Psychometric properties of FSS and CIS-20r for measuring Post-Stroke Fatigue

Article · January 2016

CITATIONS
0

READS
6

5 authors, including:

Aglaia Zedlitz
Leiden University
16 PUBLICATIONS **67** CITATIONS
SEE PROFILE

Alexander C H Geurts
Radboud University Medical Centre (Radbou…
241 PUBLICATIONS **5,805** CITATIONS
SEE PROFILE

INTERNATIONAL JOURNAL OF PSYCHOLOGY AND NEUROSCIENCE

Psychometric properties of FSS and CIS-20r for measuring Post-Stroke Fatigue

Propriedades psicométricas do FSS e CIS-20r para medir a fadiga pós-AVC

Zedlitz, Aglaia M. E. E. PhD[12], van Mierlo Marloes L. PhD [3], van Eijk Michelle MSc [2], Alexander Geurts CH PhD[4] , Luciano Fasotti PhD[56]

[1]Department of Psychology, Medical, Health, and Neuropsychology, Leiden University, Leiden, The Netherlands

[2]G-Kracht psychomedical institute,Delft,the Netherlands

[3]Brain Center Rudolf Magnus and Center of Excellence for Rehabilitation Medicine, University Medical Center Utrecht and De Hoogstraat Rehabilitation, Utrecht, The Netherlands

[4]Radboud Institute for Health Sciences, Radboud University Medical Centre, Nijmegen, The Netherlands

[5]Donders Institute for Brain, Cognition and Behaviour, Radboud University Nijmegen, Nijmegen, The Netherlands
[6]Rehabilitation Medical Centre Groot Klimmendaal, Siza Support and Rehabilitation, Arnhem, The Netherlands

Corresponding author, Aglaia Zedlitz, Email adress: a.m.e.e.zedlitz@fsw.leidenuniv.nl

ORIGINAL

Abstract

Purpose: Both the Fatigue Severity Scale (FSS), it's abbreviated version the FSS7, and the Checklist Individual Strength (CIS-20r), especially it's subscale fatigue severity (CIS-f), are used in stroke patients to measure fatigue. However neither scale was developed for this population.This study sought to examine the psychometric properties and the underlying constructs of these scales to help the clinician and/or researcher in their choice of instrument.
Methods: The FSS and the CIS-20r were administered to 239 stroke patients and 128 age matched healthy controls.
Results: Both (sub) scales were able to discriminate at scale and at item level between patients and healthy controls, except items 1 and 2 of the FSS, leaving the FSS7. The internal consistency was high for the FSS7 and the CIS-f (Cronbach's α: FSS7 = .87; CIS-f = .88). The convergent validity (Pearson Correlation) between the (sub) scales ranged from r=.47 in patients to r=.80 in healthy controls. Principal Axis Factoring analysis on all items of the FSS7 and the CIS-f combined were conducted to investigate underlying constructs. FSS7 and CIS-f items loaded on different factors. In stroke patients these revealed three factors: "Experienced fatigue" (CIS-f items 1,2,3,4,5 and 7), "Fatigue impact" (all FSS7 items) and "Physical condition" (CIS-f items 6 and 8).
Conclusions: The first two items of the original FSS do not aid in the measurement of fatigue in stroke patients and should thus be omitted in this population. The FSS7 and the CIS-f measure different constructs that correlate only moderately in stroke patients. Fatigue rating tools can thus not be used interchangeably. These differences must be taken into consideration when selecting one of these fatigue scales for either diagnostic or research purposes.

Keywords: fatigue, stroke, psychometrics, symptoms, quality of life

Resumo

Objetivo: Tanto a Fatigue Severity Scale (FSS), na sua versão abreviada FSS7, e a Checklist Individual Strength (CIS-20r), sobretudo a sua subescala fatigue severity (CIS-f), são usadas em pacientes que tiveram um AVC para medir a fadiga. No entanto, nenhuma das escalas foi desenvolvida para esta população. Este estudo procurou analisar as propriedades psicométricas e os constructos subjacentes dessas escalas como forma de ajudar o clínico e/ou investigador na sua escolha do instrumento. **Métodos:** A FSS e a CIS-20r foram aplicadas a 239 pacientes com AVC e 128 sujeitos saudáveis da mesma faixa etária como grupo controle. **Resultados:** Ambas as sub-escalas eram capazes de discriminar ao nível da escala e ao nível do item entre paciente e sujeitos saudáveis no grupo controle, excepto os itens 1 e 2 da FSS, deixando o FSS7. A consistência interna foi alta para o FSS7 e para o CIS-f (Cronbach's α: FSS7 = .87; CIS-f = .88). A validade convergente (Correlação de Pearson) entre as (sub) escalas variou entre r=.47 nos pacientes e r=.80 no grupo controle. Foi levada a cabo uma análise factorial de eixo principal em todos os itens da FSS7 e da CIS-f combinados, visando investigar constructos subjacentes. Os itens da FSS7 e da CIS-f verificaram resultados em diferentes fatores. Nos pacientes com AVC verificaram-se 3 fatores: "Experiência de fadiga" (itens 1, 2, 3, 4, 5 e 7 da CIS-f), "Impacto da fadiga" (todos os itens da FSS7) e "Condição física" (os itens 6 e 8 da CIS-f). **Conclusão:** Os dois primeiros itens da versão original da FSS não auxiliaram na medição da fadiga em pacientes com AVC e devem ser omitidos para esta população A FSS7 e a CIS-f medem diferentes constructos que se correlacionam apenas moderadamente nos pacientes com AVC. As ferramentas de avaliação da fadiga não podem, no entanto, ser usados alternadamente. Estas diferenças devem ser tidas em consideração aquando da seleção de uma dessas escalas para avaliação da fadiga, tanto para efeitos de diagnóstico como para efeitos de investigação.

Palavras-chave: fadiga, AVC'c, psicometria, sintomas, qualidade de vida

Introduction

Post stroke fatigue (PSF) is generally defined as 'a subjective experience of extreme and persistent tiredness, weakness or exhaustion after stroke, which can present itself mentally, physically or both and which is unrelated to previous exertion levels' (Staub & Bogousslavsky, 2001a). PSF is a common and debilitating complaint (Barrit & Smithard, 2011; Lerdal et al., 2009; Staub & Bogousslavsky, 2001a) with prevalence rates ranging from 38% to 77% (Lerdal et al., 2009). Even after a minor stroke or a transient ischemic attack, fatigue has been reported in 23% to 40% of the patients (Moran et al., 2014). PSF has been found to severely impact quality of life (Carlsson, Moller, & Blomstrand, 2003; van de Port, Kwakkel, Schepers, Heinemans, & Lindeman, 2007) rehabilitation outcomes (Bendz, 2003) and even mortality (Glader, Stegmayr, & Asplund, 2002; Mead et al., 2011; Naess, Lunde, Brogger, & Waje-Andreassen, 2012). PSF furthermore often co varies with several unfavorable symptoms after stroke such as depression, anxiety, physical impairments and sleep disturbances (Lerdal et al., 2009; Wu, Mead, Macleod, & Chalder, 2015; Zedlitz, Visser-Meily, Schepers, Geurts, & Fasotti, 2011). The wide variety in prevalence rates found may be partly due to different definitions and measures of PSF used.

Unfortunately, a "golden standard" for the assessment of PSF is presently unavailable given the absence of valid biological markers (Barrit & Smithard, 2011; Kutlubaev, Duncan, & Mead, 2011). Fatigue can therefore only be measured at a subjective level which is mostly done by self-report measures (Lerdal et al., 2009). As the use of a uniform definition of PSF is still lacking (Wu et al., 2015), assessment tools may differ in the concept they measure (Visser-Keizer, Hogenkamp, Westerhof-Evers, Egberink, & Spikman, 2015; Zedlitz et al., 2011). Currently many

different assessment tools and cut-off scores are in use (Dittner, Wessely, & Brown, 2004; Whitehead, 2009; Wu et al., 2015), posing challenges to researchers when comparing data and to clinicians when assessing a patient's condition. This is especially pertinent since most fatigue rating scales were not developed for nor validated for stroke patients (Mead et al., 2007; Visser-Keizer et al., 2015).

Even though recently three fatigue scales especially for stroke have been developed (the Dutch Multidimensional Fatigue Scale (Visser-Keizer et al., 2015; Visser-Keizer, Hogenkamp, Westerhof-Evers, & Schönherr, 2012), the Fatigue Scale for Motor and Cognitive Functions (FSMC) (Hubacher et al., 2012), and the Neurological Fatigue Index for Stroke (Mills et al., 2012)) these are not widely being used in clinical and/or research settings yet.

The current study thus focusses on two widely used self-report scales used to assess PSF, the Fatigue Severity Scale (FSS) (Krupp, LaRocca, Muir-Nash, & Steinberg, 1989) and the Checklist Individual Strength (CIS-20r) (Vercoulen, Alberts, & Blijenberg, 1999; Vercoulen et al., 1994). These two questionnaires are still in wide use, not only because of their familiarity but also because the data are easily comparable to the vast body of available empirical data.

The FSS is a nine-item one-dimensional scale, originally developed to assess fatigue complaints after systemic lupus erythematosus and in multiple sclerosis (Krupp et al., 1989). Later it has also been used to measure fatigue in other neurological conditions, such as Traumatic Brain Injury (TBI) and stroke (Belmont, Agar, & Azouvi, 2009; Ziino & Ponsford, 2005). Currently it is one of the most frequently used scales to assess PSF (Dittner et al., 2004; Lerdal et al., 2009; Whitehead, 2009). The average score on the FSS is most often utilized to assess *fatigue severity* in stroke patients (Dittner et al., 2004; Valko, Bassetti, Bloch, Held,

& Baumann, 2008), although the FSS was intentionally designed to reflect the *impact of fatigue on daily life* in persons with suspected fatigue (Dittner et al., 2004; Johansson, Kottorp, Lee, Gay, & Lerdal, 2014; Krupp et al., 1989; Lerdal, Kottorp, et al., 2011). Available psychometric properties include a Cronbach's alpha of .88-.93 and a retest intra class correlation of .76-.80 (Koopman, Brehm, Heerkens, Nollet, & Beelen, 2014; Rietberg, Van Wegen, & Kwakkel, 2010; Schwartz, Jandorf, & Krupp, 1993; Valko et al., 2008). Different cut of scores for PSF have been reported, ranging between a mean score of 4 and 5 (total range: 1-7) (Dittner et al., 2004; Whitehead, 2009). Furthermore, Rash analyses in patients with Human Immunodeficiency Virus (HIV), Multiple Sclerosis and stroke have revealed that the first two items should be excluded from calculation since they diminish the psychometric properties of the scale (Johansson et al., 2014; Lerdal, Johansson, Kottorp, & von Koch, 2011; Mills, Young, Nicholas, Pallant, & Tennant, 2009).

The CIS-20r is a 20-item multidimensional scale, which assesses four dimensions of fatigue on different subscales: fatigue severity, concentration problems, reduced motivation and reduced physical activity level (Vercoulen et al., 1999; Vercoulen et al., 1994). The tool was originally developed to assess chronic fatigue syndrome (Vercoulen et al., 1994). Since then the CIS-20r has become the list of choice in studies of fatigue in the Netherlands and in Belgium also for use in neurological conditions, such as TBI (Stulemeijer et al., 2006), brain tumor (Struik et al., 2009), multiple sclerosis and stroke (Snaphaan, Van der Werf, & De Leeuw, 2010; van der Werf, van den Broek, Anten, & Bleijenberg, 2001; Zedlitz, Rietveld, Geurts, & Fasotti, 2012). Reported Cronbach's alpha values lie between 0.90 and 0.93 and retest intra class correlation of 0.81- 0.85 have been reported showing good internal

consistency and retest reliability (Dittner et al., 2004; Koopman et al., 2014; Rietberg et al., 2010). Although the total score of the CIS-20r has been reported to reflect fatigue severity in non-neurological patients (Beurskens et al., 2000), in patients with stroke, only the CIS- fatigue severity subscale (CIS-f) is used to assess the severity of experienced fatigue (Snaphaan et al., 2010; van der Werf et al., 2001; Zedlitz, Rietveld, et al., 2012; Zedlitz et al., 2011). This subscale consists of eight items and the cut-off for severe fatigue is generally set at a total score of either 35 or 40 (total range; 8-56) (Snaphaan et al., 2010; Stulemeijer et al., 2006; van der Werf et al., 2001; Zedlitz, Rietveld, et al., 2012). A point of critique made by Staub and Bogouslavsky (2001) regarding this subscale is that it mainly assesses physical fatigue and not so much mental fatigue (Staub & Bogousslavsky, 2001b). As patients can suffer from either or both aspects (Zedlitz, van Eijk, Kessels, Geurts, & Fasotti, 2012) this might, if proven true, have consequences for correctly diagnosing patients.

Great benefits of both the FSS as well as the CIS-f scale are that they are short, simple to administer, and that the outcomes are easily compared to the many other studies using the same tool. However neither tool has been specifically designed for PSF (Dittner et al., 2004; Lerdal et al., 2009; Mead et al., 2007) and only few studies have focused on the reliability and validity of these measures in stroke patients. Together with the subjective nature of fatigue and its many different aspect, this gap in previous research poses difficulties to both researchers and clinicians in describing and assessing a patient's condition after stroke (Lerdal et al., 2009; van de Port et al., 2007). Both the FSS and the CIS-f are utilized to measure fatigue severity (Dittner et al., 2004; Krupp et al., 1989; Lerdal et al., 2009) and to detect changes in fatigue over time (Vercoulen et al., 1994; Whitehead, 2009). However, at face value, they seem

to measure different constructs. In stroke patients they have been found to correlate with different psychological and neurological variables (Zedlitz et al., 2011). In this perspective, the aim of the present paper is to first examine the psychometric properties of the (one-dimensional) FSS and the (multi-dimensional) CIS-20r in both stroke patients and healthy controls. Furthermore this study sought to examine the underlying constructs and the convergent validity of the FSS and the CIS scale. Taken together with the knowledge of the psychometric properties in stroke patients this could help the clinician and/or researcher in their choice of instrument..

Methods

Participants and procedure

Data were obtained from stroke patients who entered a study assessing the effectiveness of Cognitive and Graded Activity Training (COGRAT) on post-stroke fatigue (N=83) (Zedlitz, Rietveld, et al., 2012), and by additional recruitment in three different rehabilitation centers (N= 156). In the COGRAT study the inclusion criteria were (1) being aged between 18 and 70 years; (2) suffering from severe fatigue (CIS-f ≥ 40) (Vercoulen et al., 1994) (3) no severe cognitive deficits as assessed with the Rivermead Behavioural Memory Test (screening score>8; (Wilson, Cockburn, Baddeley, & Hiorns, 1989)), the Token Task (score>12; (Heesbeen & Van Loon-Vervoorn, 2001)) and the Behavioural Assessment of the Dysexecutive Syndrome (Wilson, Alderman, Burgess, Emslie, & Evans, 1996) < borderline, (4) not having co-morbid depression as assessed with the Hospital Anxiety and Depression Scale (Zigmond & Snaith, 1983) (Depression score > 10, and a clinical interview when the score was 8-10 (MINI) (Sheehan et al., 1998), (5) absence of severe pulmonary or cardiac disease and (6) being able to walk independently. The additional 156 patient's selection was based on age (over 18 years of age), the presence of a stroke,

living independently, and the ability to complete the questionnaires autonomously. For all patients, age, level of education and time since stroke were recorded. Of the combined patient sample 21 were excluded due to possible depression and 20 due to too severe cognitive deficits.

Furthermore, the present study included 129 age-matched healthy controls. These were contacted through acquaintances of the researchers. We attempted to obtain a representative control group to the patient group with an equal distribution of different age categories and educational status and common ailments as they also occur in stroke patients. All participants were asked about their current health prior to participating. We then excluded subjects with diagnosed neurological disease, depression, advanced cancer or severe pulmonary and cardiac disease as these disorders cause fatigue.

Questionnaires

The Fatigue Severity Scale (FSS) is a one-dimensional scale which consists of nine items that are scored on a 7-point Likert scale, ranging from 1 (strongly disagree) to 7 (strongly agree). The fatigue score is calculated by means of nine item scores (range 1-7), with higher scores indicating higher levels of fatigue (Krupp et al., 1989). In this study the dutch, validated, version of the FSS was used (Koopman et al., 2014; Rietberg et al., 2010)

The Checklist Individual Strength (CIS-20r) is a 20-item questionnaire designed to measure four aspects of fatigue during the previous two weeks: fatigue severity (CIS-f: 8 items), concentration problems (5 items), reduced motivation (4 items) and reduced physical activity level (3 items). Each item is scored on a 7-point Likert scale ranging from 1 (yes, that is true) to 7 (no, that is not true) (Vercoulen et al., 1999; Vercoulen et al., 1994). In this study we focused specifically on the

fatigue severity subscale (CIS-f) to measure PSF (range 8-56), because this subscale is more often used as a measure of fatigue severity than the subscales of the CIS-20r together in neurological patients. The CIS-20r originates from the Netherlands, we thus used the original, validated, version (Vercoulen et al., 1999).

Statistical Analysis

To compare the demographical and fatigue data of our groups, t-tests were used for interval and Chi-square-test for categorical variables. Then, Principal Axis Factoring (PAF) analysis with direct Oblimin Rotation was performed on the FSS and subsequently on all CIS-20R items obtained from the stroke patients to determine the construct validity of the FSS and the four subscales of the CIS-20Rfor this particular group. To investigate group differences in the FSS and the CIS-20r subscales, independent samples t-test were performed on scale and item levels. As previous studies strongly suggest the exclusion of the first two items (Johansson et al., 2014; Lerdal, Johansson, et al., 2011; Mills et al., 2009) analyses were performed on the 9-item and on the 7-item (FSS7) version of the FSS.

The internal consistency was calculated using Cronbach's alpha, and Pearson's correlation coefficient was computed to specify the convergent validity between the FSS and the CIS-f. Differences between the patient and control group were calculated by converting the correlation coefficients into z-scores, and determining the difference (z_{diff}) with the accompanying p value.

To compare our data to the prevalence rates of post-stroke fatigue presented in the literature, we counted the number of respondents who scored above 4 and 5 on the FSS, and those with higher scores than 35 and 40 on the CIS-f and calculated the convergence between the scales.

To determine the dimensional properties of the scales, a PAF analysis

with direct oblimin rotation was performed on the item scores of the FSS and the CIS-f for all subjects. This PAF analysis was then carried out for stroke subjects and healthy controls separately, to investigate construct validity across stroke patients and healthy controls. Factors were identified according to the following criteria: (1) the bend of the curve in the scree plot; (2) the amount of variance explained by the factors combined; (3) item loading of more than .4 on a factor; and (4) interpretability by the authors (Costello & Osborne, 2005). All analyses were performed using SPSS version 23 for Windows.

Results

Discriminatory analyses, internal consistency and concurrent validity of the FSS and the CIS-20r

Demographical and scaled fatigue data of all participants are presented in table 1. Comparisons between patients and healthy controls revealed a significant difference (p>.05) in educational level (Table 1).

Table 1.

Demographical and scaled fatigue data of patients and healthy controls.

Variable	Patients N=239 M (SD)	Healthy controls N=128 M (SD)	t	p	95% Confidence Interval of the difference [lower, upper]
Age, Mean (SD)	**55.67 (8.96)**	**54.45**	**1.197**	**.232**	**[-78, 3.24]**

		(10.04)			
Gender, male (%)	**51.9%**	**41.4%**	**X^2=3.664**	**.063**	
Education (1-7), median (range)	**5 (2-7)**	**6 (2-7)**	**X^2=23.993**	**<.001**	
Years since stroke	**3.82 (4.56)**				
FSS7	**5.05 (1.40)**	**2.54 (1.44)**	**16.175**	**<.001**	**[2.20, 2.81]**
FSS	**4.96 (1.26)**	**2.91 (1.25)**	**14.651**	**<.001**	**[1.75, 2.29]**
CIS fatigue severity	**37.65 (11.37)**	**20.48 (11.38)**	**13.783**	**<.001**	**[14.72, 19.62]**
CIS concentration problems	**21.80 (8.11)**	**11.70 (6.92)**	**12.527**	**<.001**	**[8.51, 11.69]**
CIS motivation	**15.00 (6.37)**	**9.83 (4.95)**	**8.052**	**<.001**	**[3.91, 6.44]**
CIS physical activity	**12.26 (5.39)**	**6.76 (4.29)**	**10.004**	**<.001**	**[4.42, 6.59]**
CIS-20r total score	**87.11 (23.61)**	**49.86 (23.03)**	**13.527**	**<.001**	**[31.84, 42.67]**

Patients scored higher than healthy controls on the FSS and on all CIS-20r subscales (Table 1). The scores on the individual items of the FSS and CIS-20r are presented in table 2. Analyses on scale and item level of the FSS and the CIS-20r revealed that patients differ significantly from the control group, save for item 2 of the FSS (Table 2). Furthermore the 95% Confidence interval (CI) of FSS item 1 lies below 1 point difference between groups and the lower bound of the 95% CI is below 1 for CIS-motivation items 1 and 3.

Table 2.

Means of individual items of the FSS and CIS-20R.

Items	Patients N=239 M (SD)	Healthy controls N=128 M (SD)	*t*	*p*	95% CI - difference [lower, upper]
FSS					
1. My motivation is lower when I am fatigued	**5.38 (1.73)**	**4.99 (1.61)**	**2.127**	.034	[.03, .77]
2. Exercise brings on my fatigue	**3.59 (2.07)**	**3.38 (1.84)**	**.983**	.326	[-.21, .62]
3. I am easily fatigued	**5.23 (1.80)**	**2.57 (1.72)**	**13.676**	**<.001**	**[2.27, 3.04]**
4. Fatigue interferes with my physical functioning	**5.21 (1.74)**	**3.52 (2.01)**	**8.016**	**<.001**	**[1.27, 2.10]**
5. Fatigue frequently causes problems for me	**4.10 (1.90)**	**2.15 (1.61)**	**10.323**	**<.001**	**[1.58, 2.32]**
6. My fatigue prevents sustained physical functioning	**4.59 (2.12)**	**2.20 (1.66)**	**11.869**	**<.001**	**[2.00, 2.78]**
7. Fatigue interferes with carrying out certain duties and responsibilities	**5.37 (1.83)**	**2.88 (2.00)**	**12.002**	**<.001**	**[2.08, 2.90]**
8. Fatigue is among my three most disabling symptoms	**5.76 (1.81)**	**2.43 (1.92)**	**16.435**	**<.001**	**[2.93, 3.73]**
9. Fatigue interferes with my work, family, or social life	**5.11 (1.92)**	**2.05 (1.65)**	**15.986**	**<.001**	**[2.69, 3.44]**
CIS-20R					
CIS-fatigue severity					
1. I feel tired	**5.10 (1.86)**	**2.77 (1.94)**	**11.274**	**<.001**	**[1.93, 2.74]**
2. Physically I feel exhausted	**4.31 (1.96)**	**2.26 (1.84)**	**9.959**	**<.001**	**[1.65, 2.46]**
3. I feel fit (reversed)	**4.74 (1.82)**	**2.48 (1.60)**	**12.245**	**<.001**	**[1.89, 2.61]**
4. I feel weak	**3.68 (2.05)**	**1.90 (1.39)**	**9.846**	**<.001**	**[1.42, 2.14]**
5. I feel rested (reversed)	**5.00 (1.88)**	**3.02 (1.85)**	**9.679**	**<.001**	**[1.58, 2.38]**
6. Physically I feel I am in a bad condition	**4.20 (2.05)**	**2.36 (1.62)**	**9.419**	**<.001**	**[1.45, 2.22]**
7. I get tired very quickly	**5.62 (1.82)**	**2.67 (1.90)**	**14.593**	**<.001**	**[2.55, 3.34]**
8. Physically I feel I am in good shape (reversed)	**5.01 (1.91)**	**3.04 (1.86)**	**9.519**	**<.001**	**[1.56, 2.38]**
CIS- concentration problems					

1. Thinking requires effort	**4.12 (2.08)**	**2.14 (1.70)**	**9.211**	**<.001**	**[1.56, 2.41]**
2. When I am doing something , I can concentrate quite well (reversed)	**3.96 (2.02)**	**2.13 (1.47)**	**9.298**	**<.001**	**[1.44, 2.22]**
3. I can concentrate well (reversed)	**4.31 (2.01)**	**2.30 (1.56)**	**9.926**	**<.001**	**[1.61, 2.41]**
4. I have trouble concentrating	**4.58 (1.96)**	**2.40 (1.70)**	**10.375**	**<.001**	**[1.77, 2.60]**
5. My thoughts easily wander	**4.88 (1.92)**	**2.94 (1.90)**	**8.644**	**<.001**	**[1.50, 2.40]**
CIS – motivation					
1. I feel very active (reversed)	**4.27 (1.91)**	**3.59 (2.18)**	**2.770**	.006	[.20, 1.17]
2. I feel like doing all kinds of nice things (reversed)	**3.32 (1.93)**	**1.91 (1.38)**	**7.567**	**<.001**	**[1.04, 1.77]**
3. I am full of plans (reversed)	**3.48 (2.03)**	**2.36 (1.54)**	**5.559**	<.001	[.73, 1.52]
4. I feel no desire to do anything	**3.93 (2.07)**	**1.97 (1.44)**	**9.935**	**<.001**	**[1.57, 2.35]**
CIS- physical activity					
1. I do quite a lot within a day (reversed)	**3.98 (2.05)**	**2.43 (1.59)**	**7.543**	**<.001**	**[1.15, 1.96]**
2. I don't do much during the day	**3.90 (2.19)**	**2.09 (1.57)**	**8.552**	**<.001**	**[1.40, 2.23]**
3. I have a low output	**4.38 (2.03)**	**2.24 (1.58)**	**10.459**	**<.001**	**[1.74, 2.55]**

A PAF analysis on all items of the FSS was conducted with congruent outcomes in the pattern matrix and structure matrix (rotation with Oblimin Kaiser Normalization converged in 4 iterations). The Kaiser –Meyer-Olkin (KMO) measure verified the sampling adequacy for the analysis (KMO= .86; 'good' according to Field (2009)). Two factors were identified. The first contained items 3 through 9 (eigenvalue= 4.20, % of variance=46.69). The second factor solely consisted of item 2 (eigenvalue=1.09, % of variance= 12.11). Item 1 of the FSS did not load above .4 on any of the factors. The internal consistency of the 9 item FSS was .846. Cronbach's α increased to .848 after deletion of item 1 and to .858 after deletion of item 2. With both items deleted (FSS7) α increased to 0.865.

PAF analysis of the CIS20-R in stroke patients largely confirmed the separation of the items in the already existing four subscales (both in the pattern matrix and structure matrix; rotation with Oblimin with Kaiser Normalization converged in 10 iterations), fatigue severity (CIS-f; eigenvalue 7.32, % of variance 36.58, α=.882), concentration problems (eigenvalue 2.53, % of variance 12.66, α=.869), reduced motivation (eigenvalue 1.80, % of variance 9.02,

α=.814), and reduced physical activity level (eigenvalue 1.39, % of variance 6.9, α=.820). Only the CIS-f item 8 loaded >.4 on both the CIS-f subscale (.445) as on reduced motivation (.415). The KMO measure was .89, again verifying good sampling adequacy for the analysis (Field, 2009). Therefore, the existing CIS-f subscale of the CIS-20r was used as an independent measure of fatigue severity in subsequent analyses. Within the subscales only deletion of Physical activity item 3 resulted in a higher Cronbach's α, from .820 to .826.

Since items 1 and 2 of the FSS did not contribute to internal consistency nor to discriminatory value, the remaining FSS7 was used in subsequent analyses. The Pearson correlation (r) between CIS-f and FSS for all participants was .742 and between CIS-f and FSS7 it was .771 (both $p<.001$). The Pearson correlations for patients and healthy controls and the differences between groups are listed in table 3. The percentage of healthy controls scoring the FSS7 cut-off score of ≥ 4 was 15.3% and 8.6% scored ≥ 5. In patients these percentages amounted to 77% and 61.2% respectively. On the CIS-f 12.5% of the healthy controls scored above the cut-off score ≥ 35, and 10.2% scored ≥ 40. The percentages for patients were 66.1% and 52.7% respectively. The congruency percentages of both scales of the groups combined are listed in table 4.

Table 3.

Pearson correlations between CIS, FSS and FSS7.

	R Patients	R Healthy controls	Z_{diff}	$P_{two\text{-}tailed}$
CIS-20R and FSS	**.497***	**.761***	**4.11**	**<.001**
CIS-20R and FSS7	**.472***	**.778***	**4.78**	**<.001**
CIS-f and FSS	**.509***	**.770***	**4.16**	**<.001**
CIS-f and FSS7	**.545***	**.797***	**4.34**	**<.001**

*** p<.001**

Table 4.

Congruency of cut-off scores between FSS7 and CIS-f

	FSS7			
	below cut off score <4 N (%)	**Between cut off scores ≥4 and <5 N (%)**	**Above Cut off score ≥5 N (%)**	**Total** N (%)
CIS-f				
below cut off scores <35 N (%)	**N=140 (38.14%)**	**N=22 (5.99%)**	**N=31 (8.45%)**	N=193 (52.59%)
Between cut off scores ≥35 and <40 N (%)	**N=5 (1.36%)**	**N=8 (2.18%)**	**N=22 (5.99%)**	N=35 (9.54%)
Above cut off score ≥40 N (%)	**N=12 (3.27%)**	**N=18 (4.90%)**	**N=109 (29.70%)**	N=139 (37.87%)
Total N (%)	N=157 (42.78%)	N=48 (13.08%)	N=162 (44.14%)	N=367 (100%)

Dimensional properties of the FSS7 and the CIS-fatigue severity subscale

Since the N to item ratios in patients (239: 15) and in healthy controls (128:15) were small, we chose to first analyze the data of both groups and then perform separate group analyses, to investigate whether the original factors of both scales would hold up. The analyses showed different results for the stroke patients compared to the healthy controls and both groups combined (see table 5). In the latter groups, two factors were identified after exploration of the scree plot, the amount of variance explained (>51%) and the initial eigenvalues. In the patient group, three factors were found. All PAF-analyses showed a distinction between the CIS-f and the FSS, with almost all items loading on factor 1 or 2 respectively, indicating different underlying constructs. This difference was least clear in healthy controls, where FSS item 3 contributed to factor 1, and FSS items 8 and 9, loaded on both factors 1 and 2. In stroke patients, a third factor was found consisting solely of CIS-f items 6 and 8. The results of these PAF analyses with direct oblimin rotation are presented in table 5.

Table 5.

Principal axis factoring on FSS items and items of CIS-f in patients and healthy controls

	Patients and Healthy controls (N=367)		**Patients (N=239)**			**Healthy controls (N=128)**	
Item	**Factor**		**Factor**			**Factor**	
	1	**2**	**1**	**2**	**3**	**1**	**2**
CIS-f 1	.855		.850			.883	
CIS-f 2	.777		.677			.766	
CIS-f 3	.801		.522		**.284**	.859	
CIS-f 4	.826		.629			.762	
CIS-f 5	.783		.653			.817	
CIS-f 6	.703		**.353**		.604	.645	
CIS-f 7	.726		.799	**.212**		.810	
CIS-f 8	.554	**-.215**	**.258**		.511	**.**612	
FSS 3	**.299**	-.602	**.253**	.635		.783	
FSS 4		-.700		.557	**.207**		.742

FSS 5		-.746		.597			.692
FSS 6		-.709		.597	**.287**		.630
FSS 7		-.935		**.**813			.888
FSS 8		-.790		.748	**-.226**	.451	.486
FSS 9		-.853		.792		.367	.520
Eigenvalues	**9.12**	**1.25**	**6.48**	**1.94**	**1.07**	**9.00**	**1.24**
% of variance	**60.81**	**8.34**	**43.17**	**12.96**	**7.13**	**60.01**	**8.27**
	KMO= .947 Rotation converged in 5 iterations.		**KMO= .882 Rotation converged in 9 iterations.**			**KMO= .921 Rotation converged in 5 iterations.**	

Interpretation of the factors was based primarily on the analysis of the patient's data, since both the FSS and the CIS-f are designed for patients suffering from fatigue, and the constructs seemed to differ between patients and healthy controls. Moreover, in stroke patients the intercorrelations between the factors were moderate at best, allowing the interpretation of different factors (factors 1 and 2 r= .38; factors 1 and 3 r= .30: and factors 2 and 3 r=.28).

Factor 1 consisted largely of items referring to the subjective feelings of weakness and tiredness in patients with stroke (CIS-f items 1: "I feel tired"; 2: "Physically I feel exhausted"; 3: "I feel fit (reversed)"; 4: "I feel weak"; 5: "I feel rested (reversed)"; and 7: "I get tired very quickly"). Therefore this factor was named "Experienced fatigue". Factor two consisted exclusively of all FSS items, covering the impact of fatigue on daily life functioning (see table 2 for all item content). Factor 3 referred to the CIS-f items (6 & 8) on physical fitness (CIS-f item 6: Physically I feel I am in a bad condition" and item 8:"physically I feel in a good shape"). Consequently this factor was named "Physical condition".

Discussion

The present study sought to investigate the psychometric properties and concurrent validity of the FSS and the CIS-20r. It was found that the last 7 items

of the one-dimensional Fatigue Severity Scale (FSS7) and the multidimensional Checklist Individual Strength-20r (CIS-20r) have good psychometric properties and adequately discriminate stroke patients with PSF from healthy controls. However, analyses of the (sub)scales that are claimed to measure fatigue severity, the FSS7 and the subscale "fatigue severity" of the CIS20-R (CIS-f), reveal that these scales assess different dimensions of fatigue in stroke patients. This is congruent with studies in patients with polio (Koopman et al., 2014) and MS (Rietberg et al., 2010) where different content of and only moderate associations between the lists were found. The FSS7 was found to assess the impact of fatigue on daily life functioning, whereas the CIS-f mostly reflected experienced fatigue. Furthermore, the convergent validity of both scales was only moderate in stroke patients. These results indicate that these assessment tools of PSF cannot be used interchangeably.

Congruent with previous studies (Johansson et al., 2014; Lerdal, Johansson, et al., 2011; Lerdal, Kottorp, et al., 2011; Mills et al., 2009) it was found that the first two items of the original FSS did not aid in differentiation between patients and healthy controls and that they diminished the reliability of the scale. Most likely, these items are too generic to aid differentiation between pathological and normal fatigue. This confirms that in the administration of the FSS to stroke patients, these first two items should be eliminated, and that thus the remaining FSS7 should be used. The average score on the FSS(7) is most often utilized to assess fatigue severity in stroke patients (Dittner et al., 2004; Valko et al., 2008; Whitehead, 2009). However, the tool was originally designed to reflect the *impact* of fatigue on daily life in patients known to suffer from fatigue (Dittner et al., 2004; Krupp et al., 1989), a distinction that is not always recognized (Johansson et al., 2014; Whitehead, 2009). A previous study in stroke patients also found the FSS to correlate only moderately (r=.39) with VAS-scales asking about the experienced fatigue severity (Zedlitz, van Eijk, et al., 2012). Moreover, none of the items of the FSS(7) ask about the severity of fatigue. Thus, taken together with the results of this study, it is questionable whether the FSS(7) is a valid scale for the assessment of fatigue *severity* in patients with stroke. The FSS7 does have its own merits though. It is a short, easy to administer self-rating tool, which assesses the impact of fatigue on the daily life of patients with stroke.

The results of this study showed that most of the CIS-f items loaded on the factor "Experienced fatigue" albeit items 6 and 8 that loaded more on "Physical condition". Even though we named the major factor of the CIS-f "experienced fatigue", one could also argue that some of the items cover a physical component of fatigue, since some of the items stress fitness and weakness. This is in line with Staub and Bogousslavsky's suggestion (Staub & Bogousslavsky, 2001b), that the CIS-f essentially assesses the *physical* component of fatigue. Furthermore, in a previous study in patients with severe post-stroke fatigue (Zedlitz et al., 2011) we found that the CIS-f showed a moderate association with somatic complaints, but not with cognitive symptoms. Although fatigue is often experienced both mentally as well as physically (Mills et al., 2012), a significant proportion experiences it as only *physical* feeling whereas a same proportion report only *mental* fatigue (Zedlitz, van Eijk, et al., 2012). Patients with predominantly *mental* fatigue could thus be at risk of being underdiagnosed with the CIS-f. In contrast fatigue in patients with little physical stamina and or many physical sequalea could be somewhat overstressed by using the CIS-f to diagnose post-stroke fatigue. The addition of the CIS-subscale – concentration might be used to capture mental fatigue, but caution is warranted since this may also reflect attention disorders which are common sequalea after stroke(Rasquin, Welter, & van Heugten, 2013).

This study has some limitations. We assessed the psychometric properties of our scales by calculating internal consistency and convergent validity in patients with stroke and healthy controls. As we used a cross-sectional design, we were unable to examine the usefulness of the scales to detect changes over time (or treatment effects) in stroke patients. Furthermore, 35% of the included patients were part of the COGRAT study (Zedlitz, Rietveld, et al., 2012) in which only patients with a CIS-f score of 40 or above were included. Therefore, it is possible that the variability of our data was restricted and the generalizability compromised. However, the majority of patients were not selected on this basis and the standard deviations of patient scores were similar to those of healthy controls. This reduces the likelihood of such a bias. Another limitation concerns the inclusion of the other patient and the control group. These patients were not screened for depression, cognitive deficits or comorbid diseases, nor were these afflictions recorded. The same holds true for the healthy control

group. Therefore comorbid disease(s) or other confounding factors might have influenced our results. A more thorough screening might improve this.

Conclusions

Both the FSS7 and the subscale CIS-fatigue show good internal consistency. However the convergent validity in stroke patients is only moderate, and factor analysis confirms that both scales measure different constructs. This means that they measure different aspects of fatigue and thus cannot be used interchangeably. In studies of fatigue *severity*, the CIS-f might be preferable over the FSS. The FSS is more suitable to assess the *impact* of fatigue on daily life. The FSS is shorter and easier to administer, whereas the CIS-20r provides a multidimensional assessment not only of "Experienced fatigue" and "Physical condition" with the CIS-f subscale, but also of the influence of fatigue on "Concentration problems", "Motivation" and "Activity" with the other subscales. The difference in the information provided must be taken into consideration when selecting a fatigue scale for either diagnostic and/or research purposes.

Compliance with ethical standards

This study was funded by The Netherlands Organization of Health Research and Development (ZonMw). None of the authors have reported any conflict of interest and all worked independently from the funding source. All procedures performed in the study were in accordance with the standards of the institutional research committees and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study. The researchers thank the rehabilitation centers for enabling this study. Also, all respondents are thanked for participating in this study.

References

Barrit, A. W., & Smithard, D. G. (2011). Targeting Fatigue in Stroke Patients. *ISRN Neurology, 2011*(Article ID 805646), 6. doi: 10.5402/2011/805646

Belmont, A., Agar, N., & Azouvi, P. (2009). Subjective fatigue, mental effort, and attention deficits after severe traumatic brain injury. *Neurorehabilitation & Neural Repair, 23*(9), 939-944.

Bendz, M. (2003). The first year of rehabilitation after a stroke - from two perspectives. *Scandinavian Journal of Caring Sciences, 17*(3), 215-222.

Beurskens, A. J. H. M., Bultmann, U., Kant, I., Vercoulen, J. H. M. M., Bleijenberg, G., & Swaen, G. M. H. (2000). Fatigue among working people: validity of a questionnaire measure. *Occupational Environment Medicine, 57*, 353-357.

Carlsson, G. E., Moller, A., & Blomstrand, C. (2003). Consequences of mild stroke in persons <75 years -- a 1-year follow-up. *Cerebrovascular Diseases, 16*(4), 383-388.

Costello, A. B., & Osborne, J. W. (2005). Best Practices in Exploratory Factor Analysis: Four Recommendations for Getting the Most From Your Analysis. *Practical Assessment, Research & Evaluation, 10*(7), 1-9.

Dittner, A. J., Wessely, S. C., & Brown, R. G. (2004). The assessment of fatigue: a practical guide for clinicians and researchers. *Journal of Psychosomatic Research, 56*(2), 157-170.

Field, A. P. (2009). *Discovering statistics using SPSS : (and sex, drugs and rock 'n' roll)* (3rd ed.). Los Angeles: SAGE Publications.

Glader, E. L., Stegmayr, B., & Asplund, K. (2002). Poststroke fatigue: a 2-year follow-up study of stroke

patients in Sweden. *Stroke, 33*(5), 1327-1333.

Heesbeen, I., & Van Loon-Vervoorn, W. (2001). *Boston Benoemingstest: Uitbreiding van de Nederlandse normen, gecorrigeerd voor opleiding en leeftijd.* Dissertation. Universiteit Utrecht.

Hubacher, M., Calabrese, P., Bassetti, C., Carota, A., Stocklin, M., & Penner, I. K. (2012). Assessment of post-stroke fatigue: the fatigue scale for motor and cognitive functions. *European Neurology, 67*(6), 377-384. doi: 10.1159/000336736

Johansson, S., Kottorp, A., Lee, K. A., Gay, C. L., & Lerdal, A. (2014). Can the Fatigue Severity Scale 7-item version be used across different patient populations as a generic fatigue measure--a comparative study using a Rasch model approach. *Health and quality of life outcomes, 12*, 24. doi: 10.1186/1477-7525-12-24

Koopman, F. S., Brehm, M. A., Heerkens, Y. F., Nollet, F., & Beelen, A. (2014). Measuring fatigue in polio survivors: content comparison and reliability of the Fatigue Severity Scale and the Checklist Individual Strength. *J Rehabil Med, 46*(8), 761-767. doi: 10.2340/16501977-1838

Krupp, L. B., LaRocca, N. G., Muir-Nash, J., & Steinberg, A. D. (1989). The fatigue severity scale. Application to patients with multiple sclerosis and systemic lupus erythematosus. *Archives of Neurology, 46*(10), 1121-1123. doi: 10.1001/archneur.46.10.1121

Kutlubaev, M. A., Duncan, F. H., & Mead, G. E. (2011). Biological correlates of post-stroke fatigue: a systematic review. *Acta Neurol Scand*. doi: 10.1111/j.1600-0404.2011.01618.x

Lerdal, A., Bakken, L., Kouwenhoven, S., Pedersen, G., Kirkevold, M., Finset, A., & Kim, H. (2009).

Poststroke Fatigue - A Review. *J Pain Symptom Manage, 38*(6), 928-949.

Lerdal, A., Johansson, S., Kottorp, A., & von Koch, L. (2011). Psychometric properties of the Fatigue Severity Scale: Rasch analyses of responses in a Norwegian and a Swedish MS cohort. *Multiple Sclerosis, 16*(6), 733-741.

Lerdal, A., Kottorp, A., Gay, C., Aouizerat, B. E., Portillo, C. J., & Lee, K. A. (2011). A 7-item version of the fatigue severity scale has better psychometric properties among HIV-infected adults: an application of a Rasch model. *Qual Life Res, 20*(9), 1447-1456. doi: 10.1007/s11136-011-9877-8

Mead, G. E., Graham, C., Dorman, P., Slot, K. B., Lewis, S. C., Dennis, M. S., . . . IST, U. C. (2011). Fatigue after Stroke: Baseline Predictors and Influence on Survival. Analysis of Data from UK Patients Recruited in the International Stroke Trial. *Plos One, 6*(3). doi: ARTN e16988

DOI 10.1371/journal.pone.0016988

Mead, G. E., Lynch, J., Greig, C., Young, A., Lewis, S., & Sharpe, M. (2007). Evaluation of fatigue scales in stroke patients. *Stroke, 38*(7), 2090-2095.

Mills, R. J., Pallant, J. F., Koufali, M., Sharma, A., Day, S., Tennant, A., & Young, C. A. (2012). Validation of the Neurological Fatigue Index for Stroke (NFI-Stroke). *Health and quality of life outcomes, 10*(1), 51. doi: 10.1186/1477-7525-10-51

Mills, R. J., Young, C., Nicholas, R., Pallant, J. F., & Tennant, A. (2009). Rasch analysis of the Fatigue Severity Scale in multiple sclerosis. *Multiple Sclerosis, 15*(1), 81-87.

Moran, G. M., Fletcher, B., Feltham, M. G., Calvert, M., Sackley, C., & Marshall, T. (2014). Fatigue,

psychological and cognitive impairment following transient ischaemic attack and minor stroke: a systematic review. *Eur J Neurol, 21*(10), 1258-1267. doi: 10.1111/ene.12469

Naess, H., Lunde, L., Brogger, J., & Waje-Andreassen, U. (2012). Fatigue among stroke patients on long-term follow-up. The Bergen Stroke Study. *Journal of the Neurological Sciences, 312*(1-2), 138-141.

Rasquin, S. M., Welter, J., & van Heugten, C. M. (2013). Course of cognitive functioning during stroke rehabilitation. *Neuropsychol Rehabil, 23*(6), 811-823. doi: 10.1080/09602011.2013.821950

Rietberg, M. B., Van Wegen, E. E., & Kwakkel, G. (2010). Measuring fatigue in patients with multiple sclerosis: reproducibility, responsiveness and concurrent validity of three Dutch self-report questionnaires. *Disabil Rehabil, 32*(22), 1870-1876. doi: 10.3109/09638281003734458

Schwartz, J. E., Jandorf, L., & Krupp, L. B. (1993). The measurement of fatigue: a new instrument. *J Psychosom Res, 37*(7), 753-762.

Sheehan, D. V., Lecrubier, Y., Sheehan, K. H., Amorim, P., Janavs, J., Weiller, E., . . . Dunbar, G. C. (1998). The Mini-International Neuropsychiatric Interview (M.I.N.I.): the development and validation of a structured diagnostic psychiatric interview for DSM-IV and ICD-10. *Journal of Clinical Psychiatry, 59 Suppl 20*, 22-33;quiz 34-57.

Snaphaan, L., Van der Werf, S., & De Leeuw, F.-E. (2010). Time course and risk factors of post-stroke fatigue: a prospective cohort study. *European Journal of Neurology, 18*(4), 611-617.

Staub, F., & Bogousslavsky, J. (2001a). Fatigue after stroke: a major but

neglected issue. *Cerebrovascular Diseases, 12*(2), 75-81.

Staub, F., & Bogousslavsky, J. (2001b). Post-stroke depression or fatigue.[comment]. *European Neurology, 45*(1), 3-5.

Struik, K., Klein, M., Heimans, J. J., Gielissen, M. F., Bleijenberg, G., Taphoorn, M. J., . . . Postma, T. J. (2009). Fatigue in low-grade glioma. *Journal of Neuro-Oncology, 92*(1), 73-78.

Stulemeijer, M., van der Werf, S., Bleijenberg, G., Biert, J., Brauer, J., & Vos, P. E. (2006). Recovery from mild traumatic brain injury: a focus on fatigue. *Journal of Neurology, 253*(8), 1041-1047.

Valko, P. O., Bassetti, C. L., Bloch, K. E., Held, U., & Baumann, C. R. (2008). Validation of the fatigue severity scale in a Swiss cohort. *Sleep, 31*(11), 1601-1607.

van de Port, I. G., Kwakkel, G., Schepers, V. P., Heinemans, C. T., & Lindeman, E. (2007). Is fatigue an independent factor associated with activities of daily living, instrumental activities of daily living and health-related quality of life in chronic stroke? *Cerebrovascular Diseases, 23*(1), 40-45.

van der Werf, S. P., van den Broek, H. L., Anten, H. W., & Bleijenberg, G. (2001). Experience of severe fatigue long after stroke and its relation to depressive symptoms and disease characteristics.[see comment]. *European Neurology, 45*(1), 28-33.

Vercoulen, J. H. H. M., Alberts, M., & Blijenberg, G. (1999). De Checklist Individual Strength (CIS). *Gedragstherapie, 32*, 131-136.

Vercoulen, J. H. H. M., Swanink, C. M., Fennis, J. F., Galama, J. M., van der Meer, J. W., & Bleijenberg, G. (1994). Dimensional assessment of chronic fatigue syndrome. *Journal*

of Psychosomatic Research, 38(5), 383-392.

Visser-Keizer, A. C., Hogenkamp, A., Westerhof-Evers, H. J., Egberink, I. J., & Spikman, J. M. (2015). Dutch multifactor fatigue scale: a new scale to measure the different aspects of fatigue after acquired brain injury. *Arch Phys Med Rehabil, 96*(6), 1056-1063. doi: 10.1016/j.apmr.2014.12.010

Visser-Keizer, A. C., Hogenkamp, A., Westerhof-Evers, M., & Schönherr, M. (2012). *Development of the Dutch Multidimensional Fatigue Scale (DMFS)*. Paper presented at the INS Mid-Year Meeting, Bergen.

Whitehead, L. (2009). The measurement of fatigue in chronic illness: a systematic review of unidimensional and multidimensional fatigue measures. *J Pain Symptom Manage, 37*(1), 107-128.

Wilson, B. A., Alderman, N., Burgess, P., Emslie, H., & Evans, J. (1996). *Behavioural Assessment of Dysexecutive Syndrome*. London: Harcourt Assessment.

Wilson, B. A., Cockburn, J., Baddeley, A., & Hiorns, R. (1989). The development and validation of a test battery for detecting and monitoring everyday memory problems. *Journal of Clinical & Experimental Neuropsychology: Official Journal of the International Neuropsychological Society, 11*(6), 855-870.

Wu, S., Mead, G. E., Macleod, M., & Chalder, T. (2015). Model of understanding fatigue after stroke. *Stroke, 46*(3), 893-898. doi: 10.1161/STROKEAHA.114.006647

Zedlitz, A. M. E. E., Rietveld, T. C., Geurts, A. C., & Fasotti, L. (2012). Cognitive and Graded Activity Training Can Alleviate Persistent

Fatigue After Stroke: A Randomized, Controlled Trial. *Stroke, 43*(4), 1046-1051. doi: 10.1161/STROKEAHA.111.632117

Zedlitz, A. M. E. E., van Eijk, M., Kessels, R. P. C., Geurts, A. C. H., & Fasotti, L. (2012). Poststroke Fatigue Is Still a Neglected Issue: Findings from an Internet-Based Study on the Need for Information and Treatment in The Netherlands. *ISRN Stroke, 2012*, 1-5. doi: 10.5402/2012/629589

Zedlitz, A. M. E. E., Visser-Meily, J. M. A., Schepers, V. P., Geurts, A. C. H., & Fasotti, L. (2011). Patients with severe post-stroke fatigue show a psychosocial profile comparable to patients with other chronic disease: implications for diagnosis and treatment. *ISRN Neurology, 2011*(Article ID 627081), 8 pages. doi: 10.5402/2011/627081

Zigmond, A. S., & Snaith, R. P. (1983). The hospital anxiety and depression scale. *Acta psychiatrica Scandinavica, 67*(6), 361-370.

Ziino, C., & Ponsford, J. (2005). Measurement and prediction of subjective fatigue following traumatic brain injury. *Journal of the International Neuropsychological Society, 11*(4), 416-425.

How to cite this Article: Zedlitz, A. M. E. E., van Mierlo, M. L., van Eijk, M., Geurts, A., & Fasotti, L. (2016).Psychometric properties of FSS and CIS-20r for measuring Post-Stroke Fatigue. *International Journal of Psychology and Neuroscience*, *2*(1), 153-179.
Received: 04/01/2016; **Revised:** 07/03/2016; **Accepted:** 17/03/2016; **Published online:** 9/05/2016; **ISSN 2183-5829**