Clinimetric properties of the CoCo-P in adults with Post COVID-19 Condition: Can we really distinguish cognitive functions?

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ABSTRACT

Background: The Cognitive Complaints – Participation (CoCo-P) identifies cognitive complaints, specifically memory, attention, and executive functioning, as well as fatigue during participation. The CoCo-P seemed appropriate for evaluation of occupational therapy in individuals with Post COVID-19 Condition (PCC), because it measures complaints experienced by individuals with PCC. For proper application and interpretation of the CoCo-P, it is necessary to know its clinimetric properties, and to explore whether cognitive complaints are associated to characteristics of individuals with PCC.

Aim: To determine responsiveness and dimensionality of the CoCo-P in individuals with PCC. Secondary, to explore whether characteristics of individuals with PCC who received occupational therapy are associated to severity and change of cognitive complaints measured with the CoCo-P.

Methods: This clinimetric study included individuals with PCC (20-73 years), who received occupational therapy in primary care in the Netherlands, and completed the CoCo-P before and after therapy. Paired samples t-tests were performed to assess changes before and after occupational therapy on the CoCo-P constructs. To determine construct responsiveness, six hypotheses were formulated in the protocol, and during the study Pearson correlation coefficients were computed to examine correlations between constructs of the CoCo-P and similar constructs of other outcome measures. Dimensionality was examined by performance of a Principal Component Analysis (PCA). To explore associations, univariate linear regression analyses were performed. P-values ≤ 0.05 were considered statistically significant.

Results: 239 individuals with PCC were included. Significant improvements with small to moderate effect sizes were found after occupational therapy on the CoCo-P constructs. 83% of the hypotheses about responsiveness were confirmed. Nine factors were identified in the PCA. Fatigue measured before occupational therapy was significantly associated to severity of cognitive complaints. No significant associations were found between characteristics and change of cognitive complaints.

Conclusion: This study demonstrates the CoCo-P is a responsive outcome measure in individuals with PCC. In contrast with the assumed cognitive functions, no underlying dimensions of the CoCo-P were found. As fatigue and cognition are associated, fatigue should be considered when observing cognitive functioning.

Recommendations: Occupational therapists can use the CoCo-P for individuals with PCC to identify and evaluate cognitive complaints in daily life.

Keywords: CoCo-P; Cognitive functioning; Occupational therapy; Post COVID-19 condition; Participation

Samenvatting

Achtergrond: De CoCo-P identificeert cognitieve klachten op het gebied van aandacht, geheugen en executieve functies, evenals vermoeidheid tijdens participatie. De CoCo-P leek geschikt om ergotherapie te evalueren bij mensen met het Post COVID-19 Syndroom (PCS), omdat het klachten meet die door mensen met PCS ervaren worden. Voor juist gebruik en interpretatie van de CoCo-P is het van belang om klinimetrische eigenschappen te weten en te ontdekken in hoeverre cognitieve klachten en karakteristieken van mensen met PCS geassocieerd zijn.

Doel: Het bepalen van de responsiviteit en dimensionaliteit van de CoCo-P bij mensen met PCS. Daarnaast het verkennen van associaties tussen karakteristieken van mensen met PCS die ergotherapie ontvingen en de ernst en beloop van cognitieve klachten, gemeten met de CoCo-P.

Methoden: Deze klinimetrische studie includeerde mensen (20-73 jaar) met PCS, die ergotherapie in de eerste lijn in Nederland ontvingen en de CoCo-P voor en na ergotherapie invulden. Gepaarde t-toetsen zijn uitgevoerd om veranderingen voor en na ergotherapie te onderzoeken. Om construct responsiviteit te bepalen zijn in het studieprotocol zes hypothesen opgesteld, tijdens de studie zijn Pearson correlatiecoëfficiënten berekend om de correlatie te bepalen tussen constructen van de CoCo-P en constructen van andere uitkomstmaten. Dimensionaliteit is onderzocht met een Principale Component Analyse (PCA). Voor het verkennen van associaties zijn univariate lineaire regressieanalyses uitgevoerd. P-waardes ≤ 0.05 zijn beschouwd als statistisch significant.

Resultaten: 239 mensen met PCS zijn geïncludeerd. Significante verbeteringen met kleine tot middelgrote effectgroottes werden gevonden na ergotherapie voor de constructen van de CoCo-P. 83% van de hypothesen over responsiviteit werd bevestigd. Negen factoren werden gevonden in de PCA. Vermoeidheid voorafgaand aan ergotherapie was significant geassocieerd met de ernst van cognitieve klachten. Geen significante associaties werden gevonden tussen karakteristieken en het beloop van cognitieve klachten.

Conclusie: Dit onderzoek laat zien dat de CoCo-P een responsieve uitkomstmaat is bij mensen met PCS. Anders dan de veronderstelde cognitieve functies zijn er geen onderliggende dimensies gevonden. Gezien de associatie tussen cognitie en vermoeidheid, dient vermoeidheid meegenomen te worden tijdens het observeren van cognitief functioneren.

Aanbevelingen: Ergotherapeuten kunnen de CoCo-P gebruiken bij mensen met PCS voor het identificeren en evalueren van cognitieve problemen in dagelijkse activiteiten.

Trefwoorden: CoCo-P; Cognitief functioneren; Ergotherapie; Post COVID-19 Syndroom; Participatie

INTRODUCTION

Only 19% of individuals with Post COVID-19 condition in the Netherlands seem to recover within a year[1]. Post COVID-19 condition (PCC), also known as Long COVID, is defined as 'persistence of any combination of symptoms for at least three months during or after a SARS-CoV-2 infection leading to COVID-19 disease'[2,3]. Frequently mentioned complaints include fatigue, cognitive dysfunction, pain, fear, sleep disturbance, and respiratory problems[3–5]. These complaints contribute to activity limitations and participation restrictions[3–5]. Persistent symptoms lead to a reduction in quality of life, quitting or reducing work, and no longer performing daily life roles[1]. Limited recovery and high impact on individuals' daily life emphasize the need for effective treatments to support recovery and participation of these individuals.

However, as PCC is a novel disease, neither proven interventions are available nor are there reliable and validated outcome measures for this target group. Despite this, allied healthcare professionals provide evidence-based therapy focused on similar complaints as experienced by individuals with PCC[6–9]. Therefore, it was expected that these interventions could contribute to recovery of individuals with PCC as well[10]. To facilitate treatment and promote research, a temporary regulation was instated by the Dutch Ministry of Health, Welfare, and Sports in July 2020[11]. Among others, occupational therapy was provided, which seemed an appropriate therapy because of its aim to address problems with resuming and rebuilding daily life activities[12]. Earlier, this therapy was experienced to be the most beneficial for individuals recovering from PCC[1]. However, the evidence base of occupational therapy needs more research for future funding of this therapy. To evaluate allied health recovery care, including occupational therapy, for individuals having complaints within six months after a SARS-CoV-2 infection, Radboud university medical center (Rumc) set up the 'ParaCov study'[13].

One of the outcome measures used to evaluate occupational therapy in the ParaCov study was the Cognitive Complaints – Participation (CoCo-P). The CoCo-P identifies cognitive complaints related to memory, attention, and executive functioning, as well as the degree of fatigue during ten participation domains[14]. Over 90% of individuals with PCC experienced these cognitive complaints as well as fatigue, which impeded their participation[1]. The combination of experienced complaints by individuals with PCC, the aim of the CoCo-P, and focus of occupational therapy, made the researchers choose for the CoCo-P as an appropriate outcome measure to evaluate occupational therapy in this target group.

Despite this justification, the CoCo-P is initially developed in 2021 for individuals with brain injury such as stroke or traumatic brain injury. Designing took place in collaboration with these individuals, and professionals and was substantiated with psychological theories[14]. No research was performed to examine clinimetric properties of the CoCo-P. This lack of knowledge restricts interpretation of findings and validity of outcomes in the ParaCov study. As a result, proper evidence-based clinical application of the CoCo-P by professionals is limited.

The CoCo-P was used as an evaluative outcome measure within the ParaCov study. However, its responsiveness, the capacity to detect change over time, or longitudinal validity, is unknown[15]. Construct responsiveness of the CoCo-P, the extent to which scores on the CoCo-P relate to changes in other outcome measures that measure related constructs[16], can be assessed with other outcome measures in the ParaCov study: 1) Canadian Occupational Performance Measure (COPM), measuring performance and satisfaction with performance of daily activities; 2) Patient Reported Outcome Measure for Occupational Therapy (PROM-OT), measuring the reported ability to perform daily activities, self-management, and management by the environment; and 3) Fatigue Severity Scale (FSS), measuring fatigue in daily life[17–19].
The underlying factors of the CoCo-P, known as dimensionality, are assumed to be memory, attention, and executive function. However, no factor analysis was performed. This needs exploration to ensure accurate scoring of items and interpretation of results[20,21]. Once this is established, characteristics of participating individuals with PCC and their cognitive complaints, measured with the CoCo-P, will be analyzed to determine whether they might be influencing variables for cognitive complaints and change during occupational therapy. This information can help therapists to improve understanding of goals and expectations of their therapy for various individuals with PCC[22].

Objectives

The first aim of this study is to evaluate clinimetric properties of the CoCo-P by investigating its responsiveness to change, correlation with other occupational therapy outcome measures, and dimensionality. The second aim is to explore whether characteristics of individuals with PCC are associated to the severity and change of cognitive complaints, measured with the CoCo-P.

For the first objective, three questions were formulated:

1. Is a statistically significant change detectable in the three cognitive domains, ten participation domains, and degree of fatigue in the CoCo-P between measurements before and after occupational therapy?
2. To what extent do change scores before and after occupational therapy of the cognitive domains, participation domains, and degree of fatigue of the CoCo-P correlate with change scores of other outcome measures with related constructs?
3. Can we distinguish cognitive domains as underlying dimensions of the CoCo-P?

For the second objective, two questions were formulated:

1. Are demographic variables, including age, gender, hospital admission, severity of COVID-19, and fatigue at baseline statistically significantly associated to severity of cognitive complaints at baseline in adults with Post COVID-19 condition who received occupational therapy?
2. Are demographic variables, including age, gender, hospital admission, severity of COVID-19, fatigue at baseline, and occupational therapy duration in weeks and number of sessions statistically significantly associated to change of cognitive complaints between measurements before and after occupational therapy in adults with Post COVID-19 condition?

METHODS

Study design

This clinimetric study is part of the ParaCov cohort study. Data before and after occupational therapy is retrospectively reviewed.

The ParaCov study has been considered a non-WMO (Law medic-scientific research with humans) study by the 'Commissie Mensgebonden Onderzoek' (CMO) of Rumc and is registered in the clinicaltrials.gov registry under identifier NCT04735744[23].

Study procedure

Inclusion of participants for the ParaCov study took place between 29th March 2021 and 19th June 2022. Individuals signed up for the ParaCov study either (1) by an invitation of their healthcare provider, or (2) on their own initiative, whereupon the research team invited their treating occupational therapist to participate[24].

Individuals and therapists used the YourResearch app or web application to report data. Individuals without access to, or lack of ability to work with, the digital tools completed the questionnaires on paper, and returned them by post.

Occupational therapists reported data on demographic and therapeutic characteristics of participating individuals, and results from outcome measure COPM[24]. The CoCo-P, the PROM-OT, and FSS were reported by individuals. The CoCo-P, COPM, and PROM-OT were completed before and after occupational therapy. The FSS was administered at set times in the ParaCov study, of which the measurements at baseline and after six months were used.

All data was anonymously entered in a secured web-based data system, the Digital Research Environment, by researchers of Rumc.

Participants

Individuals (≥18 years) recovering from COVID-19 condition were eligible to participate in the present study if they experienced activity limitations and/or participation restrictions, received occupational therapy in primary care in the Netherlands, and completed the CoCo-P before and after occupational therapy. Data from individual participation domains were excluded if not all questions within this domain were completed.

If 'not applicable' was selected in the CoCo-P, but the accompanying explanation stated that the activity was currently not possible due to complaints, it was considered a discrepancy, as the appropriate response should have been 'not possible'. Discrepant answers were excluded from the analysis.

Outcome measures

For construct responsiveness, understanding of the assessed outcome measures is of relevance. Therefore, in addition to the CoCo-P, the COPM, PROM-OT, and FSS are described in Table 1.

Table 1. Outcome measures to determine construct responsiveness of the CoCo-P

Outcome measure	Description
Cognitive Complaints - Participation (CoCo-P)	The CoCo-P is a 48-item questionnaire that measures cognitive complaints and the degree of fatigue during participation[25]. Ten participation domains are distinguished, including work and/or education, leisure activities, travel, driving a car, social contacts, family life, use of medicines, finances, grocery shopping, and cooking.

	For each participation domain, questions (varying from two to seven questions per domain) are formulated to identify cognitive complaints related to memory, attention, and/or executive functioning. These questions are answered on a 4-point rating scale, including 0 (independent without effort), 1 (independent with effort), 2 (with help), 3 (not possible). Not applicable can be chosen if items are irrelevant to an individual. In such cases, ratio scores are calculated for the total achievable score. The maximum score of 114 points is equal for summed cognitive and participation domains. Scores are also computed for each individual domain, with lower scores indicating better participation. A score above five is indicated as significant (cognitive) complaints in daily life[14]. Additionally, for each participation domain individuals indicate the degree of fatigue on a Visual Analogue Scale, ranging from 0 (not tiring at all) to 10 (extremely tiring)[25].
Canadian Occupational Performance Measure (COPM)	The COPM is a person-centered outcome measure in which occupational therapists interview individuals to identify and prioritize restrictions in activities of daily life related to self-care, productivity, and leisure. Three to five important activities are measured on performance and satisfaction with performance, both scored on a 10-point scale, ranging from 1 (not possible/ not satisfied) to 10 (totally possible/ completely satisfied)[17]. The COPM has reliable and valid clinimetric properties in several target groups, including PCC[26,27]. It is a personalized criterion-referenced outcome measure, and therefore it has no cut-off score. The COPM performance was used to obtain construct responsiveness of the participation construct of the CoCo-P.
Patient Reported Outcome Measure for Occupational Therapy (PROM-OT)	The PROM-OT is an occupational therapy specific outcome measure with statements related to daily activities, self-management, and management by the environment. The baseline measure consists of eleven statements. The follow-up contains two more statements regarding the additional value of occupational therapy. All statements are answered on 11-point scale, ranging from 0 (totally disagree) to 10 (totally agree)[18]. The PROM-OT has reliable and valid clinimetric properties in several target groups, including PCC[28–30]. Research into cut-off scores is not performed yet. The PROM-OT was used to obtain construct responsiveness of the participation construct of the CoCo-P.

Fatigue Severity Scale (FSS)	The FSS aims to identify experienced fatigue in the past week during daily activities. It contains nine questions, answered on a 7-point Likert scale, ranging from 0 (strongly disagree) to 7 (strongly agree). A score ≥4 is suggested as moderate to high fatigue[19]. The FSS has shown to be reliable and valid within several target groups[31–34]. The FSS was used to obtain construct responsiveness of the fatigue construct of the CoCo-P.

Hypotheses

Hypotheses were formulated a priori about the expected differences on CoCo-P constructs. before and after occupational therapy, and expected correlations between constructs of the CoCo-P and related constructs of other outcome measures. Moderate correlations were expected due to their similar, but still somewhat different presentation of the construct. Responsiveness is confirmed if ≥75% of the hypotheses have been confirmed[35].

1. Statistically significant differences ($p<0.05$) will be found between the scores before and the scores after occupational therapy of the cognitive domains of the CoCo-P.
2. Statistically significant differences ($p<0.05$) will be found between the scores before and the scores after occupational therapy of the participation domains of the CoCo-P.
3. Statistically significant differences ($p<0.05$) will be found between the scores before and the scores after occupational therapy of the degree of fatigue of the CoCo-P.
4. The correlation between the change score of the participation construct of the CoCo-P and the change score of the COPM performance is moderately negative ($r = -0.3<-0.5$).
5. The correlation between the change score of the participation construct of the CoCo-P and the change score of the PROM-OT is moderately negative ($r = -0.3<-0.5$).
6. The correlation between the change score of the fatigue construct in the CoCo-P and the change score in the FSS is moderately positive ($r = 0.3<0.5$).

Study size

A moderate effect size and little chance on a type I and type II error were preferred. Based on this information, for a two-tailed paired samples t-test, with α 0.05, power 0.95 and an effect size of 0.3, G*Power recommended a sample size of at least 147 participants[36].

Statistical methods

Analysis of the collected data was carried out using IBM SPSS (Version 25.0). Descriptive statistics were performed on characteristics including numbers (N) and proportions (%) for dichotomous variables. Numbers, means with standard deviations (SD), and medians with interquartile ranges (IQR) are described for continuous variables. Prior to choosing the statistical method, the assumption of normal distributed data was tested and confirmed (Kolmogorov-Smirnov p=0.200). Independent t-tests were performed to compare characteristics of the sample, and the individuals who only completed the CoCo-P before occupational therapy. P-values ≤0.05 were considered statistically significant, based on two-sided testing.

Responsiveness of the CoCo-P

Paired samples t-tests, including Confidence Intervals (CIs) and p-values, were performed between measurements before and after occupational therapy for the three cognitive domains, ten participation domains, and the degree of fatigue of the CoCo-P. Also, Cohen's D was computed to obtain effect sizes, in which ≥0.2 is a small effect, ≥0.5 is a moderate effect, and ≥0.8 is a large effect[37].

To assess construct responsiveness, bivariate Pearson Correlation Coefficients were performed for change scores before and after occupational therapy of 1) participation of the CoCo-P and the COPM performance, 2) participation of the CoCo-P and the PROM-OT, 3) fatigue of the CoCo-P and the FSS[38].

Dimensionality of the CoCo-P

Kaiser-Meyer Olkin (≥0.5) and Bartlett's test (≤0.05) were conducted to obtain the appropriateness of performing a factor analysis on the 38-item scale, regarding the participation and cognition constructs of the CoCo-P. A Principal Component Analysis (PCA) with direct oblimin was conducted to expose the underlying factors within the CoCo-P[21,39]. Oblique rotation was performed because items would not necessarily be independent of each other. The optimum number of factors was determined by the number of eigenvalues (≥1.0), total explained variance of the factors (≥50%), and the screeplot was screened for visual interpretation. Variables with item loadings <0.3 or >-0.3 were removed from the analysis[40].

Characteristics associated with severity and changes in cognitive complaints

Univariate linear regression analyses were performed to explore whether demographic variables (age, sex, hospital admission, severity of COVID-19, fatigue at baseline measured with the FSS) were associated to severity of cognitive complaints at baseline. This analysis was also performed to explore whether demographic variables (age, sex, hospital admission, severity of COVID-19, fatigue at baseline measured with the FSS, occupational therapy duration in weeks and sessions) were associated with change in cognitive complaints before and after occupational therapy.
Hospital admission, and severity of complaints at the onset of therapy were coded into three categories. For hospital admission: no admission, admission to hospital ward, admission to ICU (intensive care unit). The categories for severity of COVID-19 are based on the division by the National Institutes of Health: mild/moderate, severe, critical[41].

To prevent occurrence of the phenomenon of 'regression to the mean', occupational therapy in weeks and sessions were both included as continuous and categorical variables because of extreme outliers[42]. Four categories were made, based on the IQR.

According to Akaike's Information Criterion (AIC) variables with $p<0.157$ for 1 df, or $p<0.135$ for variables with 2 df in the univariate regression were included in the multivariate regression analysis. Then, backward elimination of variables was performed until statistically significant variables associated with the outcome remained [22].

RESULTS

Participants

364 participants of the ParaCov study started occupational therapy, of which 314 completed the CoCo-P before therapy. 239 individuals also completed the measurement after occupational therapy and were included in this study. Reasons for exclusion are unknown. The process of inclusion is presented in Figure 1.
Data of four individuals were removed for 'work' and 'grocery shopping' due to discrepancy between chosen answers 'not applicable' and accompanying explanations 'not possible'.

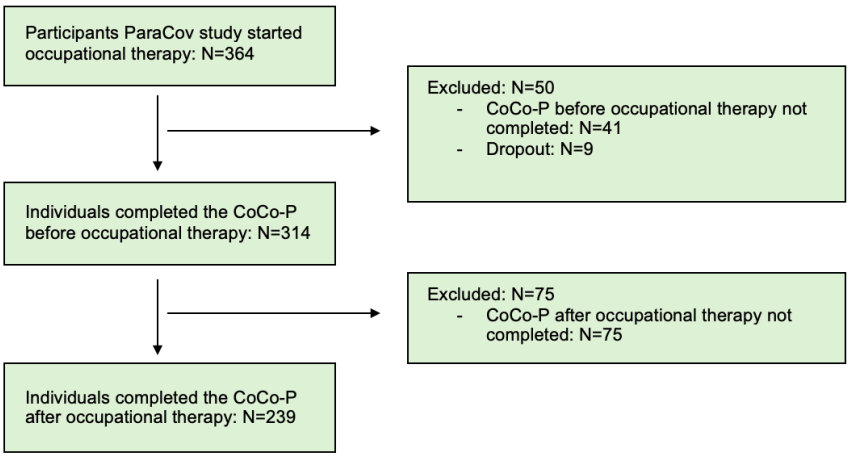

Figure 1. *Process of inclusion*

Descriptive data

Table 2 presents characteristics of the sample. Their mean age was 46 years (SD 11), and 80% of the participating individuals was female. The majority (87%) had not been hospitalized because of COVID-19, experienced mild COVID-19 complaints (84%), and gave a mean score of 5.9 points (SD 0.8) on the FSS. An average of 9 sessions occupational therapy (IQR 5-10) were provided over 24 weeks (IQR 12-31).

No statistically significant differences ($p \geq 0.391$) were found between included individuals and the 314 individuals who completed the CoCo-P before occupational therapy.

Table 2. Participant characteristics

Characteristic	N	Mean (SD)	Median	Range (min-max)	IQR (25-50-75)
Age (years)	220	45.7 (11.3)	48.0	20.0 - 73.0	36.3 – 48.0 – 54.8
FSS T0	235	5.9 (0.8)	6.0	1.4 - 7.0	5.4 – 6.0 - 6.4
OT duration (weeks)	144	23.5 (13.4)	20.0	3.0 - 52.0	12.0 – 20.0 – 31.0
OT duration (sessions)	144	8.7 (5.1)	8.0	2.0 - 42.0	5.0 – 8.0 – 10.0
	N	**%**			
Gender	220				
Male	45	20.5			
Female	175	79.5			
Hospital admission	215				
No admission	187	87.0			
Hospital ward	20	9.3			
Admission ICU	8	3.7			
COVID-19 severity	216				
Mild/moderate	181	83.8			
Severe	30	13.9			
Critical	5	2.3			

Abbreviations: N: number. SD: standard deviation. IQR: Interquartile values. FSS T0: Fatigue Severity Scale at baseline. OT: occupational therapy. ICU: Intensive care unit.

Outcomes before and after occupational therapy

239 individuals completed the CoCo-P before and after occupational therapy. Participation domains were scored between 102 and 237 times, whereby 'travelling' was scored 102 times, and 'use of medicines' 150 times. Table 3 demonstrates the results before and after therapy for the three constructs of the CoCo-P with their subdomains. Statistically significant improvements were found after occupational therapy for the cognitive domains, seven out of ten participation domains, and for fatigue. Change in dependency for the ten participation domains is illustrated in Figure 2. It presents the degree of dependency, based on the four scoring categories of the CoCo-P, before and after occupational therapy. Results before and after occupational therapy remain unchanged for 'use of medicines', and 'finances', which can also be found in Table 3.

Table. 3 Outcomes of the CoCo-P constructs before and after occupational therapy

Variable	N	Before OT (SD)	After OT (SD)	Mean difference (SD)	95% CI of the difference		t (df)	P-value	Cohen's D
					Lower	Upper			
Total	239	33.6 (16.5)	26.7 (19.5)	7.0 (15.8)	5.0	9.0	6.8 (238)	<0.001	0.4
Cognitive domains									
Memory	237	28.1 (16.8)	25.1 (18.9)	3.0 (15.8)	0.9	5.0	2.9 (236)	0.004	0.2
Attention	238	46.9 (18.9)	36.2 (23.2)	10.7 (20.2)	8.1	13.3	8.1 (237)	<0.001	0.5
Executive functioning	239	27.0 (17.6)	21.6 (19.5)	5.5 (16.3)	3.4	7.5	5.2 (238)	<0.001	0.3
Participation domains									
Work	233	48.1 (20.0)	37.1 (23.1)	10.9 (21.9)	8.1	13.8	7.6 (232)	<0.001	0.5
Leisure time	236	39.9 (20.3)	28.5 (23.1)	11.4 (24.1)	8.3	14.5	7.3 (235)	<0.001	0.5
Travelling	102	38.6 (33.0)	30.1 (29.2)	8.5 (29.2)	2.8	14.2	2.9 (101)	0.004	0.3
Driving a car	217	19.1 (22.0)	12.8 (18.6)	6.3 (20.0)	3.6	9.0	4.6 (216)	<0.001	0.3
Social contacts	237	36.2 (20.4)	29.7 (21.7)	6.5 (21.8)	3.7	9.2	4.6 (236)	<0.001	0.3
Family life	217	42.8 (23.8)	29.7 (25.3)	13.1 (24.3)	9.8	16.3	7.9 (216)	<0.001	0.5
Use of medicines	150	14.6 (19.9)	13.4 (20.0)	1.2 (17.7)	-1.6	4.1	0.8 (149)	0.400	0.1
Finances	222	10.4 (19.5)	12.2 (20.7)	-1.7 (22.1)	-4.7	1.2	-1.2 (221)	0.246	-0.1
Grocery shopping	223	33.3 (24.6)	28.1 (24.7)	5.2 (23.5)	2.0	8.3	3.3 (222)	<0.001	0.2
Cooking	217	25.6 (22.8)	23.1 (22.5)	2.5 (18.9)	-0.0	5.0	2.0 (216)	0.052	0.1
Fatigue									
Total	237	56.0 (15.5)	47.9 (22.0)	8.1 (17.7)	5.8	10.3	7.0 (236)	<0.001	0.5

Abbreviations: N: Number. OT: Occupational Therapy. SD: standard deviation. CI: Confidence Interval. t (df): t-statistic with associated degrees of freedom.

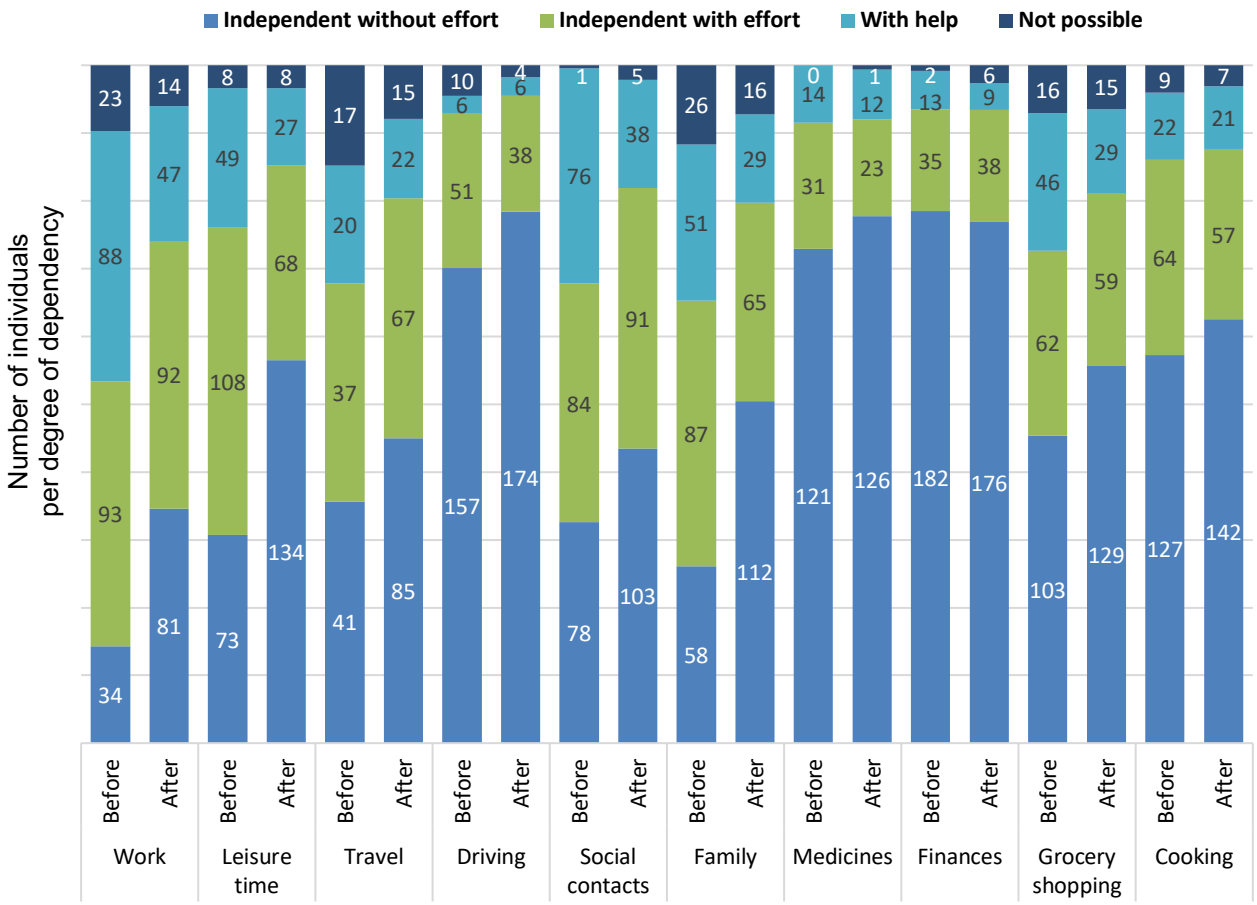

Figure 2. *Degree of dependency before and after occupational therapy for the participation domains of the CoCo-P*

Construct responsiveness

Of the 239 participants who completed the CoCo-P, 143 individuals administered the COPM together with their therapists. The PROM-OT was completed by 156 individuals, and the FSS by 209 individuals (as part of the multidisciplinary evaluation within the ParaCov study).

The results of all formulated hypotheses are statistically significant. The expected correlations between the CoCo-P, and PROM-OT, and the CoCo-P, and FSS were confirmed. The found correlation between the CoCo-P and COPM was small negative, by which this hypothesis was not confirmed. Table 4 presents previously formulated hypotheses with corresponding correlations, and p-values. 83% of the hypotheses were confirmed.

Table 4. Hypotheses responsiveness CoCo-P

RQ	Hypothesis	N	Pearson r	P-value	Approved
1	Statistically significant differences (p<0.05) will be found between the scores before and the scores after occupational therapy of the cognitive domains of the CoCo-P.	239	NA	<0.001	Yes
	Statistically significant differences (p<0.05) will be found between the scores before and the scores after occupational therapy of the participation domains of the CoCo-P.	239	NA	<0.001	Yes
	Statistically significant differences (p<0.05) will be found between the scores before and the scores after occupational therapy of the degree of fatigue of the CoCo-P.	237	NA	<0.001	Yes
2	The correlation between the change score of the participation construct of the CoCo-P and the change score of the COPM performance is moderately negative (r = -0.3<-0.5).	143	-0.25	0.002	No
	The correlation between the change score of the participation construct of the CoCo-P and change score of the PROM-OT is moderately negative (r = -0.3<-0.5).	156	-0.32	<0.001	Yes
	The correlation between the change score of the fatigue construct of the CoCo-P and change score in the FSS is moderately positive (r = 0.3<0.5).	208	0.35	<0.001	Yes
Number of confirmed hypotheses					5/6

Abbreviations: RQ: Research question. NA: Not applicable. CoCo-P: Cognitive Complaints – Participation. COPM: Canadian Occupational Performance Measure. PROM-OT: Patient Reported Outcome Measure for Occupational Therapy. FSS: Fatigue Severity Scale.

Dimensionality of the CoCo-P

Kaiser-Meyer Olkin (0.518) and Bartlett's test ($p<0.001$) confirmed the appropriateness of performing a factor analysis. The scree plot suggested two factors, accounting for 42.0% of the total variance. Nine factors were found with an eigenvalue ≥1.0, explaining 66.7% of the total variance. In the 2-factor model twelve of the thirty-eight items of the CoCo-P failed to load meaningful on the two factors, which made this model inappropriate. Therefore, a 9-factor model was made (both models can be found in Appendix 1).

To identify underlying dimensions, all thirty-eight questions were categorized based on their highest item loading. The seven memory questions do not load on the same factor, nor do the eleven attention questions, nor the twenty executive functioning questions (see Table 5). The questions of the cognitive domains are divided over the nine factors, and questions of different cognitive domains load on similar factors. For four participation domains, the questions within each domain load on the same factor. Questions of remaining participation domains are spread over two or three factors.

Table 5. Outcomes factor analysis CoCo-P

	Identified factors									Total questions
	1	2	3	4	5	6	7	8	9	
Cognitive domains*										
Memory	1			1	3		1	1		7
Attention		3	2	1		1		2	1	11
Executive functioning	3	4	3	4	1		1	2	2	20
Participation domains*										
Work		1						5	1	7
Leisure time		2			1	1				4
Travelling									2	2
Driving a car			3							3
Social contacts		3	1		1					5
Family life		2			1					3
Use of medicines	3									3
Finances			2							2
Grocery shopping	1			1			1			3
Cooking				5			1			6

**Highest item loading for each question of a subdomain (based on the structure pattern) on the identified factors is presented.*

Characteristics associated with severity of cognitive complaints

Univariate associations of characteristics with cognitive complaints during participation, measured with the CoCo-P before occupational therapy, are shown in Table 6. Fatigue at baseline, measured with the FSS, was statistically significantly associated to cognitive complaints at baseline (R^2=0.04, p<0.05). No multivariate regression model was tested as only fatigue had a p-value <0.157. There were no signs of multicollinearity (VIF≤1.841) and Q-Q plots showed no sign of heteroscedasticity. Characteristics gender, age, hospital admission, and severity of COVID-19 were not significantly associated.

Table. 6 Univariable linear regression models on CoCo-P cognition scores before occupational therapy

Characteristic	β	95% Confidence Interval	P-value
Gender		**R^2 overall model[a]**: -0.005	0.996
Male	Ref		
Female	-0.014	-5.471 – 5.443	
Age	-0.128	**R^2 overall model:** 0.003	0.194
		-0.323 – 0.066	
Hospital admission		**R^2 overall model**: -0.007	0.748
No	Ref		
Yes, no ICU/CCU	-0.294	-7.938 – 7.351	0.940
Yes, and ICU/CCU	-4.530	-16.262 – 7.202	0.447
FSS mean score T0	4.194	**R^2 overall model**: 0.040	<0.001
		1.666 – 6.722	
COVID-19 severity		**R^2 overall model**: -0.006	0.727
Mild/moderate	Ref		
Severe	-2.487	-8.879 – 3.905	0.444
Critical	-2.036	-16.737 – 12.664	0.785

Abbreviations: ICU/CCU: Intensive care unit/ cardio care unit. FSS mean score T0: Fatigue Severity Scale before start of occupational therapy. Ref: Reference value.
a: adjusted R square

Characteristics associated with change of cognitive complaints

Univariate associations with change of cognitive complaints during participation, measured with the CoCo-P before and after occupational therapy, are shown in Table 7. Although being male and receiving fewer weeks of occupational therapy show greater improvements, none of the variables was statistically significant associated with cognitive change. Therefore, no multivariate models were tested.

Table. 7 Univariable logistic regression models on CoCo-P cognition change scores

Characteristic	β	95% confidence interval	P-value
Gender		**R^2 overall model[a]**: 0.005	0.153
Male	Ref		
Female	-3.850	-9.139 – 1.439	
Age	0.120	**R^2 overall model**: 0.003	0.212
		-0.069 – 0.309	
Hospital admission		**R^2 overall model**: -0.007	0.775
No	Ref		
Yes, no ICU/CCU	1.374	-6.182 – 8.931	0.720
Yes, and ICU/CCU	3.761	-7.836 – 15.357	0.523
FSS mean score T0	-1.678	**R^2 overall model**: 0.003	0.187
		-4.177 – 0.820	
COVID-19 severity		**R^2 overall model:** -0.007	0.776
Mild/moderate	Ref		
Severe	1.395	-4.915 – 7.705	0.663
Critical	-4.117	-18.629 – 10.395	0.577
OT weeks			
Continuous	-0.083	**R^2 overall model**: -0.002	0.399
		-0.276 – 0.110	
Categorical		**R^2 overall model**: -0.007	0.565
0-12	Ref		
12-20	-0.279	-7.670 – 7.111	0.941
21-31	-0.174	-7.565 – 7.216	0.963
32+	-4.357	-11.496 – 2.782	0.230
OT sessions			
Continuous	-0.152	**R^2 overall model**: -0.005	0.561
		-0.666 – 0.363	
Categorical		**R^2 overall model**: -0.014	0.781
0-5	Ref		
6-8	0.039	-7.029 – 7.107	0.991
9-10	3.766	-9.905 – 4.985	0.515
11+	3.704	-10.270 – 4.377	0.428

Abbreviations: FSS T0: Fatigue Severity Scale (FSS) before start of occupational therapy. OT: occupational therapy duration. ICU/CCU: intensive care unit/ cardio care unit. Ref: Reference value.
a: adjusted R square

DISCUSSION

The purpose of this study was to examine responsiveness and dimensionality of the CoCo-P and explore associations between (change in) cognitive complaints during participation and characteristics of adults with Post COVID-19 condition. The study included 239 individuals, 80% female, with a mean age of 46 years. 84% of them had mild COVID-19 complaints, and 87% were not hospitalized. On average, nine occupational therapy sessions were provided over twenty-four weeks.

Overall, significant improvements were found in CoCo-P constructs with small to moderate effect sizes between measurements before and after occupational therapy. The CoCo-P was confirmed as responsive, with over 75% of hypotheses confirmed. No underlying dimensions could be distinguished, since no common characteristics were found between items loading most on the same factors. This finding is in contrast with presumed dimensions memory, attention, and executive functioning.
Fatigue at baseline was the only characteristic associated with severity of cognitive complaints. No characteristics were associated with change of cognitive complaints. Both findings are consistent with previous studies that examined predictors for developing PCC, and persistence of complaints[43,44].

It should be noted that ‘travel’, and ‘use of medicines’ were completed by fewer individuals than other domains. The first of which is likely due to the lockdown of the COVID pandemic. Little dependency was experienced for ‘finances’, and for ‘use of medicines’, the latter of which is different from the initial target group, individuals with brain injury[45]. Currently, there are no effective pharmaceuticals for treating COVID-19, especially for those with mild symptoms, which applies to most individuals in this study and explains differences in dependency[46,47].

Although most hypotheses were confirmed, indicating that the CoCo-P is responsive, the correlation between the CoCo-P and the COPM was lower than the expected moderately negative correlation. The reason is probably because the COPM is a personalized, non-standardized outcome measure, resulting in dissimilar measured domains and a lower correlation. Nevertheless, all three correlations showed significant differences, indicating that the CoCo-P measures different aspects than the COPM, PROM-OT, and FSS, emphasizing its added value in measuring cognition and fatigue in daily life.

Despite these findings, caution is advised when interpreting CoCo-P results, as the cognitive domains were not found as underlying dimensions nor were other dimensions found. Findings suggest that daily life activities require a combination of the cognitive functions, which emphasizes the importance of current occupational therapy methods in which strategies are used or developed to support participation rather than train specific cognitive functions without their context[48,49]. Thus, it seems appropriate to use the CoCo-P as an evaluative outcome measure for cognitive functioning in its entirety and more specific to identify problems within participation domains.

Strengths and limitations

This is the first study examining clinimetric properties of the CoCo-P in a relatively large sample of individuals with PCC. The importance of this study is reflected in the relevance of having a responsive outcome measure for a novel condition with a major impact on one's life. Another strength of this study is the inclusion of all individuals with PCC who received allied healthcare, including occupational therapy, in the cohort of the ParaCov study. Although reasons for exclusion in the occupational therapy cohort were unknown, in the ParaCov study exclusion was established as at random, indicating no selection bias[10]. Furthermore, researchers were not involved as therapists, narrowing observer bias. Abovementioned aspects contribute to generalizability of the results of this study for individuals with PCC.

Although results seem promising, discrepancy was found at least four times between 'not possible', and 'not applicable' based on accompanying explanations. Whether this happened to other participating individuals is unknown. To prevent validity from being compromised, data of the four individuals was excluded for the analysis of 'work' and 'grocery shopping'.

The comparison of the PROM-OT's total score to determine construct responsiveness is questionable due to one small subdomain 'management by the environment', which does not focus on the individual's participation, but on the management by relatives or near ones. This could potentially affect the validity of results, even though it comprised only two questions.

Implications for clinical practice and future research

The remarkable finding that a priori presumed cognitive functions cannot be distinguished leads to the recommendation for professionals to primarily use the CoCo-P to identify cognitive complaints within participation domains. As a result, the CoCo-P is an applicable measurement tool for occupational therapists, because outcomes can be directly incorporated into treatment methods focused on promoting participation. Moreover, the finding that the CoCo-P is responsive makes this outcome measure even more appropriate since it can also be used for evaluation of functioning within the context. Considering the association between cognition and fatigue, it is important to take fatigue into account when assessing cognitive functioning.

To improve applicability and appropriateness of the CoCo-P for clinical practice, personalizing the CoCo-P by use of Computerized Adaptive Testing (CAT) might be considered. For individuals with PCC, the domains 'use of medicines', and 'finances' could be omitted considering the little experienced problems. Additionally, giving its purpose, the CoCo-P might be also appropriate for other target groups, but not all domains apply to every condition and everyone's life. CAT is found to improve efficiency and minimize question burden in an accurate manner and thus could improve use and appropriateness of the CoCo-P[50,51]. However, domains should be excluded only if an individual never engages in them, rather than because they are currently not participating due to their condition. The possibility of individualization needs further examination, as well as clinimetric properties of the CoCo-P within other target groups.

CONCLUSION

This study presents general improvements of the CoCo-P constructs and confirms its' responsiveness within individuals with PCC. Underlying dimensions could not be distinguished. A combination of cognitive functions seems necessary to perform activities of daily life. Therefore, the CoCo-P seems useful to identify and evaluate cognitive complaints in daily life activities.

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Appendix 1. Factor models dimensionality CoCo-P

To investigate the contribution of each item to the scale, both a 2-factor model and 9-factor model were tested and categorized by cognitive domains, and by factor loadings. In the 2-factor models, five items fail to load meaningfully into the model, and for only twelve items the highest loading is presented (Table 8). Also, no common characteristics were found between the items.

The 9-factor model is demonstrated in Tables 9 and 10, in which Table 9 shows that assumed items of each cognitive domain are not loaded on the same component, not confirming these three domains as underlying dimensions. As shown in Table 10, several items of individual participation domains have the highest loading on similar factors. No common characteristics were found, so no dimensions were identified. Both models demonstrate items of the scale are loaded on multiple factors, and the highest loading of each item differs among the nine factors.

Table 8. Factor loadings for 2-Factor model of the CoCo-P

Items categorized by cognitive domains	Factor 1	Factor 2	Items categorized by factor loadings	Factor 1	Factor 2
Memory					
6. I remember the information I heard at work meetings or during classes.		0.431	1. I plan my activities for the day and the week	0.492	0.313
11. I remember the last person I met during my leisure activities.	0.335		11. I remember the last person I met during my leisure activities.	0.335	
19. I remember the names of family members and friends I have known for some time.			12. When travelling, I prepare myself, such as by booking a flight, packing my belongings, and using a timetable or flight schedule.	0.460	0.430
23. I remember what events and conversations took place with my family.	0.374	0.325	13. While travelling, I can adjust my schedule if there is any delay.	0.473	0.401
26. I remember to take my medication.	**0.913**		21. I make appointments in my community, such as with the general practitioner or hairdresser.	0.415	0.392
31. While shopping for groceries, I remember what products I need to buy.	0.395	0.370	23. I remember what events and conversations took place with my family.	0.374	0.325
35. I remember the order of actions while cooking a familiar recipe.			25. I keep track of when I need a new prescription for my medication and when I need to pick it up.	**0.692**	0.350
Attention			26. I remember to take my medication.	**0.913**	
2. I pay attention to my work, without being distracted by things that happen around me.		0.382	27. I take my medication at fixed times.	**0.896**	
3. I can carry out my tasks and activities in busy surroundings.	0.403	0.562	28. I plan my budget and spending. I am aware of how much money I have to spend.	0.530	

4. I can tolerate looking at a bright computer screen, tablet computer or phone.		0.328	29. I pay the bills on time and when necessary, I pay overdue bills.	0.536	
5. I have enough mental energy for tasks at my work/education. I do not need to take extra breaks.		**0.779**	30. I keep track of what groceries to buy, for example by using a shopping list.	**0.652**	
8. I stay awake while carrying out leisure activities.			31. While shopping for groceries, I remember what products I need to buy.	0.395	0.370
9. I can carry out multiple activities consecutively, such as working, cooking and my leisure activities.		**0.734**	32. While shopping for groceries, I find the right products in the supermarket.	0.363	0.360
14. While driving, I pay attention to other road users.		0.397	33. I check whether I have all ingredients before I start cooking.	0.642	
15. I stay awake while driving.			34. While cooking, I am not distracted by things that happen around me.	0.327	0.305
17. I can converse in busy surroundings, like when at a birthday party.	0.405	**0.662**	36. I make sure that the food is prepared at the right temperature.	0.319	
18. I have enough mental energy for birthdays or family gatherings. I do not need to take extra breaks.		**0.819**	37. I determine beforehand how long the cooking will take, and this is also a correct estimation.	0.479	
34. While cooking, I am not distracted by things that happen around me.	0.327	0.305	2. I pay attention to my work, without being distracted by things that happen around me.		0.382
Executive functioning			3. I can carry out my tasks and activities in busy surroundings.	0.403	0.562
1. I plan my activities for the day and the week	0.492	0.313	4. I can tolerate looking at a bright computer screen, tablet computer or phone.		0.328
7. I check my completed tasks and activities and decide what still needs to be done.		0.302	5. I have enough mental energy for tasks at my work/education. I do not need to take extra breaks.		**0.779**
10. I can carry out my leisure activities or hobby.		**0.618**	6. I remember the information I heard at work meetings or during classes.		0.431
12. When travelling, I prepare myself, such as by booking a flight, packing my belongings and using a timetable or flight schedule.	0.460	0.430	7. I check my completed tasks and activities and decide what still needs to be done.		0.302
13. While travelling, I can adjust my schedule if there is any delay.	0.473	0.401	9. I can carry out multiple activities consecutively, such as working, cooking and my leisure activities.		**0.734**
16. I stick to the speed limit while driving.			10. I can carry out my leisure activities or hobby.		**0.618**
20. I maintain contact and meet with my family and friends.	0.335	**0.610**	14. While driving, I pay attention to other road users.		**0.397**
21. I make appointments in my community, such as with the general practitioner or hairdresser.	0.415	0.392	17. I can converse in busy surroundings, like when at a birthday party.	0.405	**0.662**
22. I organize activities and family trips for my family.	0.357	**0.627**	18. I have enough mental energy for birthdays or family gatherings. I do not need to take extra breaks.		**0.819**
24. I actively participate in the day-to-day activities of my family.	0.328	**0.628**	20. I maintain contact and meet with my family and friends.	0.335	**0.610**
25. I keep track of when I need a new prescription for my medication and when I need to pick it up.	**0.692**	0.350	22. I organize activities and family trips for my family.	0.357	**0.627**

27. I take my medication at fixed times.	**0.896**		24. I actively participate in the day-to-day activities of my family.	0.328	**0.628**
28. I plan my budget and spending. I am aware of how much money I have to spend.	0.530		38. I can do several activities at the same time, for example have a conversation while cooking.		0.401
29. I pay the bills on time and when necessary, I pay overdue bills.	0.536		8. I stay awake while carrying out leisure activities.		
30. I keep track of what groceries to buy, for example by using a shopping list.	**0.652**		15. I stay awake while driving.		
32. While shopping for groceries, I find the right products in the supermarket.	0.363	0.360	16. I stick to the speed limit while driving.		
33. I check whether I have all ingredients before I start cooking.	0.642		19. I remember the names of family members and friends I have known for some time.		
36. I make sure that the food is prepared at the right temperature.	0.319		35. I remember the order of actions while cooking a familiar recipe.		
37. I determine beforehand how long the cooking will take, and this is also a correct estimation.	0.479				
38. I can do several activities at the same time, for example have a conversation while cooking.		0.401			

Bold: the highest loading of each item. No results presented for item loadings <0.30 or >-0.3.
Results based on the structure matrix with rotation method: Oblimin with Kaiser Normalization

Table 9. Factor loadings for 9-Factor model of the CoCo-P categorized by cognitive domains

Items	F1	F2	F3	F4	F5	F6	F7	F8	F9
Memory									
6. I remember the information I heard at work meetings or during classes.		0.431	0.369	-0.328	0.378	0.390	-0.329	**-0.459**	0.473
11. I remember the last person I met during my leisure activities.	0.335				**0.653**	0.412			0.378
19. I remember the names of family members and friends I have known for some time.					**0.754**				
23. I remember what events and conversations took place with my family.	0.374	0.325		-0.302	**0.703**		-0.372	-0.414	
26. I remember to take my medication.	**0.913**			-0.342					
31. While shopping for groceries, I remember what products I need to buy.	0.395	0.370	0.427	-0.405			**-0.667**	-0.393	
35. I remember the order of actions while cooking a familiar recipe.				**-0.793**					
Attention									
2. I pay attention to my work, without being distracted by things that happen around me.		0.382	0.315	-0.365				**-0.794**	
3. I can carry out my tasks and activities in busy surroundings.	0.403	0.562					-0.305	**-0.613**	0.373
4. I can tolerate looking at a bright computer screen, tablet computer or phone.		0.328	0.349			0.443			**0.558**
5. I have enough mental energy for tasks at my work/education. I do not need to take extra breaks.		**0.779**						-0.360	
8. I stay awake while carrying out leisure activities.						**0.750**			

9. I can carry out multiple activities consecutively, such as working, cooking and my leisure activities.		**0.734**							
14. While driving, I pay attention to other road users.		0.397	**0.748**						0.468
15. I stay awake while driving.			**0.793**			0.367			
17. I can converse in busy surroundings, like when at a birthday party.	0.405	**0.662**	0.361				-0.429	-0.367	0.417
18. I have enough mental energy for birthdays or family gatherings. I do not need to take extra breaks.		**0.819**						-0.348	
34. While cooking, I am not distracted by things that happen around me.	0.327	0.305	0.399	**-0.656**			-0.339	-0.465	
Executive functioning									
1. I plan my activities for the day and the week	0.492	0.313			0.303			**-0.546**	0.362
7. I check my completed tasks and activities and decide what still needs to be done.		0.302		-0.434	0.334			**-0.610**	0.609
10. I can carry out my leisure activities or hobby.		**0.618**		-0.315		0.464			
12. When travelling, I prepare myself, such as by booking a flight, packing my belongings, and using a timetable or flight schedule.	0.460	0.430	0.427	-0.408			-0.335		**0.806**
13. While travelling, I can adjust my schedule if there is any delay.	0.473	0.401	0.454	-0.381			-0.302	-0.428	**0.839**
16. I stick to the speed limit while driving.			**0.822**	-0.367					0.334
20. I maintain contact and meet with my family and friends.	0.335	**0.610**	0.452				-0.385		0.402
21. I make appointments in my community, such as with the general practitioner or hairdresser.	0.415	0.392	**0.615**	-0.417				-0.306	0.494
22. I organize activities and family trips for my family.	0.357	**0.627**	0.407	-0.312					0.587
24. I actively participate in the day-to-day activities of my family.	0.328	**0.628**	0.337	-0.392			-0.317		0.415
25. I keep track of when I need a new prescription for my medication and when I need to pick it up.	**0.692**	0.350	0.569	-0.520	0.417			-0.375	0.464
27. I take my medication at fixed times.	**0.896**			-0.326					
28. I plan my budget and spending. I am aware of how much money I have to spend.	0.530		**0.682**	-0.428				-0.386	
29. I pay the bills on time and when necessary, I pay overdue bills.	0.536		**0.658**	-0.556				-0.303	
30. I keep track of what groceries to buy, for example by using a shopping list.	**0.652**		0.409	-0.451				-0.492	
32. While shopping for groceries, I find the right products in the supermarket.	0.363	0.360	0.466	**-0.550**			-0.511		0.363
33. I check whether I have all ingredients before I start cooking.	0.642		0.357	**-0.647**				-0.371	
36. I make sure that the food is prepared at the right temperature.	0.319		0.339	**-0.842**					
37. I determine beforehand how long the cooking will take, and this is also a correct estimation.	0.479		0.339	-0.797				-0.363	
38. I can do several activities at the same time, for example have a conversation while cooking.		0.401	0.390	-0.504			**-0.526**	-0.408	

Abbreviation: F: Factor.
Bold: the highest loading of each item. No results presented for item loadings <0.30 or >-0.3.
Results based on the structure matrix with rotation method: Oblimin with Kaiser Normalization.

Table 10. Factor loadings for 9-Factor model of the CoCo-P categorized by factor loadings

Item	F1	F2	F3	F4	F5	F6	F7	F8	F9
25. I keep track of when I need a new prescription for my medication and when I need to pick it up.	**0.692**	0.350	0.569	-0.520	0.417			-0.375	0.464
26. I remember to take my medication.	**0.913**			-0.342					
27. I take my medication at fixed times.	**0.896**			-0.326					
30. I keep track of what groceries to buy, for example by using a shopping list.	**0.652**		0.409	-0.451				-0.492	
5. I have enough mental energy for tasks at my work/education. I do not need to take extra breaks.		**0.779**						-0.360	
9. I can carry out multiple activities consecutively, such as working, cooking and my leisure activities.		**0.734**							
10. I can carry out my leisure activities or hobby.		**0.618**		-0.315		0.464			
17. I can converse in busy surroundings, like when at a birthday party.	0.405	**0.662**	0.361				-0.429	-0.367	0.417
18. I have enough mental energy for birthdays or family gatherings. I do not need to take extra breaks.		**0.819**						-0.348	
20. I maintain contact and meet with my family and friends.	0.335	**0.610**	0.452				-0.385		0.402
22. I organize activities and family trips for my family.	0.357	**0.627**	0.407	-0.312					0.587
24. I actively participate in the day-to-day activities of my family.	0.328	**0.628**	0.337	-0.392			-0.317		0.415
14. While driving, I pay attention to other road users.		0.397	**0.748**						0.468
15. I stay awake while driving.			**0.793**			0.367			
16. I stick to the speed limit while driving.			**0.822**	-0.367					0.334
21. I make appointments in my community, such as with the general practitioner or hairdresser.	0.415	0.392	**0.615**	-0.417				-0.306	0.494
28. I plan my budget and spending. I am aware of how much money I have to spend.	0.530		**0.682**	-0.428				-0.386	
29. I pay the bills on time and when necessary, I pay overdue bills.	0.536		**0.658**	-0.556				-0.303	
32. While shopping for groceries, I find the right products in the supermarket.	0.363	0.360	0.466	**-0.550**			-0.511		0.363
33. I check whether I have all ingredients before I start cooking.	0.642		0.357	**-0.647**				-0.371	
34. While cooking, I am not distracted by things that happen around me.	0.327	0.305	0.399	**-0.656**			-0.339	-0.465	
35. I remember the order of actions while cooking a familiar recipe.				**-0.793**					
36. I make sure that the food is prepared at the right temperature.	0.319		0.339	**-0.842**					
37. I determine beforehand how long the cooking will take, and this is also a correct estimation.	0.479		0.339	**-0.797**				-0.363	

11. I remember the last person I met during my leisure activities.	0.335				**0.653**	0.412			0.378
19. I remember the names of family members and friends I have known for some time.					**0.754**				
23. I remember what events and conversations took place with my family.	0.374	0.325		-0.302	**0.703**		-0.372	-0.414	
8. I stay awake while carrying out leisure activities.						**0.750**			
31. While shopping for groceries, I remember what products I need to buy.	0.395	0.370	0.427	-0.405			**-0.667**	-0.393	
38. I can do several activities at the same time, for example have a conversation while cooking.		0.401	0.390	-0.504			**-0.526**	-0.408	
1. I plan my activities for the day and the week	0.492	0.313			0.303			**-0.546**	0.362
2. I pay attention to my work, without being distracted by things that happen around me.		0.382	0.315	-0.365				**-0.794**	
3. I can carry out my tasks and activities in busy surroundings.	0.403	0.562					-0.305	**-0.613**	0.373
6. I remember the information I heard at work meetings or during classes.		0.431	0.369	-0.328	0.378	0.390	-0.329	**-0.459**	0.473
7. I check my completed tasks and activities and decide what still needs to be done.		0.302		-0.434	0.334			**-0.610**	0.609
4. I can tolerate looking at a bright computer screen, tablet computer or phone.		0.328	0.349			0.443			**0.558**
12. When travelling, I prepare myself, such as by booking a flight, packing my belongings, and using a timetable or flight schedule.	0.460	0.430	0.427	-0.408			-0.335		**0.806**
13. While travelling, I can adjust my schedule if there is any delay.	0.473	0.401	0.454	-0.381			-0.302	-0.428	**0.839**

Abbreviation: F: Factor.
Bold: the highest loading of each item. No results presented for item loadings <0.30 or >-0.3.
Results based on the structure matrix with rotation method: Oblimin with Kaiser Normalization.