour recall
ATC	Anatomical Therapeutic Chemical Classification System
bCI	bootstrapped Confidence Intervals
BMI	Body Mass Index
BSI	Brief Symptom Inventory
CS-coefficient	Correlation Stability coefficient
DDD	Daily Defined Dose
FBDG	the National food-based dietary guidelines
GGM	Gaussian Graphical Model
GSI	Global Severity Index
LASSO	Least absolute shrinkage and selection operator
MAP	Mean Arterial Pressure
MI	Mental illness
MULTI+	multidisciplinary lifestyle focused approach in the treatment of inpatients with mental illness
QoL	Quality of Life
SCOPA	Scales for Outcomes in Parkinson's Disease
SLEEP	Sleep
SIMPAQ	Simple Physical Activity Questionnaire
WHOQoL-BREF	World Health Organization Quality of Life-BREF
WoF	Wheel of Five

Supplementary material. The supplementary material for this article can be found at https://doi.org/10.1192/j.eurpsy.2025.2442.

Data availability statement. Due to the strict regulations and its sensitive nature, supporting data cannot be made openly available.

Acknowledgements. The authors are grateful to all patients and mental healthcare professionals of GGz Centraal for their time and efforts dedicated to participating in this study. We would also like to thank our research assistants for their contribution to data collection. Additionally, as non-native English speakers, we used Large Language Models (LLM) for AI assisted copy editing (AI-assisted improvements to human-generated texts for readability and style, and to ensure that the texts are free of errors in grammar, spelling, punctuation, and tone). The authors take full accountability for the work presented.

Financial support. This study received funding from " Stichting tot Steun Vereniging tot Christelijke Verzorging van Geestes- en Zenuwzieken", grant number 277. The funding organization had no involvement in the study's design, data collection, analysis, interpretation, or manuscript preparation.

Competing interests. None of the authors have any competing interests

Trial registration. ClinicalTrials.gov registration. Identifier: NCT04922749. Retrospectively registered 3rd of June 2021.

References

[1] Firth J, Siddiqi N, Koyanagi A, Siskind D, Rosenbaum S, Galletly C, et al. The Lancet Psychiatry Commission: a blueprint for protecting physical health in people with mental illness. Lancet Psychiat 2019;6:675–712. https://doi.org/10.1016/S2215-0366(19)30132-4.

[2] Firth J, Solmi M, Wootton RE, Vancampfort D, Schuch FB, Hoare E, et al. A meta-review of "lifestyle psychiatry": the role of exercise, smoking, diet and sleep in the prevention and treatment of mental disorders. World Psychiat 2020;19:360–80. https://doi.org/10.1002/wps.20773.

[3] Correll CU, Solmi M, Veronese N, Bortolato B, Rosson S, Santonastaso P, et al. Prevalence, incidence and mortality from cardiovascular disease in patients with pooled and specific severe mental illness: a large-scale meta-analysis of 3,211,768 patients and 113,383,368 controls. World Psychiat 2017;16:163–80. https://doi.org/10.1002/wps.20420.

[4] Bendayan R, Kraljevic Z, Shaari S, Das-Munshi J, Leipold L, Chaturvedi J, et al. Mapping multimorbidity in individuals with schizophrenia and bipolar disorders: evidence from the South London and Maudsley NHS Foundation Trust Biomedical Research Centre (SLAM BRC) case register. BMJ Open 2022;12:e054414. https://doi.org/10.1136/bmjopen-2021-054414.

[5] Plana-Ripoll O, Pedersen CB, Agerbo E, Holtz Y, Erlangsen A, Canudas-Romo V, et al. A comprehensive analysis of mortality-related health metrics associated with mental disorders: a nationwide, register-based cohort study. Lancet 2019;394:1827–35. https://doi.org/10.1016/S0140-6736(19)32316-5.

[6] Chan JKN, Correll CU, Wong CSM, Chu RST, Fung VSC, Wong GHS, et al. Life expectancy and years of potential life lost in people with mental disorders: a systematic review and meta-analysis. eClinicalMedicine 2023;65:102294. https://doi.org/10.1016/j.eclinm.2023.102294.

[7] Gronholm PC, Chowdhary N, Barbui C, Das-Munshi J, Kolappa K, Thornicroft G, et al. Prevention and management of physical health conditions in adults with severe mental disorders: WHO recommendations. Int J Ment Health Syst 2021;15:22. https://doi.org/10.1186/s13033-021-00444-4.

[8] Stubbs B, Ma R, Schuch F, Mugisha J, Rosenbaum S, Firth J, et al. Physical Activity and Mental Health: A Little Less Conversation, a Lot More Action 2024. https://doi.org/10.1123/jpah.2024-0404.

[9] Plana-Ripoll O, Weye N, Momen NC, Christensen MK, Iburg KM, Laursen TM, et al. Changes Over Time in the Differential Mortality Gap in Individuals With Mental Disorders. JAMA Psychiat 2020;77:648–50. https://doi.org/10.1001/jamapsychiatry.2020.0334.

[10] Stubbs B, Vancampfort D, Hallgren M, Firth J, Veronese N, Solmi M, et al. EPA guidance on physical activity as a treatment for severe mental illness: a meta-review of the evidence and Position Statement from the European Psychiatric Association (EPA), supported by the International Organization of Physical Therapists in Mental Health (IOPTMH). European Psychiat 2018;54:124–44. https://doi.org/10.1016/j.eurpsy.2018.07.004.

[11] Scott AJ, Webb TL, Martyn-St James M, Rowse G, Weich S. Improving sleep quality leads to better mental health: A meta-analysis of randomised controlled trials. Sleep Med Rev 2021;60:101556. https://doi.org/10.1016/j.smrv.2021.101556.

[12] Spanakis P, Peckham E, Young B, Heron P, Bailey D, Gilbody S. A systematic review of behavioural smoking cessation interventions for people with severe mental ill health—what works? Addiction 2022;117: 1526–42. https://doi.org/10.1111/add.15724.
[13] Noetel M, Sanders T, Gallardo-Gómez D, Taylor P, Del Pozo Cruz B, Van Den Hoek D, et al. Effect of exercise for depression: systematic review and network meta-analysis of randomised controlled trials. BMJ 2024: e075847. https://doi.org/10.1136/bmj-2023-075847.
[14] Burrows T, Teasdale S, Rocks T, Whatnall M, Schindlmayr J, Plain J, et al. Effectiveness of dietary interventions in mental health treatment: A rapid review of reviews. Nutr Diets 2022;79:279–90. https://doi.org/10.1111/1747-0080.12754.
[15] Lederman O, Ward PB, Firth J, Maloney C, Carney R, Vancampfort D, et al. Does exercise improve sleep quality in individuals with mental illness? A systematic review and meta-analysis. J Psychiat Res 2019;109: 96–106. https://doi.org/10.1016/j.jpsychires.2018.11.004.
[16] Jurado-Fasoli L, De-la-O A, Molina-Hidalgo C, Migueles JH, Castillo MJ, Amaro-Gahete FJ. Exercise training improves sleep quality: A randomized controlled trial. Eur J Clin Investigation 2020;50:e13202. https://doi.org/10.1111/eci.13202.
[17] Pilcher JJ, Morris DM, Donnelly J, Feigl HB. Interactions between sleep habits and self-control. Front Hum Neurosci 2015;9. https://doi.org/10.3389/fnhum.2015.00284.
[18] Luciano M, Sampogna G, Amore M, Bertolino A, Dell'Osso L, Rossi A, et al. Improving physical activity and diet in patients with severe mental disorders: Results from the LIFESTYLE multicentric, real-world randomized controlled trial. Psychiat Research 2022;317:114818. https://doi.org/10.1016/j.psychres.2022.114818.
[19] Godos J, Grosso G, Castellano S, Galvano F, Caraci F, Ferri R. Association between diet and sleep quality: A systematic review. Sleep Med Rev 2021; 57:101430. https://doi.org/10.1016/j.smrv.2021.101430.
[20] Gordon HW. Differential effects of addictive drugs on sleep and sleep stages. J Addict Res (OPAST Group) 2019;3:10.33140/JAR.03.02.01. https://doi.org/10.33140/JAR.03.02.01.
[21] Robinaugh DJ, Hoekstra RHA, Toner ER, Borsboom D. The network approach to psychopathology: a review of the literature 2008–2018 and an agenda for future research. Psychol Med 2020;50:353–66. https://doi.org/10.1017/S0033291719003404.
[22] Borsboom D, Cramer AOJ. Network analysis: an integrative approach to the structure of psychopathology. Annual Review of Clinical Psychology 2013;9:91–121. https://doi.org/10.1146/annurev-clinpsy-050212-185608.
[23] Epskamp S, Borsboom D, Fried EI. Estimating psychological networks and their accuracy: A tutorial paper. Behav Res 2018;50:195–212. https://doi.org/10.3758/s13428-017-0862-1.
[24] Epskamp S, Waldorp LJ, Mõttus R, Borsboom D. The Gaussian graphical model in cross-sectional and time-series data. Multivariate Behavioral Research 2018;53:453–80. https://doi.org/10.1080/00273171.2018.1454823.
[25] den Bleijker NM, van Schothorst MME, Hendriksen IJM, Cahn W, de Vries NK, van Harten PN, et al. Effectiveness and implementation of a multidisciplinary lifestyle focused approach in the treatment of inpatients with mental illness (MULTI +): a stepped wedge study protocol. BMC Psychiatry 2022;22:230. https://doi.org/10.1186/s12888-022-03801-w.
[26] Rosenbaum S, Morell R, Abdel-Baki A, Ahmadpanah M, Anilkumar TV, Baie L, et al. Assessing physical activity in people with mental illness: 23-country reliability and validity of the simple physical activity questionnaire (SIMPAQ). BMC Psychiatry 2020;20:108. https://doi.org/10.1186/s12888-020-2473-0.
[27] Marinus J, Visser M, van Hilten JJ, Lammers GJ, Stiggelbout AM. Assessment of sleep and sleepiness in Parkinson disease. Sleep 2003;26:1049–54. https://doi.org/10.1093/sleep/26.8.1049.
[28] Hippisley-Cox J, Coupland C, Brindle P. Development and validation of QRISK3 risk prediction algorithms to estimate future risk of cardiovascular disease: prospective cohort study. BMJ 2017;357:j2099. https://doi.org/10.1136/bmj.j2099.
[29] for the Committee Dutch Dietary Guidelines 2015, Kromhout D, Spaaij CJK, De Goede J, Weggemans RM. The 2015 Dutch food-based dietary guidelines. Eur J Clin Nutr 2016;70:869–78. https://doi.org/10.1038/ejcn.2016.52.
[30] World Health Organization. WHOQOL-BREF: introduction, administration, scoring and generic version of the assessment: field trial version 1996; WHO; 1996.
[31] Derogatis LR, Melisaratos N. The brief symptom inventory: an introductory report. Psychological Medicine 1983;13:595–605. https://doi.org/10.1017/S0033291700048017.
[32] World Health Organization. Collaborating Centre for Drug Statistics Methodology. Guidelines for ATC classification and DDD assignment 2021;Oslo, Norway; 2021.
[33] Isvoranu A-M, Epskamp S. Which estimation method to choose in network psychometrics? Deriving guidelines for applied researchers. Psychological Methods 2023;28:925–46. https://doi.org/10.1037/met0000439.
[34] Blanken TF, Isvoranu A-M, Epskamp S. Estimating network structures using model selection. Network Psychometrics with R, Routledge; 2022.
[35] Fruchterman TMJ, Reingold EM. Graph drawing by force-directed placement. Softw Pract Exp 1991;21:1129–64. https://doi.org/10.1002/spe.4380211102.
[36] Jones PJ, Mair P, McNally RJ. Visualizing psychological networks: a tutorial in R. Front Psychol 2018;9. https://doi.org/10.3389/fpsyg.2018.01742.
[37] Hevey D. Network analysis: a brief overview and tutorial. Health Psychology and Behavioral Medicine 2018;6:301–28. https://doi.org/10.1080/21642850.2018.1521283.
[38] R Core Team. R: A language and environment for statistical computing 2021.
[39] Epskamp S, Cramer AOJ, Waldorp LJ, Schmittmann VD, Borsboom D. qgraph: Network visualizations of relationships in psychometric data. J Stat Software 2012;48:1–18. https://doi.org/10.18637/jss.v048.i04.
[40] Stafford A, Oduola S, Reeve S. Sleep and socio-occupational functioning in adults with serious mental illness: a systematic review. Psychiat Res 2024; 339:116111. https://doi.org/10.1016/j.psychres.2024.116111.
[41] Gee B, Orchard F, Clarke E, Joy A, Clarke T, Reynolds S. The effect of non-pharmacological sleep interventions on depression symptoms: a meta-analysis of randomised controlled trials. Sleep Med Rev 2019;43:118–28. https://doi.org/10.1016/j.smrv.2018.09.004.
[42] Freeman D, Sheaves B, Waite F, Harvey AG, Harrison PJ. Sleep disturbance and psychiatric disorders. Lancet Psychiat 2020;7:628–37. https://doi.org/10.1016/S2215-0366(20)30136-X.
[43] Pape LM, Adriaanse MC, Kol J, van Straten A, van Meijel B. Patient-reported outcomes of lifestyle interventions in patients with severe mental illness: a systematic review and meta-analysis. BMC Psychiat 2022;22:261. https://doi.org/10.1186/s12888-022-03854-x.
[44] Noortman L, de Winter L, van Voorst A, Cahn W, Deenik J. Screening and prevalence of cardiometabolic risk factors in patients with severe mental illness: A multicenter cross-sectional cohort study in the Netherlands. Compreh Psychiat 2023;126:152406. https://doi.org/10.1016/j.comppsych.2023.152406.
[45] Fortier-Brochu É, Beaulieu-Bonneau S, Ivers H, Morin CM. Insomnia and daytime cognitive performance: A meta-analysis. Sleep Med Rev 2012;16: 83–94. https://doi.org/10.1016/j.smrv.2011.03.008.
[46] Saksvik-Lehouillier I, Saksvik SB, Dahlberg J, Tanum TK, Ringen H, Karlsen HR, et al. Mild to moderate partial sleep deprivation is associated with increased impulsivity and decreased positive affect in young adults. Sleep 2020;43:zsaa078. https://doi.org/10.1093/sleep/zsaa078.
[47] Tomaso CC, Johnson AB, Nelson TD. The effect of sleep deprivation and restriction on mood, emotion, and emotion regulation: three meta-analyses in one. Sleep 2021;44:zsaa289. https://doi.org/10.1093/sleep/zsaa289.
[48] Schoeneck M, Iggman D. The effects of foods on LDL cholesterol levels: a systematic review of the accumulated evidence from systematic reviews and meta-analyses of randomized controlled trials. Nutr, Metab Cardiovasc Dis 2021;31:1325–38. https://doi.org/10.1016/j.numecd.2020.12.032.
[49] Douglas J, Nasrallah HA. Low high-density lipoprotein and psychopathology: a review. Ann Clin Psychiatry 2019;31:209–13.
[50] Carranza Navarro F, Álvarez Villalobos NA, Contreras Muñoz AM, Guerrero Medrano AF, Tamayo Rodríguez NS, Saucedo Uribe E. Predictors of the length of stay of psychiatric inpatients: protocol for a systematic

review and meta-analysis. Syst Rev 2021;10:65. https://doi.org/10.1186/s13643-021-01616-6.
[51] Fried EI, Cramer AOJ. Moving forward: challenges and directions for psychopathological network theory and methodology. Perspect Psychol Sci 2017;12:999–1020. https://doi.org/10.1177/1745691617705892.
[52] Hertenstein E, Trinca E, Wunderlin M, Schneider CL, Züst MA, Fehér KD, et al. Cognitive behavioral therapy for insomnia in patients with mental disorders and comorbid insomnia: a systematic review and meta-analysis. Sleep Med Rev 2022;62:101597. https://doi.org/10.1016/j.smrv.2022.101597.
[53] Rosenbaum S, Morell R, Abdel-Baki A, Ahmadpanah M, Anilkumar TV, Baie L, et al. Assessing physical activity in people with mental illness: 23-country reliability and validity of the simple physical activity questionnaire (SIMPAQ). BMC Psychiatry 2020;20:108. https://doi.org/10.1186/s12888-020-2473-0.
[54] Marinus J, Visser M, van Hilten JJ, Lammers GJ, Stiggelbout AM. Assessment of Sleep and Sleepiness in Parkinson Disease. Sleep 2003;26:1049–54. https://doi.org/10.1093/sleep/26.8.1049.
[55] Hippisley-Cox J, Coupland C, Brindle P. Development and validation of QRISK3 risk prediction algorithms to estimate future risk of cardiovascular disease: prospective cohort study. BMJ 2017;357:j2099. https://doi.org/10.1136/bmj.j2099.
[56] Moshfegh AJ, Rhodes DG, Baer DJ, Murayi T, Clemens JC, Rumpler WV, et al. The US Department of Agriculture Automated Multiple-Pass Method reduces bias in the collection of energy intakes1. The American Journal of Clinical Nutrition 2008;88:324–32. https://doi.org/10.1093/ajcn/88.2.324.
[57] Trompenaars FJ, Masthoff ED, Van Heck GL, Hodiamont PP, De Vries J. Content validity, construct validity, and reliability of the WHOQOL-Bref in a population of Dutch adult psychiatric outpatients. Qual Life Res 2005;14:151–60. https://doi.org/10.1007/s11136-004-0787-x.
[58] World Health Organization. WHOQOL-BREF: introduction, administration, scoring and generic version of the assessment: field trial version 1996; WHO; 1996.
[59] Derogatis LR, Melisaratos N. The Brief Symptom Inventory: an introductory report. Psychological Medicine 1983;13:595–605. https://doi.org/10.1017/S0033291700048017.
[60] De Beurs E, Zitman, F. De Brief Symptom Inventory (BSI): De betrouwbaarheid en validiteit van een handzaam alternatief voor de SCL-90 2013;Leiden: Leids Universitair Medisch Centrum.