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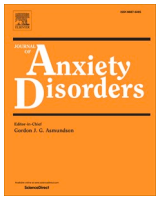
Journal of Anxiety Disorders 100 (2023) 102793

Contents lists available at ScienceDirect

Journal of Anxiety Disorders

journal homepage: www.elsevier.com/locate/janxdis



Age related differences in symptom networks of overall psychological functioning in a sample of patients diagnosed with anxiety, obsessive compulsive disorder, or posttraumatic stress disorder

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ARTICLE INFO

Keywords:
Anxiety
OCD
PTSD
Age
Network analysis

ABSTRACT

Anxiety disorders, obsessive compulsive disorder (OCD), and posttraumatic stress disorder (PTSD) are among the most prevalent mental disorders across the lifespan. Yet, it has been suggested that there are phenomenological differences and differences in treatment outcomes between younger and older adults. There is, however, no consensus about the age that differentiates younger adults from older adults. As such, studies use different cut-off ages that are not well founded theoretically nor empirically. Network tree analysis was used to identify at what age adults differed in their symptom network of psychological functioning in a sample of Dutch patients diagnosed with anxiety disorders, OCD, or PTSD (N = 27,386). The networktree algorithm found a first optimal split at age 30 and a second split at age 50. Results suggest that differences in symptom networks emerge around 30 and 50 years of age, but that the core symptoms related to anxiety remain stable across age. If our results will be replicated in future studies, our study may suggest using the age split of 30 or 50 years in studies that aim to investigate differences across the lifespan. In addition, our study may suggest that age-related central symptoms are an important focus during treatment monitoring.

1. Introduction

Anxiety disorders, obsessive compulsive disorder (OCD), and posttraumatic stress disorder (PTSD) are among the most prevalent mental disorders across the lifespan (Andreas et al., 2017; Kessler et al., 2005) and are associated with a high disease burden (Bandelow & Michaelis, 2022). Recent epidemiological studies found lifetime prevalence rates of anxiety and anxiety related disorders in older adults between 15 % (Kessler et al., 2015) and 17 % (Andreas et al., 2017). These numbers correspond to the prevalence of anxiety and anxiety related disorders among adults aged 18–65 years (de Graaf et al., 2010). Even though prevalence rates are comparable across younger and older adults, there is emerging evidence suggesting that older adults experience different symptoms of anxiety compared to younger adults (Altunoz et al., 2018; Gonçalves & Byrne, 2013).

Examples of age-related differences in symptom expression include findings that older adult patients and older community-dwelling adults worry less in comparison to younger adults (Brenes, 2006; Gould & Edelstein, 2010) and that the content of worrying varies across age. That is, younger adults are more likely to worry about school/work,

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https://doi.org/10.1016/j.janxdis.2023.102793
Received 26 May 2023; Received in revised form 13 October 2023; Accepted 30 October 2023
Available online 2 November 2023

interpersonal relations, and finances, whereas older adults are more likely to worry about their health and the health and welfare of their loved ones (Altunoz et al., 2018; Diefenbach et al., 2001; Goncalves & Byrne, 2013; Wuthrich et al., 2015). There is also research showing that older adults with generalized anxiety disorder (GAD) are more likely to report sleep disturbances (Altunoz et al., 2018), difficulties concentrating, experiencing nausea, and feeling dizzy or faint (Goncalves & Byrne, 2013), although other studies do not report differences between younger and older adults on sleep disturbances (Wuthrich et al., 2015).

Moreover, older adults generally experience less severe clinical presentations of anxiety in comparison to younger adults (Altunoz et al., 2018; Jorm, 2000; Saunders et al., 2021). It is, however, also possible that older adults may be less likely to report their symptoms, while the severity of the anxiety disorder is actually similar to younger adults. Hendriks et al. (2010), for example, found that older adults reported fewer agoraphobic cognitions, while the agoraphobic avoidance and severity of the panic disorder (PD) was similar to younger adults. This may be due to the chronic course of the disorder, in which age-related changes in cognitions seem likely.

Previous studies comparing symptoms or treatment outcomes across the lifespan have solely focused on disorder specific symptoms and did not focus on general psychological functioning. Moreover, these studies were mainly focused on GAD, and few studies also focused on PD (i.e., Hendriks et al., 2010; Stanley et al., 2003), but they did not investigate other anxiety related disorders. Furthermore, these studies have mostly been conducted in non-clinical samples, show inconsistent findings (i.e., Goncalves & Byrne, 2013; Wuthrich et al., 2015), and used different age cut-offs to differentiate younger adults from older adults. To illustrate, some studies include participants of 55 years and older (i.e., Diefenbach et al., 2001) or 60 years and older (i.e., Hendriks et al., 2010; Wuthrich et al., 2015), whereas others include participants of 65 years and older (i.e., Altunoz et al., 2018; Goncalves & Byrne, 2013; Gould & Edelstein, 2010; Saunders et al., 2021). With respect to the cut-off age to differentiate younger adults from older adults, the World Health Organization (WHO, 2022) describes older adults as adults aged 60 years and older. However, many (developing) countries consider people older adults when they retire, which is often around 65 years (Maunder, 2022; National Academy of Social Insurance, 2022). Yet, retirement ages differ between countries and are subject to change. To illustrate, the retirement age in The Netherlands used to be 65 years in 2018, while it is currently 66 years (Maunder, 2022). Similarly, the retirement age in the United States used to be 65 and is currently 66 years (National Academy of Social Insurance, 2022). Overall, there is no clear consensus about a cut-off that differentiates younger adults from older adults, when in fact, a lot of societal (e.g., retirement age), clinical (e.g., the allocation of care across the lifespan), and research decisions (see below) are influenced by this cut-off.

As for now, studies use different, rather arbitrary, cut-off ages for several reasons. For example, researchers in late-life mental disorders use a cut-off age that was used in another study or base their decision on pragmatic reasons such as power (i.e., a cut-off at 55 years would result in more power compared to a cut-off at 65 years because of decreasing number of participants with increasing age in studies in older adults). This inconsistency creates a lot of noise in results. To illustrate, this inconsistency complicates the interpretation of results from randomized controlled trials (RCT's) and meta-analyses. This in turn has important consequences for the interpretation of results regarding the symptom phenomenology and recommendations for effectiveness of treatments for specific age groups. As for now, we do not know whether these current cut-off ages that are used are theoretically and empirically justified. Therefore, it is difficult to determine whether and how younger adults and older adults differ in their symptom presentations and at what age these differences can be observed. Given that current research relies on age cut-offs to determine treatment efficacy, it is important to have research efforts in further analyzing the nature of this cut-off. As such, further research is needed to determine whether there are age-related differences in symptoms of anxiety disorders, OCD, and PTSD (Altunoz et al., 2018; Goncalves & Byrne, 2013), and perhaps even more importantly, to gain a more fine-grained understanding of the age at which these differences can be observed. This could possibly inform researchers that aim to investigate differences in phenomenology across the lifespan, add to our understanding of developing age-appropriate interventions, and inform clinicians about a proper allocation of care across the lifespan.

A potential way to assess age-related differences in symptom phenomenology is the network approach. Network theory conceptualizes psychopathology in terms of mutually reinforcing symptoms and examines how symptoms (called "nodes") are associated with other symptoms (called "edges"; Borsboom & Cramer, 2013). This approach offers the advantage of investigating relationships among symptoms that cannot be analyzed by standard univariate statistics. Moreover, the network tree approach (Jones et al., 2019; Jones, 2020; Jones et al., 2020) is specifically able to identify differences in symptom networks across age. Given that there is an ambiguous cut-off score for the differentiation between younger and older adults, and that these groups may differ from each other based on their phenomenology, a network tree approach is ideal to test whether and how patterns between symptoms differ across age and to identify at what age these differences can be observed. This may help to gain insight into changes in symptoms and symptom severity across the life span. In contrast, if relationships between symptoms remain stable across age, this would suggest that there might be no reason to assume that younger and older adults differ from each other in their symptom network.

In the current study, we examined the network structure of overall psychological functioning in a large, clinical sample of patients diagnosed with anxiety disorders, OCD, or PTSD, who have been referred for psychological interventions at generalized mental health care. As there is no consensus about the age that differentiates younger adults from older adults in terms of phenomenology, the goal of this study was to use a data-driven approach to identify a cut-off age at which adults show a different pattern of overall psychological functioning. Hence, we first aimed to investigate at what age differences can be observed in a symptom network of overall psychological functioning (i.e., at what age do we observe the first split point of the network tree)? Second, we examined differences in symptom networks between the derived age groups. Given the exploratory nature of network analyses, no specific hypotheses were formulized about a specific age at which the networks would diverge or how the network structure would differ between the derived age groups.

2. Methods

2.1. Design and participants

This study used data from a routine outcome monitoring (ROM) and Electronic Patient Record (EPR) dataset tracking treatment progress through validated self-report questionnaires. The preregistration for the study can be found on the Open Science Framework (https://osf.io/kw9y7/). Any deviations that were not specified in the preregistration or exploratory analyses beyond the preregistration are explicitly marked as such within this manuscript.

The original dataset consisted of 40,310 patients diagnosed with an anxiety disorder not otherwise specified (NOS), GAD, PD with or without agoraphobia (A), social anxiety disorder (SAD), PTSD, or OCD who received treatment at various centers for generalized mental health care (outpatient) in the Netherlands (Indigo, the Netherlands). All patients were referred by their general practitioner and all data were obtained between 2014 and 2021 as part of routine clinical care. Data of patients were used if patients received treatment for a DSM-5 anxiety disorder, OCD, and/or PTSD between 2014 and 2021, and if patients completed the Outcome Questionnaire (OQ-45.2) approximately 30 days around the start of the treatment. A comorbid diagnosis was

allowed, as long as an anxiety disorder, OCD or PTSD was the primary diagnosis. Data of patients were excluded if data on age were missing or if they did not complete the OQ-45.2 (note that if OQ-45.2 data were missing, the whole OQ-45.2 was missing). This procedure resulted in a final sample of 27,386 patients presenting for treatment for an anxiety disorder, OCD, or PTSD.

2.2. Procedure

2.2.1. Routine outcome monitoring (ROM)

We obtained an anonymized ROM and EPR dataset. ROM is a systematic way of monitoring patient progress during the course of treatment. ROM consists of questionnaires (e.g., general disorder related impairment or disorder specific symptom questionnaires), which are conducted at several stages during treatment. In the Netherlands, ROM is frequently used by mental health care institutions to provide clinicians with feedback about the effectiveness of treatment (Metz et al., 2017; Trimbos Instituut, 2015). To this end, all patients had to fill in the questionnaires at the start of treatment (baseline), halfway through treatment, and at treatment discontinuation (all online). For the current study, the baseline measure was used.

2.2.2. Patient data anonymization

The current study did not require ethical approval because data were anonymized with statistical disclosure control techniques (Meindl et al., 2018) by Initi8, a Third Trusted Party, before data was shared with the researchers. This process is in accordance with the General Data Protection Regulation (GDPR; EU regulation 2016/679) (Regulation EU, 2016) and Dutch Civil Law (Article 7:458). Patients who did not grant permission to use their anonymized data for research purposes were excluded during this process.

All procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

2.3. Measures

Outcome Questionnaire (OQ-45.2; Lambert et al., 2006). The OQ-45.2 is a widely used self-report questionnaire assessing psychological problems and functioning in daily life. The OQ-45.2 includes a problems in interpersonal relationships (IR), symptom distress (SD), and problems in social role performance (SR) subscale. The OQ-45.2 is a generic questionnaire that can be used for various disorders. This offers the advantage to compare patients with various diagnoses (Hatfield & Ogles, 2004). Participants rated the extent to which an item (e.g., "I feel fearful") described their situation over the last week on a 5-point Likert scale ranging from 0 (*never)* to 4 (*almost always*). The OQ-45.2 has been normalized for age ranges from 18 to 80 (Lambert et al., 2004). In the present sample, the validated Dutch version of the OQ-45.2 (de Jong et al., 2007, pp. 529) demonstrated acceptable internal consistency ($\alpha = .790$).

2.4. Data analysis

We used network analysis for our main analyses. All analyses were conducted in the R programming environment (Version 3.6.3; R Core Team, 2020). The R code can be found on the Open Science Framework (https://osf.io/kw9y7/).

2.4.1. Item selection

Items with substantially overlapping content can distort network analyses (Fried & Cramer, 2016). To screen for such overlapping content, we exploratively ran the "goldbricker" function in the R package *networktools* (Jones, 2020). The *p* value was set at.05 and the significant proportion for inclusion was set at.25 (Hittner et al., 2003).

2.4.2. Networktree

A typical network model computes each edge across the entire sample. This possibly hides important differences that exist within subgroups. The current study wanted to examine whether relationships between symptoms of psychological functioning differ across age. The R package *networktree* (Jones et al., 2019; Jones et al., 2020) was used to compute such a network. We used model-based recursive partitioning, a semi-parametric approach that searches for possible heterogeneity in the network structure. These computations are based on correlations, which are independent of sample size, by definition. In case of heterogeneity, the algorithm identifies optimal split points based on the selected covariates and produces a tree-like structure, in which it is possible to find a primary split and possible further split points. The network model for each partition will be shown at the bottom of the tree. Given the large sample size, we used an alpha threshold of $p = .001$ to reduce spurious partitions.

In the preregistration, we described to investigate the network tree analysis for each diagnosis separately (i.e., anxiety disorders, OCD, PTSD), in order to assess whether there would be different age split points for age depending on the primary diagnosis. However, the network tree package allows us to test whether network structures are heterogeneous with respect to 1 or more covariates (or partitioning variables; Jones et al., 2020). In other words: the network tree analysis is able to detect an interaction between age and diagnosis, such that the analysis would detect whether optimal age cut-offs differed by diagnosis. Hence, we applied the network tree algorithm to the complete dataset, and included both age and diagnosis as potential partitioning variables. Age was included as a continuous variable without analyses in increments. After partitioning the dataset using networktree, we recovered the empirical fluctuation processes with respect to age, in order to visually inspect instability of the correlations as a function of age. The maximum Lagrange multiplier (max*LM*) was used for age as a continuous variable (Jones et al., 2020).

2.4.3. Graphical LASSO network

The resulting networks (i.e., terminal nodes) were plotted using the graphical least absolute shrinkage and selection operator (LASSO), by using the R package *qgraph* (Epskamp et al., 2018) and *glasso* (Friedman et al., 2008). This approach estimates regularized partial correlations between symptoms (i.e., nodes) and reduces false positive errors by shrinking small relationships (i.e., edges) to zero. The default hyperparameter value ($gamma = 0.5$) was used for regularization. The most central symptoms within the network were determined by using the centrality indices strength (i.e., the direct connection of a given node to all other nodes in the network) and expected influence (EI; the weighted sum of all edge weights for a given node while taking into account the sign of the edge; Robinaugh et al., 2016).

2.4.4. Network comparisons tests

Networktree finds splits that maximize heterogeneity across groups. Because a split is defined by both a splitting variable and value, it first selects the splitting variable that is most strongly associated with heterogeneity through a statistical test, and next selects the split point by taking the value that maximizes both within-group homogeneity and between-group heterogeneity. However, this procedure is driven by heterogeneity across the entire network and does not test for differences in specific edges or centralities across the networks. Therefore, we further tested for significant differences in the global network structure, network density (i.e., global EI, the sum of all edge weights, indicating the total amount of positive connectivity between nodes and global strength invariance), specific edges, and centralities across the regularized networks for age by using the R package *NetworkComparisonTest* (NCT; van Borkulo et al., 2022). To correct for multiple comparisons of the edges, we used a Holm-Bonferroni correction with a post-correction threshold of $p = .05$ (Holm, 1979). Lastly, the stability of the networks were examined by using the R package *bootnet* (Epskamp et al., 2018).

2.4.5. Univariate statistics

An independent sample t-test was conducted to provide complementary information about significant differences in total OQ-scores between the age groups that were based on the age splits revealed by the network analysis outlined above (i.e., 2.4).

3. Results

3.1. Sample characteristics

This sample included 18,428 (67.3 %) participants who identified as females and 8958 (32.7 %) participants who identified as males. The mean age was 36.3 years ($SD = 13.7$, range 9–94). A distribution of age can be found in Fig. S1. Educational level was low for 5906 participants (29.5 %), medium for 8611 participants (31.4 %), high for 5501 participants (20.1 %) and unknown for 7368 participants (26.9 %). Within this sample, the diagnoses consisted of GAD (8.4 %), PD (14.5 %), agoraphobia (0.3 %), specific phobia (0.9 %), SAD (7.2 %), OCD (3.3 %), PTSD (26.1 %), acute stress disorder (0.3 %), anxiety disorder NOS (38.6 %) and anxiety disorder due to a medical condition (0.4 %). The average score on the OQ-45.2 was 77.3 ($SD = 23.1$), which is high. A moderate significant negative correlation between OQ-45.2 score and age was found, $r = -0.42$, $p < .001$.

3.2. Item selection

The goldbricker function revealed no pairs of overlapping items. Therefore, all items were included in the analyses.

3.3. Network tree analysis

The *networktree* algorithm found five subgroups, defined by age and diagnosis. The first optimal split was found at age 30, indicating that networks of individuals aged 30 or younger differed from networks of individuals above age 30 (see Fig. 1). A key for all nodes included in the network can be found in Table S1. The empirical fluctuation process

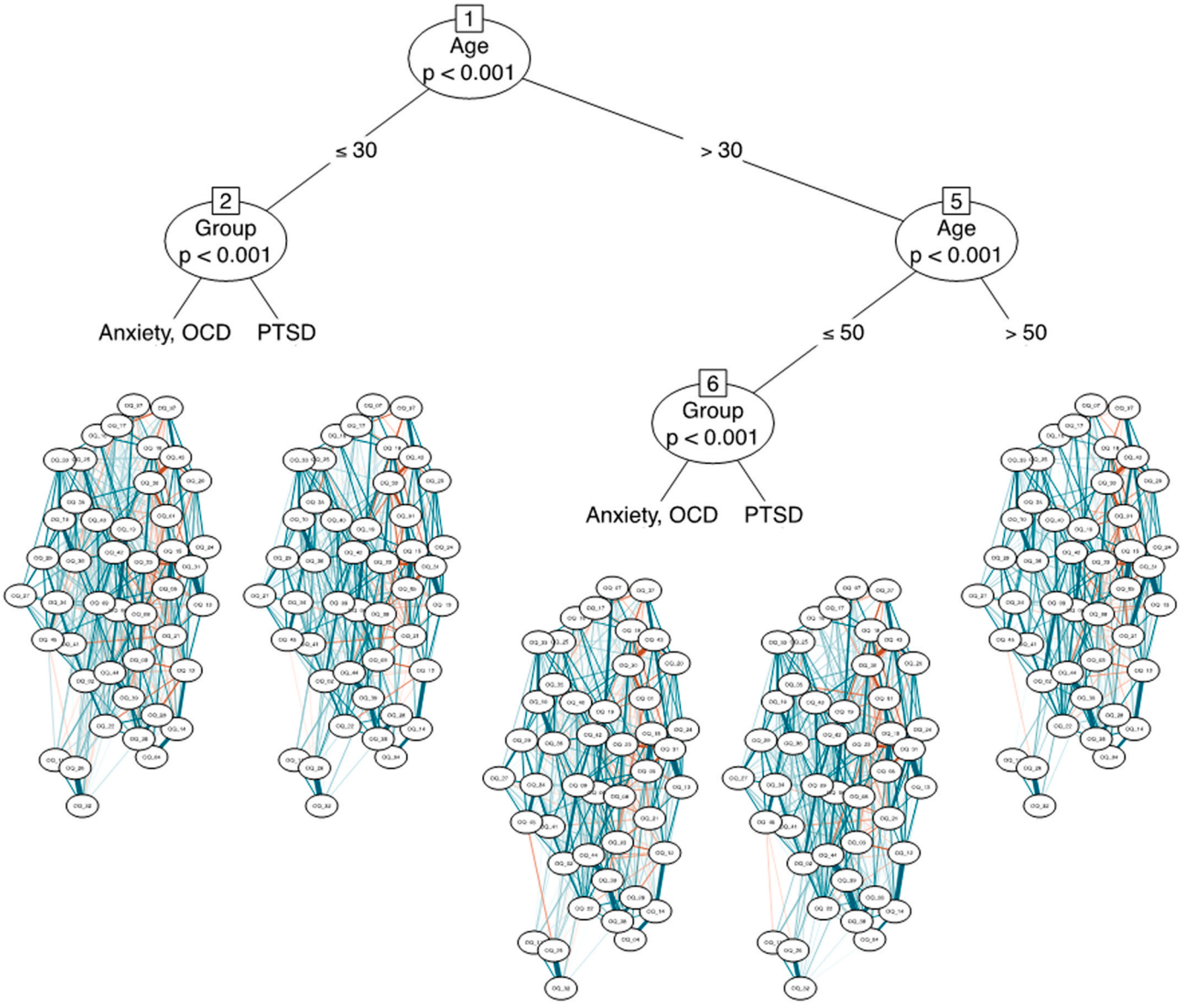

Fig. 1. Networktree by age and diagnosis. Results of the networktree analysis show that symptom networks of individuals of age 30 or younger differed from networks of individuals above age 30. The analysis also shows that symptom networks of individuals aged between 31 and 50 differed from networks of individuals above age 50. Circles represent symptoms of the OQ-45 measure. Lines reflect the strength of the relations between symptoms, with thicker lines indicating stronger relationships. Note that the partitions are independent of sample size of the respective subgroups.

(Fig. S2) shows clear support for a single first split point at age 30. Next, a second split based on age was implemented in the group aged > 30, with an optimal split point found at 50 years of age. This shows that networks of individuals aging between 31 and 50 years differed from networks of individuals above the age of 50 (Fig. 1). However, the plot of the empirical fluctuation process shows a somewhat less clear pattern for this second split, suggesting two peaks for parameter instability between ages 40 and 60 (Fig. S3). Additional information about sample size in each subnetwork is presented in Table S2. Note that the partitions are independent of sample size of the respective subgroups.

3.4. Network comparison tests (NCT)

The NCT of the first network tree split for age, showed a significant difference in overall network structure for the group aged ≤ 30 and the group aged > 30, $M_{(Max\ difference\ in\ edge\ weights)} = .101$, $p < .001$. After correcting for multiple testing, 52 significant edge differences in the networks were found (see Table S3). There were no significant differences in the global network strength ($S = .39$, $p = .854$) and the global network EI ($S = .52$, $p = .075$). However, there were significant differences in EI of nodes between the networks. The node representing feeling that something bad is going to happen was significantly more central in the network of individuals aged ≤ 30 than in the network of individuals aged > 30. The nodes representing having disturbing thoughts that come into mind that you cannot get rid of, and having too many disagreements at work/school were significantly more central in the network of individuals aged > 30. See Table S4 for a complete overview of significant differences in centralities. The nodes with the highest EI in both networks were: feeling that something bad is going to happen, feeling weak, finding that your heart pounds too much, and feeling nervous (See Fig. S4 and S5). There were also significant differences in the strength of nodes between the networks (see Table S5 for a complete overview). The nodes with the highest strength value in both networks were: feeling that you are not doing well at work/school, being satisfied with life, feeling fearful, being satisfied with your relationship with others, and feeling weak (see Fig. S6 and S7). The stability of EI and strength was excellent in both age groups (CS coefficient =.75).

3.4.1. Network comparison test for the second network tree split for age

The NCT showed a significant difference in the overall network structure for the group aged >30 and ≤50, and the network for the group aged >50, $M_{(Max\ difference\ in\ edge\ weights)} = .095$, $p = .035$. After correcting for multiple testing, 13 significant edge differences in the networks were found (see Table S6). There was no significant difference in the global network EI ($S = .37$, $p = .642$). The global network strength invariance was significantly higher in the group of individuals aged >30 and ≤50 (23.10) compared to the group of individuals aged >50 (20.02), $S = 3.07$, $p = .005$. There were also significant differences between the networks in the EI of some nodes. Feeling weak and feeling nervous were significantly more central in the network of individuals aged >30 and ≤50, although these nodes were highly central among both age groups. Moreover, having sore muscles was significantly more central in the network of individuals aged >30 and ≤50. See Table S7 for a complete overview of significant differences in EI centralities. The nodes with the highest EI in both networks were: feeling that you're not doing well at work/school, feeling weak, feeling nervous, and feeling that something bad is going to happen (see Fig. S8 and S9). There were also significant differences in the strength of nodes between the networks. Feeling fearful was significantly more central in the network of individuals aged >30 and ≤50. Moreover, feeling worthless was significantly more central in the network of individuals aged >50, see Table S8 for a complete overview of significant differences in strength centralities. The nodes with the highest strength value in both networks were: feeling that you are not doing well at work/school, being satisfied with your relationship with others, being satisfied with life, and feeling weak (see Fig. S10 and S11). The stability of EI and strength was excellent in both age groups (CS coefficient =.75).

3.5. Differences in total OQ-scores between the age groups

There was no significant difference in the total OQ-score before treatment between the group of individuals aged ≤30 ($M = 77.35$, $SD = 22.40$) compared to the group of individuals aged >30 ($M = 77.39$, $SD = 23.64$), $t(27384) = -.14$, $p = .887$. There was a significant difference in the total OQ-score before treatment between the group the group of individuals aged > 30 and ≤ 50 ($M = 78.64$, $SD = 23.64$), compared to the group of individuals aged >50 ($M = 77.35$, $SD = 22.45$), $t(22758) = 4.21$, $p < .001$.

4. Discussion

To our knowledge, this study is the first to investigate age-related differences in the phenomenology of psychological functioning in anxiety, OCD or PTSD patients using network tree analysis. Results show that symptom networks differ as a function of age whereas some of the core symptoms of anxiety and related disorders remain stable across age. We found a first split at the age of 30 years, meaning that individuals above the age of 30, show a different symptom network of psychological functioning at the start of treatment compared to individuals aged 30 years or younger. In addition, a second age split was observed at the age of 50 years, indicating that individuals above the age of 50 show a different symptom network of psychological functioning at the start of treatment compared to individuals aged between 31 years and 50 years.

With respect to the first split at the age of 30 years, there were differences in the overall network structure, edges, and EI and strength of symptoms between the two age groups. Given that a focus on individual edges could increase the change of type 1 errors because of the multiple comparisons problem, we emphasized differences with respect to their centrality. Feeling that something bad is going to happen was significantly more central in the network of individuals aged ≤30, thereby indicating that this symptom seems more strongly connected to other symptoms of psychological (dys) functioning. Having disturbing thoughts that come into mind that you cannot get rid of, and having too many disagreements at work/school were significantly more central in the network of individuals aged >30, thereby indicating that these symptoms are more strongly connected to other symptoms of psychological (dys) functioning in this age group. It is possible that these central symptoms activate other aspects of psychological (dys)functioning. Alternatively, other symptoms of psychological (dys) functioning may jointly activate these central symptoms. Additional longitudinal research is needed to examine the pathways through which different aspects of psychological functioning emerge.

With respect to the split at the age of 50 years, there were again differences in the overall network structure, edges, and EI and strength of symptoms between the two age groups. Moreover, the global network strength invariance was significantly higher in the group of individuals aged >30 and ≤50, which indicates that this symptom network is more strongly connected compared to the network of individuals aged >50. Thus, activation of certain symptoms, is more likely to co-occur with other symptoms in the group of individuals aged >30 and ≤50. Interestingly, feeling weak, feeling fearful, feeling nervous, and having sore muscles were more central in the network of individuals aged >30 and ≤50, which suggests that these symptoms are more strongly connected to other aspects of (dys) functioning compared to individuals aged >50. It is often assumed and reported that individuals show increased complaints of musculoskeletal pain and sore muscles with aging (Vecchiet, 2020). Our study, however, illustrates that having sore muscles is more influential for the network of individuals aged >30 and ≤50. Perhaps older individuals are used to having sore muscles and other symptoms, so that an increase in these symptoms has less influence on their symptom network compared to the younger group. Alternatively, an increase in other symptoms of (dys)functioning may be less likely to

activate sore muscles in the older age group.

There were also similarities across the age groups. With respect to EI, feeling that something bad is going to happen, feeling weak, and feeling nervous were among the most central symptoms across all age groups, which are especially the symptoms associated with anxiety and related disorders (Arikian & Gorman, 2001). Thus, even though symptom networks change across age, the core symptoms of the disorders seem stable across each age group. Previous studies have shown that node centrality predicts treatment outcomes (Elliott et al., 2020; Olatunji et al., 2018; Rodebaugh et al., 2018). Interestingly, the OQ-45.2 is developed to monitor patient progress during the course of treatment (de Jong et al., 2007, pp. 529). Our results therefore suggest that the symptoms with the highest centrality in this study could be an important focus during treatment monitoring. Besides the aforementioned central symptoms across all age groups, clinicians could also focus on symptoms that are especially central across a specific age group (e.g., having sore muscles across individuals aged between 31 and 50 years). It is, however, important to note that although centrality has been found to predict treatment outcomes (Elliott et al., 2020; Olatunji et al., 2018; Rodebaugh et al., 2018), it has also been stated that this prediction is limited to the specific measure used in the network analysis (Rodebaugh et al., 2018). It is, therefore, unclear whether node centrality could serve as an indicator of change for other measures of psychopathology, that have not been used in the current study. As such, more longitudinal (network) research is needed into the clinical applications of focusing on central symptoms during treatment monitoring as well as studies that assess how symptom networks change over the course of treatment.

Interestingly, we found that most differences on a general symptomatic self-report level emerge around the age of 30 and 50 years. This first cut-off of 30 years, is partly in line with previous studies in young adults where young adulthood was described as a group of individuals aged 18/19 years to somewhere between 25 and 34 years (Lachman, 2004; Mills et al., 2021; Stroud et al., 2015). Our results add to this research by showing that most variability in symptom networks of psychological functioning exists around the age of 30. This is reflective of a transition from the phase of young to middle adulthood.

Importantly, the age of 50 at which the networks significantly differed is not in line with current cut-off ages (i.e., 55, 60 or 65) that are used to distinguish younger adults from older adults (e.g., Diefenbach et al., 2001; Hendriks et al., 2010; Saunders et al., 2021). Therefore, the results of our study challenge the idea of a strict cut-off age to differentiate older adults from younger adults. That is, differentiation based on the calendar age of 55, 60 or 65 may not be meaningful with respect to the phenomenology of psychological functioning in anxiety, OCD, and PTSD patients.

It is, however, important to note that our clinical sample consisted of relatively healthy and vital older adults. The subgroup of immobile, less vital, and frail older adults (Topinková, 2008) is not well represented in this sample as these patients are usually treated in specialized mental health care. As such, we cannot rule out the possibility that this subgroup of frail, older adults, will show a different symptom network compared to younger adults. We therefore cannot generalize these results to frail older adults. Similarly, our clinical sample limits the generalizability to community-based samples and/or non-help seeking patients.

Our study offers a first step in identifying a cut-off age at which adults show a different pattern of psychological functioning. To this end, our study aims to provide a more fine-grained understanding of symptom differences across the lifespan. However, one important limitation of the current study is that the OQ-45.2 limits the generalizability to other samples with different symptom measures. Even though the use of the OQ-45.2 offered the advantage of comparing psychological functioning in a broad range of patients, irrespective of their diagnosis, more research is needed into age-related differences in the strength and centralities of specific edges and nodes for disorder specific symptoms (e.g., avoidance, hypervigilance, or repeated memories in the case of PTSD). Peckham et al. (2020) found an optimal split at the age of 46 for a borderline personality disorder (BPD) symptom network in a large transdiagnostic treatment seeking sample. Even though this study focused on BPD, it is interesting that the split was close to the split that was found in the current study. This possibly suggests that variability for other symptoms may also be highest around the age of 50 years, although future studies in other samples and other treatment settings are needed to confirm this. As such, we are careful in making conclusions beyond the very specific context examined in this study. However, if our results will be replicated, this would confirm that most differences on a general symptomatic self-report level emerge around the age of 30 and 50 years. This subsequently impacts the interpretation of RCT's or meta-analyses, and as a result, the psychological care that is delivered across the lifespan. Future studies that aim to investigate differences across the lifespan, should therefore take this age split into account when designing their study. This is especially important given that there is currently no clear consensus about an appropriate age cut-off (e.g., Diefenbach et al., 2001; Hendriks et al., 2010; Maunder, 2022; Saunders et al., 2021; WHO, 2022). It is, however, important to note that this study focused on phenomenology and did not investigate etiological differences. We therefore do not know whether etiological differences apply to these same age groups.

The most important limitation of the current study is that the symptom network was calculated using cross-sectional data. Therefore, we can only suggest relationships between symptoms and cannot confirm causal connections among symptoms. Longitudinal data are needed to clarify the temporal structure and causal connections of the relations found in the current study.

Despite the use of cross-sectional data, the networks that emerged were stable, allowing for reliable interpretations. Moreover, our naturalistic heterogeneous clinical sample provided variability among all symptoms and validity of results. Hence, the current study provides novel insight into the age at which patients diagnosed with anxiety disorders, OCD, or PTSD show a different symptom network. The age split around 30 and 50 years challenges the use of the calendar age of 55, 60 or 65 years to differentiate younger adults from older adults based on their phenomenology. Moreover, the results show that some symptoms were especially prominent in a specific age group (i.e., having disturbing thoughts that come into mind that you cannot get rid of in the group aged > 30), but that the core symptoms related to anxiety disorders were prominent across each age group (i.e., feeling that something bad is going to happen, feeling weak, and feeling nervous). If our results will be replicated in future studies, our study may suggest that these age-related central symptoms are an important focus during treatment monitoring. Moreover, our results may suggest to use the age split of 30 or 50 years in studies that aim to investigate differences across the lifespan.

Declaration of Competing Interest

None.

Data availability

The R code can be found on the Open Science Framework (https://osf.io/kw9y7/).

Acknowledgement

No results in this manuscript have been disseminated anywhere else. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.janxdis.2023.102793.

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