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Individual Video-Based Case Formulation for Participants With Persistent Physical Symptoms Associated With Indoor Environment or Chronic Fatigue

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Persistent physical symptoms (PPS) refer to a wide range of symptoms that cannot be fully explained by traditional medical assessment of bodily pathology or environmental factors. The aim of the current study was to illustrate the application of an online interview and Functional Analytic Clinical Conceptualization to describe psychological and life problems perceived by participants with PPS and to give examples of how a functional analysis approach to case formulation could assist in their treatment. We applied the Functional Analytic Clinical Case Model (FACCM) in the assessment of participants with PPS (n = 50), including three focus groups: those with PPS related to the indoor environment (n = 11), those with PPS related to prolonged fatigue (n = 28), and those with both symptoms (n = 11). Among the 50 participants with PPS, a typical amount of concurrent psychological and life problems was 9. In addition to PPS, the most typical problems reported were symptoms of stress and burnout (74%), low mood (68%), narrowing of daily life (58%), and worrying (52%). The results highlight the complexity of the participants' life situations. We found that the FACCM was acceptable and useful in identifying potential individual treatment targets.

PERSISTENT physical symptoms (PPS) are common in health care (Wittchen et al., 2011). It is estimated that, in primary care, around 20% to 35% of physical complaints have no clear medical explanation (Eliassen et al., 2016; Hiller et al., 2006). Clinical presentations and symptoms of PPS vary greatly, from mild symptoms to severely disabling conditions (Creed et al., 2011). Patients frequently report bodily complaints such as headache, musculoskeletal pain, gastrointestinal complaints, palpitations, dizziness, and fatigue (Henningesen et al., 2018; Houwen, 2022). In addition to bodily complaints, psychological and

behavioral problems such as health anxiety are common (Henningesen et al., 2018). In particular, the severely disabling forms of PPS are associated with considerable distress, impaired functioning, reduced quality of life (Koch et al., 2007; Selinheimo et al., 2019; Vuokko et al., 2015), and high costs for society due to multiple referrals and excess use of health-care services, work absenteeism (Rief & Martin, 2014; van Dessel et al., 2014), and potential long-term work disability (Aamland et al., 2012; Loenggaard et al., 2015; Rask et al., 2015).

Although similar symptoms occur in diseases, PPS refers to symptomatology with no full medical or toxicological explanation. Often there is no well-defined organic or environment-related pathology to be found that is associated with the symptoms. Therefore, diagnostic and therapeutic approaches to assess and treat PPS typically focus on managing the most severe symptoms and can vary significantly across and within medical specialties (Henningesen et al., 2018). This

Keywords: persistent physical symptoms; indoor-environment-related symptoms; chronic fatigue syndrome; case formulation; functional analytic clinical case diagram

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fragmented approach to PPS with its multiple symptoms that cut across diagnoses makes PPS challenging to manage and treat (Husain & Chalder, 2021). While medical treatment of the symptoms and concomitant disorders can provide a line for treatment, there are nonmedical management options for behavioral interventions, such as cognitive behavioral therapy (CBT) and multimodal therapy, that show at least some beneficial effects for PPS (Leaviss et al., 2020). However, studies examining the effectiveness of psychological interventions for PPS have reported modest effect sizes, and no intervention has been found to be effective across all PPS (Henningesen et al., 2018; Leaviss et al., 2020).

The complexity of the symptoms and differences among individuals in the problems they face call for a more flexible, individualized approach to clinical case formulation and treatment of patients with PPS. A holistic framework is needed to integrate susceptibility, triggering, and maintaining factors in assessment and treatment planning. A cognitive behavioral case formulation is an individual-based approach to assessment and treatment (Bruch & Bond, 1998). The functional analysis is a case formulation model based on learning theory, evidence-based assessment, and treatment and involves the collection of information regarding factors that may be relevant to treatment and formulating a hypothesis as to how these factors relate to one another and influence the patient's problems (Haynes & O'Brien, 2000; Haynes & Williams, 2003; Sturmey et al., 2007). The Functional Analytic Clinical Case Model (FACCM) is illustrated with a Functional Analytic Clinical Case Diagram (FACCD; Haynes & O'Brien, 2000; Haynes & Williams, 2003; Haynes et al., 2020), a vector diagram that presents how different variables (an individual's behavioral and life problems) are connected to each other, emphasizing the functional relations among causal and moderating variables and an individual's central problems. Of central importance in the FACCM is the initial assessment interview, in which relevant data about the individual's situation are collected and integrated into a meaningful description (Bruch, 2003). Data can be collected through multiple sources using interviews, observations, self-report questionnaires, and self-monitoring (Haynes & O'Brien, 2000).

Clinically, the functional analysis and the FACCM are considered most useful when assessing complex clinical cases such as patients with multiple problem areas and multiple interacting causal variables and when standardized treatment is ineffective (Haynes et al., 2011; Lappalainen & Tuomisto, 2005; Lappalainen et al., 2009). A psychiatric diagnosis is often insufficient to explain the individual variation

of the problems and the complexity of the situation (Hofmann & Hayes, 2019; Lappalainen et al., 2009). For example, "chronic fatigue syndrome" (CFS) is often too nonspecific to provide information about the etiology of the problem, what maintains the problem, how the behavior/problem varies across situations and contexts, and how different problems the patient experiences interact with each other (Lappalainen & Tuomisto, 2005; Lappalainen et al., 2009). In contrast, a functional analysis considers individual differences and emphasizes potential causal relations, aiming at collaboratively identifying the need for change and ensuring a shared understanding of the factors central to treatment (Haynes & Williams, 2003; Lappalainen et al., 2009). Based on these considerations presented in previous literature on the need for individualized assessment of PPS and opportunities that the FACCM offers, patients with PPS and professionals working with them could benefit from a functional analysis and the FACCM.

The use of the FACCM may also be important for patients with PPS for better communication purposes, as good communication with the patient, including a comprehensive and shared understanding of the patient's current situation, is essential at all stages of treatment (Henningesen et al., 2018; van Ravenzwaaij et al., 2010). The quality of the clinical consultation is considered significant, but in general overlooked, in which case it can even act as a perpetuating factor for PPS (Houwen, 2022; Salmon, 2007). Studies suggest that although medical doctors spend more time in consultations with patients with PPS than with other patients, concerns and expectations are often not explored to the patients' satisfaction, leaving patients dissatisfied and feeling that their symptoms are not taken seriously enough (Husain & Chalder, 2021). Diagnostic uncertainty and insufficient communication skills of the health-care providers may maintain or aggravate the patients' symptoms and lead to negative outcomes, such as dropping out from the planned treatment (Houwen, 2022). On the other hand, research suggests that enhanced practitioner-patient communication and interaction have an impact on patients' health outcomes, such as decreased stress and anxiety, and illness perception and severity (e.g., Dowrick et al., 2004; Fassaert et al., 2008; Kappen & van Dulmen, 2008), and, in the long run, reduced use of health care (Weiland et al., 2012). Houwen (2022) found three essential themes for patients with PPS that make them feel that they are being understood and their complaints considered seriously: (a) empathic attention to the patient as an individual, (b) a doctor-patient relationship in which patients are seen as equal partners, and (c) attention to the

problems and symptoms experienced by the patients. In an FACCD, respect for an individual patient and acknowledgment of individuality is a defining feature of the approach. This view is reflected in [Dryden \(2003\)](#), who rejects the phrase “making a case formulation” as it indicates objectification of the patient, instead preferring “understanding the person in the context of his/her problems.” Indeed, in an FACCD, various aspects of the patient’s life and current problems are collaboratively cocreated and discussed to help the patient attain his or her treatment goals. Working in this way may increase the patient’s motivation, cooperation, and active participation in the treatment.

Case studies applying the FACCD model assessing individual patients with a diverse range of psychological problems and disorders are numerous (see [Bruch & Bond, 1998](#)). [Deary and Chalder \(2006\)](#) presented a case conceptualization of a patient with CFS; however, an FACCD was not administered. According to the CBT model, CFS and other PPS can be conceptualized in terms of the factors that (a) predisposed the person to be vulnerable to it/them, (b) precipitated the current period of illness, and (c) are now maintaining it/them ([Deary et al., 2007](#)).

Research concerning case formulation at group level is scarce. However, [Hassinen et al. \(2013\)](#) applied the case formulation model in the treatment of 26 people with hearing and vision problems and found that the most often reported main problems were communication problems, traumatic or distressing experiences, mistrust and suspicion, sleep difficulties, and loneliness and isolation. Using the case formulation models, [Hassinen et al. \(2013\)](#) identified common and distinct problem areas of individuals with vision impairment since birth and those whose vision had become impaired during their life, which can be beneficial for planning the rehabilitation of individuals with vision impairments. In addition, the case formulation models provided information on the variance of the number of different problems among individuals with complex situations ([Hassinen et al., 2013](#)).

Objectives

There is a need for a more individualized, patient-friendly, and, at the same time, holistic approach in the assessment of individuals with PPS that goes beyond the labeled disorders. Therefore, we applied the functional case formulation model in the assessment of the symptom characteristics and the individual affecting or related factors of participants with PPS. It is important to collect more information on the individ-

ual needs and problems that individuals with PPS encounter in order to make individual treatment and rehabilitation plans and to increase patients’ understanding of the various factors contributing to their reactions and behavior. In addition, it is important to support the patients in managing their distress and to increase adherence to psychosocial treatment models.

The aim of this study was to investigate the feasibility and acceptability of individual case formulation by using an FACCM and collaborative goal setting for PPS treatment among participants with symptoms related to indoor environments, chronic fatigue, or both. Further, the main goal of the current study was to describe the individually identified psychological and life problems that directly or indirectly affect the life quality and daily functioning of patients with PPS. We were also interested in examining whether PPS related to indoor environments or CFS would be associated with specific psychological or life problems. To illustrate the complexity of the individual cases of participants with these PPS symptoms, two individual case examples in the form of FACC diagrams were presented: a participant with indoor-environment-related symptoms and a participant with symptoms related to CFS. In addition, we aimed to examine possible differences in demographic variables among the groups. More specifically, the following research questions were set:

1. What are the psychological and life problems identified in building the FACCD for the groups with PPS related to the indoor environment, CFS, or both?
2. Are there differences between the groups in the amount, or themes, of individual problems related to PPS?
3. How can the FACCM behavioral case formulation be applied in the assessment and treatment of PPS, in particular with participants with PPS related to the indoor environment and CFS.

Methods

Background

This study is part of a randomized controlled trial carried out in Finland by the Finnish Institute of Occupational Health in collaboration with the University of Jyväskylä, the University of Helsinki, and the HUS Helsinki University Hospital between 2020 and 2023. The study protocol ([Selinheimo et al., 2023](#)) and its amendments were approved by the Ethics Committee of the Hospital District of Helsinki and Uusimaa, Finland. Written consent to participate was collected from all participants. The trial has been registered at ClinicalTrials.gov (identifier NCT04532827).

Recruitment

For the study protocol and a detailed description of the recruitment procedure and channels, see [Selinheimo et al. \(2023\)](#). Potential participants filled in an electronic questionnaire prior to the inclusion interview. Participant enrollment was further carried out by medical doctors at the Finnish Institute of Occupational Health, where participants underwent an individual, structured, video-based interview (45–60 minutes) in which eligibility was ensured by a medical doctor. The interview was based on the modified version of the semistructured Research Interview for Functional somatic Disorders (RIFD; [Petersen et al., 2019](#)), which was used to identify the wide range and course of the different symptoms or disorders: cardiopulmonary, gastrointestinal, musculoskeletal, neurological, general and other symptoms, fatigue, environmental intolerance, health anxiety, depression, anxiety, and other mental disorders. The assessment encompassed information about the presence of symptoms or symptom patterns, the severity of the symptoms and impairment, and possible comorbid medical conditions that may account for the individual's symptomatology and disability. Participation in the current study did not affect ongoing or planned medical treatment.

Eligibility criteria for the current study included participants who (a) provided informed consent, (b) were 18 to 65 years of age, (c) were fluent in the Finnish language, (d) were in working life or studied actively, (e) had PPS associated with indoor environments ([IPCS/WHO, 1996](#); [Lacour et al., 2005](#)) or chronic fatigue, defined according to the criteria of myalgic encephalomyelitis/CFS ([Jason et al., 2014](#); see [Table 1](#)). Participants were excluded if (a) they were on prolonged sick leave, (b) had a serious and/or acute medical or psychiatric illness (bipolar disorder, psychotic disorders, alcohol and/or drug dependency, eating disorders, severe mood disorders), or (c) parallel psychotherapy (see [Table 1](#) for details).

Before enrollment in the study, participants declared their interest in the study via an online form, after which they received oral and written information on the study, and those who consented to participate filled in an electronic informed consent. Participants who required medical or psychiatric care or further medical examinations (i.e., an untreated medical or psychiatric condition was suspected) were referred to a health-care professional and were excluded from the study based on the expert opinion of the medical doctors conducting the initial medical interview to establish existing or current diagnosis. Most common reasons for exclusion included age, unemployment,

ongoing psychological treatment and untreated or undiagnosed other illnesses.

Randomization

After the interview by medical doctors ($n = 192$), eligible participants ($n = 105$) were randomly assigned to the treatment group (eHealth intervention, $n = 52$) or the control group (treatment-as-usual, $n = 53$) by an IBM SPSS Statistics software generated random allocation sequence modified from [Arifin \(2012\)](#). One participant assigned in the treatment group and one participant assigned in the control group withdrew from the study after randomization, leaving a total of 103 participants (eHealth intervention, $n = 51$; TAU, $n = 52$). The randomization was carried out by a researcher outside of the research group. The allocation ratio was 1:1 and the number of participants with indoor-environment-related persistent symptomatology, chronic fatigue, or both were balanced in both groups. When participants had been randomized, they were informed of their allocation by telephone and email and simultaneously received an educational leaflet by email. The current study focused solely on participants in the eHealth intervention group ($n = 51$; $n = 1$ participant withdrawal from the study after the case formulation and declined usage of the participant's data in the study) who participated in the videoconference-based case formulation assessment administered by the same psychologist and were subsequently offered a web-based eHealth intervention. See [Figure 1](#) for the participant flow.

The Video-Based Individual Case Conceptualization

The first step of the eHealth intervention was to build and present a case formulation model ([Haynes & O'Brien, 2000](#)). It was administered individually by a psychologist using the videoconferencing application doxy.me in two video meetings (2×45 –60 minutes) to build the case diagram and reach a shared understanding of each participant's symptomatology, individual goals, and treatment targets. The first session was composed of an initial interview based on the psychosocial interview model of [Strosahl et al. \(2012\)](#) related to the participant's psychosocial well-being and life situation. The interview served as a means of gathering information about three themes: (a) current life situation (e.g., whether the participant was working or not, relationships, friends), (b) health and well-being (e.g., exercise and sleeping habits), (c) description of the problems/symptoms and efforts to solve them (e.g., symptoms/problems experienced, when they started, and their impact on life; see [Table 2](#) for a detailed description).

Table 1
Inclusion and Exclusion Criteria of Study

Criteria	Description
Inclusion	
Age	Age 18 to 65 years
Language	Fluent (omitted)
Duration of symptoms	Onset of symptoms with disability of 3 years maximum before the study
Symptomatology A) Indoor air-related symptoms (Lacour et al., 2005, IPCS/WHO, 1996) or	A) Indoor air-related symptoms a) Self-reported symptoms attributed to indoor (non-industrial) environments including: i) symptoms in at least two different organ systems e.g. respiratory, digestive or nervous system. b) Symptoms recurring i) in more than one indoor environment or ii) despite environmental improvements (e.g. work arrangements and/or workplace reparations)
B) Chronic fatigue (Jason et al., 2014)	B) Chronic fatigue a) Post-exertional malaise and/ or post-exertional fatigue b) Unrefreshing sleep or disturbance of sleep quantity or rhythm disturbance c) Pain, often widespread d) Two or more neurological or cognitive symptoms e) At least two symptoms from the following categories i) Autonomic manifestations, ii) Neuroendocrine manifestations or iii) Immune manifestations
Duration and severity of condition	Minimum of six months; Symptoms are not lifelong and result in substantial functional restrictions in daily life.
Exclusion	
Work situation	Long sick leave (≥ 3 months) without return-to-work plan, not actively participating in study or work life (retired or unemployed)
Medical reasons	a) Some serious and/or acute medical disease or illness that may explain the symptoms i) Somatic disease that may explain the symptoms (e.g. uncontrolled asthma, hypothyroidism, sleep apnoea) ii) Psychiatric disorder (bipolar disorder, psychotic disorders, alcohol and/or drug dependency or abuse, eating disorders, and/or severe mood disorders) b) Developmental disorders
Psychotherapy	Psychotherapy (current)
Other	Patient refusal

The psychologist was instructed to remain observant of functional relationships (i.e., how problems are related to each other) and to understand the background, context, and effects of prolonged symptoms for everyone. Table 2 illustrates the structure of the psychosocial interview.

Based on the interview, a visual description of the situation, i.e., case conceptualization (FACCD), was prepared by the psychologist after the first interview and verified in the second video-based session with the patient. The goal of this session was to discuss the case conceptualization in more detail, modify it accordingly, and find a common understanding of functional relationships among factors contributing to the individual's well-being. At the end of the second meeting,

the following questions were discussed: *What can be influenced and what cannot be changed directly? What kind of behavioral chains can be identified as central? Which of the chains are easier to influence and which require more work? Can widely or very strongly influencing factors be identified? What is the patient motivated to focus on?* After the second meeting with the psychologist, the web-based program was offered to participants in the intervention group.

Statistical Analyses

Possible differences in the demographic variables and self-reported health and work ability between the PPS groups (PPS related to indoor environment, CFS, or both) were examined using the chi-square test.

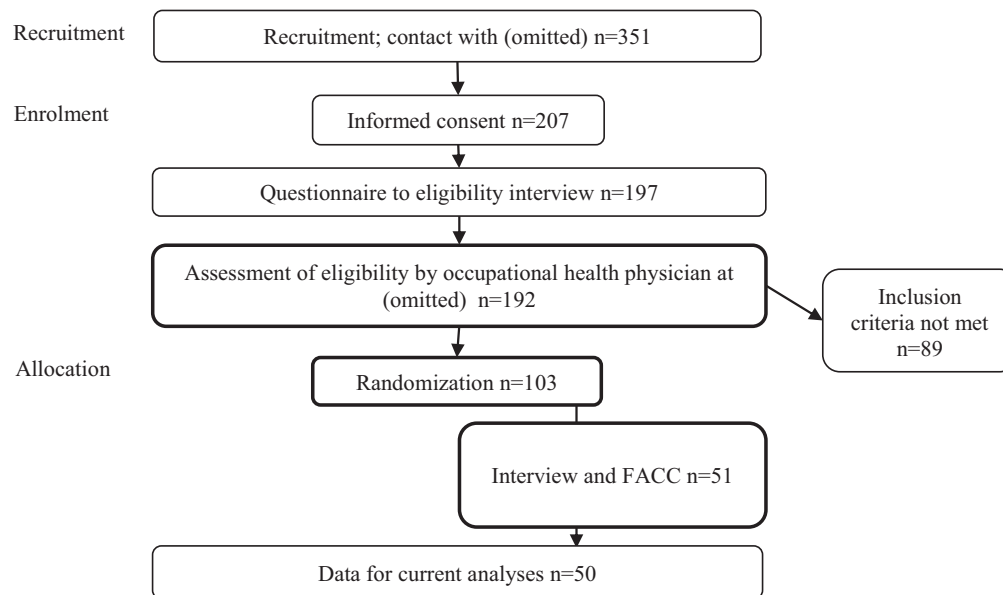


Figure 1. Flow of participants. Note: FACC = Functional analytic case conceptualization.

The FACCs were analyzed to examine the number of individual problems and variation in the number of problems between the PPS groups using one-way analysis of variance.

Results

Characteristics of Participants

Among a total of 51 study participants, who were randomized into the intervention group and participated in the clinical case formulation, 50 were chosen for the current study, as their case formulation was made by the same psychologist. Therefore, one participant in the pilot interview was not included in the current analyses. Study participants ($n = 50$) were labeled and assigned to three groups according to the initial video-based interview (RIFD; Petersen et al., 2019) administered by the medical doctor: participants with PPS related to the indoor environment ($n = 11$), participants with PPS related to CFS ($n = 28$), and participants with both symptoms ($n = 11$). Among them, 84% ($n = 42$) were female and 60% ($n = 30$) highly educated. They ranged from 30 to 62 years old, with a mean age of 45.9 years (standard deviation, $SD = 8.12$). Among all participants ($n = 50$), self-reported health was low (evaluated on a visual analog scale [VAS] of 0–10; mean, $M = 3.28$, $SD = 0.83$) and self-reported work ability was moderate (VAS 0–10; $M = 5.76$, $SD = 1.90$). There were no significant differences between the symptom groups in the level of self-reported health or work ability, $F(2, 47) = 0.85$, $p = 0.433$, and $F(2, 47) = 2.49$, $p = 0.094$, respectively. With the exception of one participant, all (98%) were

in working life. At premeasurement, there were no significant differences between the three groups in terms of age, $F(2, 47) = 1.678$, $p = 0.196$; gender, $\chi^2 = 0.502$, $df = 2$, $p = 0.778$; and education, $\chi^2 = 3.654$, $df = 4$, $p = 0.455$. In contrast, there was a significant difference in marital status, $\chi^2 = 15.306$, $df = 6$, $p = 0.018$, with more married participants in the group of PPS related to indoor environment (63.6% vs 46.4% and 45.5%). Table 3 summarizes participant characteristics for the three groups and the whole sample.

Reported Problems

Based on the case conceptualization interview, all 50 participants with PPS reported an average of about 9 psychological or other problems per person (ranging from 6 to 13; $M = 9.10$, $SD = 1.84$). In addition, the participants reported an average of about 3 historical causal variables or background factors (ranging from 0 to 8; $M = 3.16$, $SD = 2.29$). With regard to the total number of problems, the group of PPS related to indoor environment reported, on average, 8.8 ($SD = 2.79$) problems, whereas participants with PPS related to chronic fatigue (CFS) reported, on average, 9.2 ($SD = 1.55$) problems, and the participants with both symptoms 9.1 ($SD = 1.51$) problems. There was no significant difference between the groups regarding the quantity of reported problems ($p = 0.839$). The list of the most reported problems (reported by more than 10% of the participants) is presented in Table 4.

All case diagrams were built around PPS or chronic fatigue, which were presented as the central problems. Other common problems experienced by all study par-

Table 2
The Case Conceptualization Interview (Modified Version of [Strosahl et al., 2012](#))

Theme	Question
Current life situation	<ol style="list-style-type: none"> 1. What do you do for living? Are you currently working? <ol style="list-style-type: none"> a) If Yes: Do you like your job? Do you get along with your coworkers? b) If No: Why? How long? Did you like your job? Would you like to come back? 2. Are you married or in a stable relationship? How are you doing? If necessary: When you argue, does it involve physical or verbal violence? 3. Who do you live with? Do you have children? <ol style="list-style-type: none"> a) If Yes: How many children do you have? Do they live with you? How are they doing? Do you get along with your children? Do you see them regularly? b) If No: Would you like children? / Would you have liked children? 4. Do you have friends? Do you see them often? When was the last time? 5. Do you have your own time? How do you spend your free time? When was the last time you did something you enjoyed doing? 6. Are you involved in a community, e.g., an association or a spiritual community? Are you involved in peer support groups or online groups?
Health and well-being	<ol style="list-style-type: none"> 1. Do you exercise regularly? What kind? How often? When was the last time? 2. Do you drink alcohol? Do you use other substances? Do you smoke? How much? 3. Do you eat healthily? Do you eat regularly? Do you drink water? Do you drink energy drinks? 4. Do you sleep well? Are you getting enough rest? When do you go to sleep/wake up? 5. Do you have any medication? Do you take it regularly? 6. Are you sexually active? Is there anything wrong with this? 7. Do you spend a lot of time on the computer or on other electronic devices?
Description of the problem/symptoms and efforts to solve the problem	<ol style="list-style-type: none"> 1. Why are you applying for this study? What symptoms have you experienced? 2. How do the problems manifest themselves in practice? <ol style="list-style-type: none"> a) Have you been supported by working capacity measures? Job editing etc. b) Have the symptoms affected the family? Have your children and spouse (if any) been healthy? c) Does the symptom limit meeting friends? How? d) Does the symptom limit your hobbies? How? e) Have the symptoms had other consequences in everyday life? 3. What treatment and rehabilitation have you received for these symptoms? Which of them has helped? Have you received psychological treatment before? Which of them have helped? And why do you think? 4. Using other (alternative) treatments and self-care, have you tried anything? Which of them have helped? And why do you think? 5. When did the problem start? Did something else happen at the same time when your well-being was affected? How has your health improved since the onset of symptoms? Has something happened along the way that has worsened the symptoms? And has something happened that otherwise affected your well-being? 6. In what situations are you in particular distressed or in what situations do you have symptoms in particular? How do you cope in difficult situations? 7. What kind of things have affected or could have a positive effect on your situation? Is there something that has made it difficult or can make it difficult for the change to happen?

(continued on next page)

Table 2 (continued)

Theme	Question
	8. What kind of things do you do to promote or support your own well-being? Does it work? Are you doing something that could be harmful to your well-being? How does it affect your life?
	9. What do you think about the future? What do you hope for the future? What are your hopes or expectations for this study? What do you hope to change?

Table 3

Participant Characteristics (Patients Who Participated in Case Formulation, $n = 50$)

Baseline characteristics	All ($n = 50$)	IEI ($n = 11$)	CFS ($n = 28$)	Both IEI and CFS ($n = 11$)
Age M (SD)	45.9 (8.12)	42 (6.02)	47.1 (8.67)	46.6 (7.89)
Gender				
Female	42 (84%)	10 (90.9%)	23 (82.1%)	9 (81.8%)
Male	8 (16%)	1 (9.1%)	5 (17.9%)	2 (18.2%)
Marital status				
Unmarried	10 (20%)	2 (18.2%)	8 (28.6%)	–
Married	25 (50%)	7 (63.6%)	13 (46.4%)	5 (45.5%)
Cohab	8 (16%)	2 (18.2%)	1 (3.6%)	5 (45.5%)
Divorced	7 (14%)	–	6 (21.4%)	1 (9.1%)
Education				
Low	1 (2%)	–	–	1 (9.1%)
Middle	19 (38%)	4 (36.4%)	11 (39.3%)	4 (36.4%)
High	30 (60%)	7 (63.6%)	17 (60.7%)	6 (54.5%)
Working status				
Full time	37 (74%)	9 (81.8%)	20 (71.4%)	8 (72.7%)
Part time	12 (24%)	2 (18.2%)	7 (25%)	3 (27.3%)
Not working	1 (2%)	–	1 (3.6%)	–
Self-reported health ^a M (SD)	3.28 (0.83)	3.09 (0.83)	3.25 (0.89)	3.55 (0.67)
Self-reported workability ^a M (SD)	5.76 (1.90)	6.55 (2.02)	5.25 (2.01)	6.27 (1.01)

Note. IEI = Indoor-air related symptoms, CFS = Chronic Fatigue Syndrome, ^a = self-reported on a scale of 0–10.

ticipants (Table 4) were symptoms of stress and burnout (74%), followed by low mood (68%), narrowing of daily life (58%), and worrying (52%).

Among the group of participants with PPS related to the indoor environment ($n = 11$), stress and burnout, low mood, and narrowing of daily life were reported by over half. Among the patients with CFS, stress and burnout, and low mood, were reported by approximately 80% of the 28 participants, and nearly 70% experienced that their life had become narrowed due to various physical restrictions and a limited social network. In addition, approximately half of these participants reported tension or worrying as a problem. Overall, as we can see from Table 4, there was a large variation in the reported symptoms.

Functional Analysis and the Functional Analytic Clinical Case Model

To illustrate the complexity of the individual cases of participants with PPS symptoms, two case examples will be presented. These case examples—a participant with PPS related to the indoor environment and a participant with PPS related to CFS—were made by the psychologist after the first assessment and psychosocial interview over the telemedicine videoconference application doxy.me and presented to the participant and discussed during the second videoconference meeting. Both case formulations were confirmed by the participants. The information has been modified to protect the anonymity of the participants.

Table 4
Assessment of Problems and Issues Perceived by PPS Patients ($n = 50$)

Problem	All ($n = 50$)	Back-ground factor* (all)	IEIn = 11	Back-ground factor	CFSn = 28	Back-ground factor	Bothn = 11	Back-ground factor
1. Stress and burnout	37 (74%)	3	7 (64%)	2 (18%)	23 (82%)	1 (4%)	7 (64%)	–
2. Low mood	34 (68%)	–	6 (55%)	–	22 (79%)	–	6 (55%)	–
3. Persistent physical symptoms	32 (64%)	–	10 (91%)	–	12 (43%)	–	10 (91%)	–
4. Narrowing of daily life	29 (58%)	–	6 (55%)	–	19 (68%)	–	4 (36%)	–
5. Worrying	26 (52%)	–	5 (46%)	–	14 (50%)	–	7 (64%)	–
6. Loneliness and social withdrawal	25 (50%)	–	5 (46%)	–	16 (57%)	–	4 (36%)	–
7. Tension	25 (50%)	–	4 (36%)	–	17 (61%)	–	4 (36%)	–
8. Work-related problems ¹	25 (50%)	4	6 (55%)	2 (18%)	16 (57%)	1 (4%)	3 (27%)	1 (9%)
9. Sleeping problems	22 (44%)	–	4 (36%)	–	12 (43%)	–	6 (55%)	–
10. Fatigue	22 (44%)	2	5 (46%)	1 (9%)	9 (32%)	–	8 (73%)	1 (9%)
11. Anxiety	21 (42%)	1	4 (36%)	–	13 (46%)	1 (4%)	4 (36%)	–
12. Chronic fatigue	19 (38%)	–	1 (9%)	–	17 (61%)	–	1 (9%)	–
13. Inactivity	19 (38%)	–	1 (9%)	–	12 (43%)	–	6 (55%)	–
14. Pain	16 (32%)	2	5 (46%)	–	6 (21%)	2 (7%)	5 (46%)	–
15. Difficult emotions ²	16 (32%)	–	3 (27%)	–	9 (32%)	–	4 (36%)	–
16. Family and marital problems ³	15 (30%)	10	3 (27%)	1 (9%)	10 (36%)	5 (18%)	2 (18%)	4 (36%)
17. Mold exposure	13 (26%)	13	–	7 (64%)	–	–	–	6 (55%)
18. Problems with concentration	12 (24%)	–	3 (27%)	–	8 (29%)	–	1 (9%)	–
19. Covid restrictions	1 (2%)	11	–	3 (27%)	–	6 (21%)	1 (9%)	2 (18%)
20. Specific physical symptoms	10 (20%)	2	3 (27%)	–	4 (14%)	1 (4%)	3 (27%)	1 (9%)
21. Covid infection	10 (20%)	10	–	–	–	9 (32%)	–	1 (9%)
22. Other illness	10 (20%)	10	2 (18%)	2 (18%)	2 (7%)	5 (18%)	1 (9%)	3 (27%)
23. Death or illness of a loved one	–	6	–	2 (18%)	–	4 (14%)	–	2 (18%)
24. Unpredictability of symptoms ⁴	9 (18%)	–	3 (27%)	–	2 (7%)	–	4 (36%)	–
25. Chemical sensitivity	8 (16%)	–	5 (46%)	–	1 (4%)	–	2 (18%)	–
26. Memory problems	6 (12%)	–	–	–	5 (18%)	–	1 (9%)	–
27. Perfectionism (Suorittaminen, vaativuus itseä kohtaan)	6 (12%)	–	2 (18%)	–	2 (7%)	–	2 (18%)	–
28. Problems related to economy and housing	6 (12%)	2	–	1 (9%)	2 (7%)	–	4 (36%)	1 (9%)

Note: PPS = Persistent physical symptoms; IEI = Indoor air related environmental intolerance; CFS = Chronic fatigue syndrome.

*Background factor = Historical causal variable that cannot be changed

¹workload, problems with communication, relationships and work environment, bullying

²hatred, irritation, sadness, hopelessness, feelings of failure, disappointment, unfairness and guilt, feelings of not being taken seriously

³relationship problems, parenting stress, problems and worry related to children and own parents

⁴loss of control, difficulties to plan daily life, self-monitoring

The FACCM uses a variety of symbols: a rectangle indicates a central problem, a circle an antecedent, a consequence, or a moderator variable, and a diamond refers to a historical causal variable that cannot be modified (background factors in Table 4). The functional relations between the variables are arrows or lines that indicate the strength, direction, and form of the functional relation (Haynes et al., 2011). The problems and the factors affecting the problems can be multimodal in nature, including thoughts, feelings, physiology, and activity (Haynes & O'Brien, 2000; Haynes et al., 2011).

Case 1. Participant With Indoor-Environment-Related Symptomatology

The participant was a man in his forties. He had a high level of education and lived together with his partner. He was working full-time as an employee. During the interview, PPS related to the indoor environment was defined as the central problem (depicted in a rectangle in Figure 2).

The functional analysis illustrated by the Functional Analytic Clinical Conceptualization (FACC; see Figure 2) suggested that his PPS and sensitivity to symptoms were perceived to have been caused by previous exposure to mold. The worry regarding harmful exposure to mold had led to changing apartments, which increased the burden he was experiencing. There was a bidirectional relationship between his PPS and distress, indicating that gathering more information about the nature of the distress would be needed. Stress was connected to symptoms that appeared from even minor exposure. Stress also disturbed sleep and contributed to the experience of not being able to enjoy things. There was a mutual relationship between the PPS and stress, indicating that stress increased his symptoms but also that the symptoms caused more stress, and, via stress, the symptoms also increased anxiety, fatigue, and sleeping problems. Sleeping problems affected fatigue, which was mutually related to stress. Not being able to enjoy things contributed to decreased mood, and low mood was a consequence of the prolonged symptoms. There was also a bidirectional relationship between low mood and worrying, suggesting that low mood affected worrying but also worrying contributed to the decline in mood.

The FACC points out several options for psychological intervention. One alternative could be to make a more detailed analysis of stress and try to influence it. Based on the analysis, stress is connected to several different factors, such as persistent symptoms, symptoms in certain indoor environments, fatigue, and anxiety, which contributes to poor sleep and, further, to loss of enjoyment in life. A second alternative would be to

alleviate the anxiety, which affects the severity of the PPS and thus has an indirect effect on many problems the patient is experiencing. Another option would be to examine the patient's worry behavior more closely and start working on it, as it is mutually related to low mood. Taken together, this functional analysis points out individual contributing factors that may require collecting additional data in order to possibly identify more relevant connections. For example, emotional and physical reactions and thoughts related to stress, anxiety, and worrying might be some of the targets for the treatment and should be verified. Some of the assumptions may have to be abandoned, but it might be possible to find other variables that may be associated with maintaining or aggravating the physical symptoms the participant is experiencing.

Case 2. Participant With Persistent Physical Symptoms Related to CFS

The participant was a woman of about 50 years and her symptoms were associated with CFS, and prolonged chronic fatigue was defined as the central problem (depicted in a rectangle; see Figure 3). She was divorced and had a middle-level education. She had work experience of about 30 years and currently worked full-time as an employee.

According to the FACC (Figure 3), chronic fatigue experienced by this person was affected by distress and burden. Life changes and relocating and current living situation were associated with the burden. Divorce also affected her living circumstances. Both the living situation and chronic fatigue were associated with worry. Worrying, on the other hand, was connected to symptoms of chronic fatigue also through the feeling of hopelessness. Chronic fatigue was connected to low mood, which was also affected by hopelessness and worry and the narrowing of everyday life. Depressed mood was associated with difficulties concentrating and anxiety. Difficulty winding down was related to chronic fatigue through distress. According to the case formulation, there were five different factors that were directly associated with the symptoms of chronic fatigue: distress, relocating, worrying, hopelessness, and depressed mood. In addition, five factors were indirectly connected to chronic fatigue: divorce, narrowing of everyday life, difficulties concentrating, difficulties winding down, and anxiety.

When investigating the associations and the directions of the associations, one of the main targets for treatment could be to reduce the distress and burden the patient is experiencing. Since there was a mutual association between low mood and chronic fatigue symptoms, it would be worthwhile to find out whether it is possible to influence her mood. Low mood was

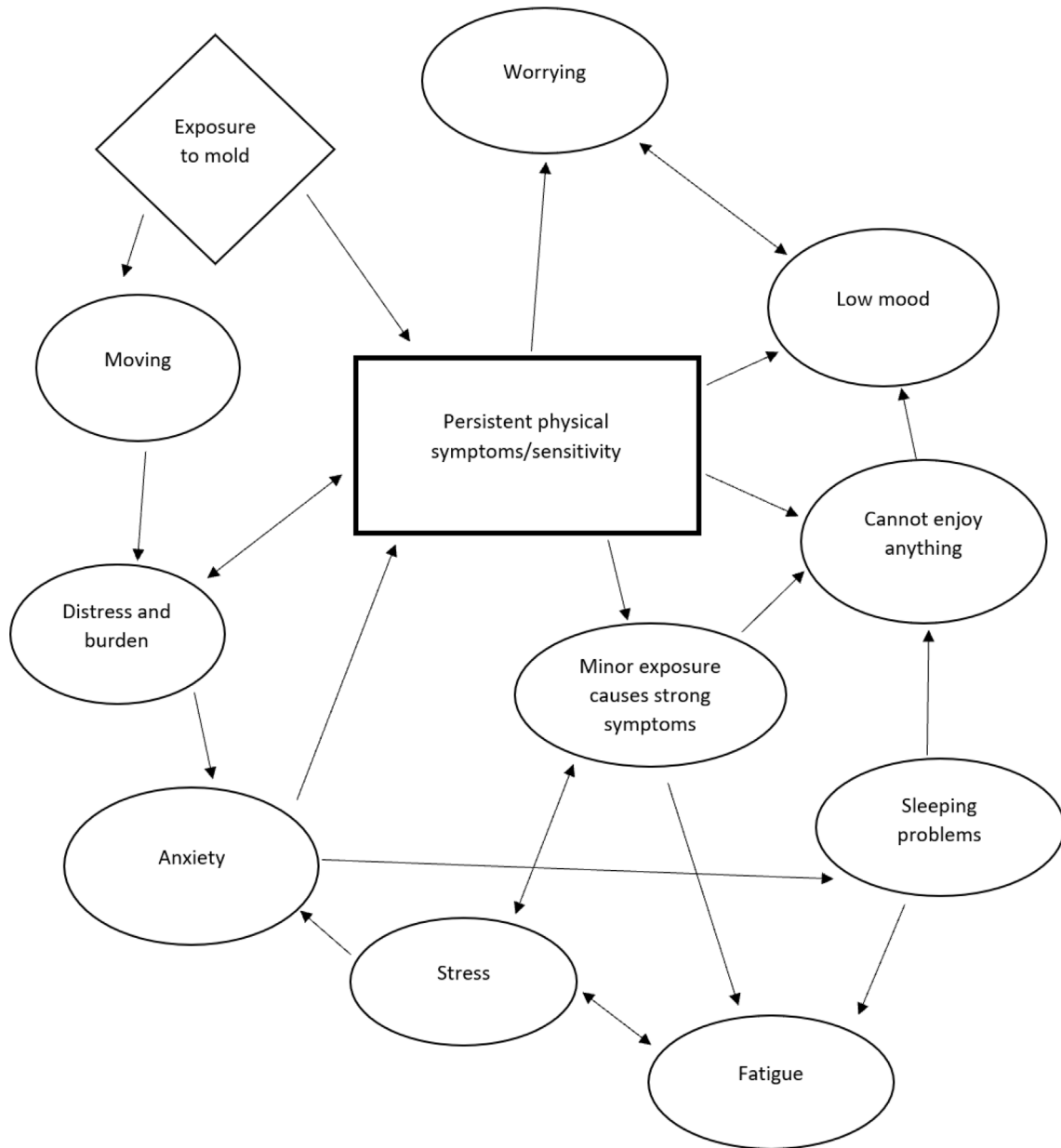


Figure 2. Patients with indoor air-related environmental intolerance (IEI).

associated with her life having become narrowed, which was also connected to worry and hopelessness and through these also to symptoms of fatigue. Thus, the diagram points out that it would be useful to examine more closely which way her life has become narrowed and map out potential change options related to it. Finally, anxiety is also a potential treatment target

as decreasing anxiety may also affect mood and, through changes in mood, symptoms of fatigue. Thus, the diagram offers several options for planning interventions targeting problems that increase or maintain symptoms of chronic fatigue. A combination of therapeutic approaches to relieve these contributing factors may benefit the well-being of the individual and lead to

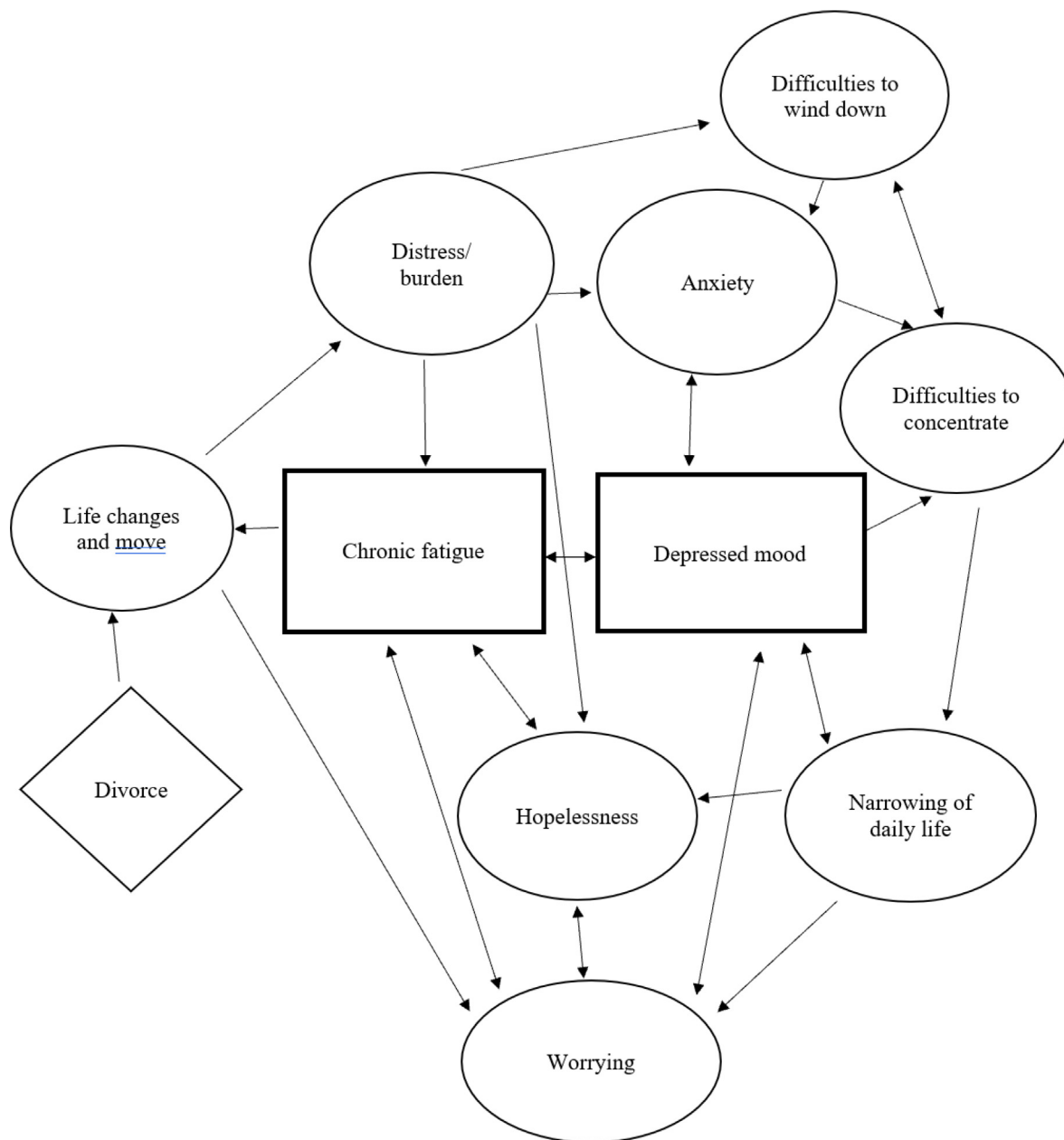


Figure 3. Patients with chronic fatigue syndrome (CFS)

milder fatigue symptoms and the opportunity to reevaluate the situation after an intervention has been delivered.

Discussion

PPS associated with the indoor environment and chronic fatigue have serious consequences for individuals' daily functioning and quality of life. Further, PPS are often associated with multiple referrals and excess use of health-care services, creating a challenge for health-care providers. The aim of this study was to illus-

trate a highly individual assessment procedure applied to individuals with PPS. We present the application of an individual video-based functional analysis and a visual FACC (Haynes et al., 2011) to describe possible psychological and life problems among patients with PPS and to give examples of how a functional analytic approach to case formulation and FACCs could assist in the assessment of, and identification of treatment targets for, individuals with PPS. The groups investigated in the current study were participants with PPS related to the indoor environment, individuals with

PPS related to chronic fatigue (CFS), and individuals with both symptomatology.

At group level, the case conceptualization interview and FACC indicated that persons with PPS reported a large number of psychological and life problems affecting their quality of life. The three groups reported approximately an average of nine problems in addition to their main difficulty. Interestingly, there was no significant difference between the groups in terms of the quantity of problems. The most frequent problems in all three groups (indoor-environment-related persistent symptomatology, CFS-related persistent symptomatology, or both) were symptoms of stress and burnout, low mood, narrowing of daily life, and worrying. This finding suggests that a comprehensive interview and individual assessment are essential factors in planning the treatment of patients with PPS. Further, our data suggested that the four aforementioned psychological symptoms could be the target of the intervention whether the individual experienced PPS related to the indoor environment or CFS. Interestingly, among the participants assigned in the PPS related to CFS group ($n = 28$), the FACC of 12 (43%) was constructed using PPS and not chronic fatigue as the main problem. This suggests that our inclusion criteria interview and case conceptualization interview and model resulted in slightly different definitions of the main problem among nearly half of the participants with PPS related to chronic fatigue.

The FACC diagrams describing two individual case examples suggested that there were multiple factors that could impact the quality of life of the patients with PPS and partially explain or even maintain both indoor-environment-related symptomatology as well as persistent fatigue symptoms. Research evidence suggests that people are more likely to have gone through stressful life events in the year prior to developing chronic fatigue (Chalder, 1998). Other vulnerability factors are prior chronic stress and/or psychological distress, such as anxiety and/or depression (Salit, 1997). It is possible that stressful life events activate the sympathetic nervous system and leave people more vulnerable to the effects of infections; however, the exact mechanisms are still unclear (see, e.g., Deary et al., 2007). According to the current FACCs, stressful life events alone or in combination with other events, such as divorce, the illness of a near family member, or exposure to mold, in individuals under stress seem to have led to more distress, which, in turn, produced more symptoms and further distress, such as worrying, anxiety, low mood, and sleep disturbances. These interactions can create a vicious cycle that can lead to increased anxiety, hopelessness, a focus on symptoms, narrowing of daily life, and difficulties con-

centrating. In the case of the participant with prolonged fatigue, for example, there were five factors that were directly associated with persistent fatigue and seven factors that were indirectly connected to persistent fatigue. This is in line with the CBT model for CFS (Deary & Chalder, 2006; Suraway et al., 1995), which hypothesizes that vulnerable individuals can get caught in a vicious cycle of symptom maintenance, where each factor can result in physical symptoms and/or distress. Research suggests that identifying the elements maintaining the autopoietic cycles and identifying the elements that made the individual vulnerable in the first place are crucial. Some theoretical models of persistent symptoms suggest that vulnerability factors and triggering factors can be moderated by sensory and cognitive factors. Further, symptoms can be maintained or aggravated by experiences and emotional and cognitive factors contributing to chronic and disabling distress (Henningson et al., 2018).

Clinical case formulations help the clinician recognize clinically important differences between persons with similar symptom manifestations due to a unique behavior–cognitive–environment–genetic interplay of causal mechanisms. They also assist in identifying which changes in which factors, or their interactions, may lead to improvement in symptoms as well as assisting in forming the rationale for treatment (Deary & Chalder, 2006). Thus, the FACC is one tool with which the psychologist, doctor, and patient together can search for the patient's personal circumstances that might contribute to the distress and target the mechanisms of change that are the most important in treatment, reducing symptom maintenance, and enhancing the quality of life.

Based on the current findings, treatment and rehabilitation for PPS would include interventions for stress/burnout, low mood, worrying, narrowing of daily life, loneliness, and work-related problems. In addition, among chronic fatigue patients, attention should be paid to tension. A more detailed understanding of the patients' thoughts and feelings related to their symptoms is also important to establish, for example, whether worrying is related to catastrophic beliefs or thoughts regarding their symptoms, as catastrophizing beliefs have been found to be one of the most common maintaining factors in patients with persistent fatigue (Deary et al., 2007). Physical symptoms may be perceived as aversive or threatening, which triggers a physiological response, which, in turn, serves to maintain avoidance, symptom focus, and symptoms.

The case formulation model and FACC presented here can be a useful tool that clinicians such as psychologists, trained nurses, psychotherapists, and medical doctors could use to better understand and treat per-

sons with PPS. It is difficult to understand behavior out of context, which comprises both the individual's external context as well as the "internal context" composed of her/his thoughts and feelings. The FACCD makes it easier for clinicians to see the complexity of a patient's situation and may give useful hypotheses of complex interactions between different variables that may not otherwise be noticed but might be important for change. The visual FACCD tool may also help patients with PPS gain a new perspective on their own situation. Further, the FACCD can serve in building a shared understanding of a complex situation between the individual and health-care professionals. However, as the FACCD is based mostly on a hypothesis made on the basis of limited information, more detailed analyses of central variables and further assessment of expected changes would be needed in order to verify the hypotheses. The hypothesized relationships should be further analyzed and verified during the treatment.

Limitations

The study has at least the following limitations. First, the decisions of inclusion and exclusion were based on structured video-based clinical interviews and self-reported measures. The inclusion interview by the medical doctor did, however, aim to exclude a diagnosed or suspected medical disease as a cause of PPS. Second, participation in the study was based on voluntary enrollment, which may cause selection bias, as intervention studies, in general, include participants who are willing to receive psychological treatment (van Dessel et al., 2014). In addition, it is important to note that these problems were collected from individual study participants who voluntarily took part in the assessment. The data presented in the current study do not suggest that all persons with PPS have similar psychological and life problems. Psychosocial problems experienced by patients with PPS may vary from individual to individual. Therefore, clinicians should be aware that patients may experience difficulties other than those shown in this study. Further, the number of participants in the current study was relatively small, which limits the generalization of the conclusions.

Despite these limitations, this study provides information on how case formulation and the visual FACC can be applied in the assessment and treatment of patients with PPS. Especially in complex cases, such as PPS, understanding complicated interactions from a biopsychosocial framework with various susceptibility, triggering, and maintaining factors may be crucial for successful treatment. For this purpose, the FACC offers a practical tool with several benefits. One of the benefits is its contextual nature—it considers interaction

between different contexts, behaviors, and causal variables. In addition, the case formulation and the visual FACC are relatively easy to learn and may complement the assessment of patients with PPS conducted by medical doctors and show direction for treatment. After all, within cognitive behavioral approaches, case formulation is considered a core skill for all practitioners (Sturme, 2007). Further, this study recognizes individual differences and provides a structured but individual-oriented approach to the assessment of unique factors that contribute to the ill-being of each patient with PPS. Importantly, presenting the case formulation model to the patient and considering his/her views connect the patient to the treatment process and, therefore, facilitate motivation to change and emotional reactions associated with that change. Finally, this study illustrates how the FACCD can be successfully conducted online, via a videoconferencing tool, and, therefore, can be used by professionals across long distances.

This is one of the first studies applying the visual FACCD to individuals with PPS. More studies are needed to verify how the FACCD best can be used in the assessment and treatment of patients with PPS and whether individual assessment models could contribute to our understanding of the unique behavior-cognitive-environment-genetic interplay of the causal mechanisms of PPS.

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AV works as a part-time medical consultant at OP Insurance Ltd. and has worked as a part-time medical consultant at The Social Insurance Institution of Finland (Kela, until 30 November 2018). AV has been a substitute member of the medical expert group of the Unemployment Security Appeal Board (TTLK, in accordance with the Unemployment Security Commission Act) until 31 December 2017. MS works as a part-time medical adviser to the Finnish Patient Insurance Centre (in accordance with the Patient Injuries Act). The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The Ethics Committee of the Hospital District of Helsinki and Uusimaa, Finland, has granted approval for the study.

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