Lagogianni, Christodouli and Thomas, Shirley A. and Lincoln, Nadina (2016) Examining the relationship between fatigue and cognition after stroke: a systematic review. Neuropsychological Rehabilitation . pp. 1-60. ISSN 1464-0694

Examining the Relationship Between Fatigue and Cognition After Stroke: A Systematic Review.

[Paper published as follows: Lagogianni, C., Thomas, S. & Lincoln, N. (2015). Examining the Relationship Between Fatigue and Cognition After Stroke: A Systematic Review. Neuropsychological Rehabilitation. doi:10.1080/09602011.2015.1127820]

2.1 Abstract

Background:

Many stroke survivors experience fatigue, which is associated with a variety of factors including cognitive impairment. A few studies have examined the relationship between fatigue and cognition and have obtained conflicting results.

Objective:

The aim of the current study was to review the literature on the relationship between fatigue and cognition post-stroke.

Methods:

The following databases were searched: EMBASE (1980-February, 2014), PsycInfo (1806-February, 2014), CINAHL (1937-February, 2014), MEDLINE (1946-February, 2014), Ethos (1600-February, 2014) and DART (1999-February, 2014). Reference lists of relevant papers were screened and the citation indices of the included papers were searched using Web of Science. Studies were considered if they were on adult stroke patients and assessed the following: fatigue with quantitative measurements ($\geq$3 response categories), cognition using objective measurements and the relationship between fatigue and cognition.

Results:

Overall, 413 papers were identified, of which 11 were included. Four studies found significant correlations between fatigue and: memory, attention, speed of information processing and reading speed (r= -.36 to

.46) whereas seven studies did not. Most studies had limitations; quality scores ranged from 9 to 14 on the Critical Appraisal Skills Programme Checklists.

Conclusions:

There was insufficient evidence to support or refute a relationship between fatigue and cognition post-stroke. More robust studies are needed.

2.2 Introduction

Fatigue is frequently reported after stroke (Barbour & Mead, 2012). It is conceptualised as disproportionate mental or physical exhaustion and lack of energy triggered by simple activities that do not ameliorate with ordinary rest (De Groot et al., 2003; Staub & Bogousslavsky, 2001). However, there is no universally agreed-upon definition, despite the consensus that fatigue is clinically significant, which makes it difficult to diagnose and impedes its assessment (De Groot et al., 2003). The reason for such lack of definition stems from the fact that fatigue is complex.

While the exact aetiology of fatigue is unclear, it is argued that post-stroke fatigue is multifaceted and studies have revealed associations between fatigue and several factors, including biological (neuroanatomical abnormalities and neurotransmitter dysregulations, lesion location, corticomotor components and impaired movement speed) (Kuppuswamy, Clark, Turner, Rothwell, & Ward, 2015; Kuppuswamy, Clark, Sandhu, Rothwell, & Ward, 2015; Kutlubaev et al., 2012), psychological (Jaracz et al., 2007a; Schepers et al., 2006), social support (Michael et al., 2003) and physical (Duncan, Kutlubaev, Dennis, Greig & Mead, 2012; Ingles, Eskes, & Phillips, 1999).

Due to the lack of a standard definition, different terminology is used which complicates its understanding. The lack of definition has been extensively discussed in previous papers (Aaronson et al., 1999; Barbour & Mead, 2012; De Groot et al., 2003; Falconer et al., 2010; Staub & Bogousslavsky, 2001). For the purpose of this review, fatigue was defined as a subjective feeling of physical or mental exhaustion and weariness

(Mead et al., 2007; van de Port et al., 2007).

Studies show that the prevalence of fatigue after stroke ranges from 28% to 77% (Christensen, Johnsen, Watt, Harder, Kirkevold & Andersen, 2008; Zedlitz, Visser-Meily, Schepers, Geurts, & Fasotti, 2011; Feigin et al., 2012; Michael, 2014). Variations in prevalence may be attributed to methodological differences in studies and the fact that fatigue is multifactorial and complex (Aaronson et al., 1999). In addition, fatigue prevalence depends on the definition of fatigue, participant characteristics and the measures used (Annoni, Staub, Bogousslavsky, & Brioschi, 2008; Christensen et al., 2008; Choi-Kwon & Kim, 2011). Fatigue may persist for up to 12 months post-stroke (van der Werf et al., 2001) but some individuals may experience it for even longer (Ingles et al., 1999; Michael et al., 2003).

Many stroke patients experience mental or physical fatigue, which differs in quality and duration from the typical symptoms of tiredness in that it rarely ameliorates with ordinary rest (Kirkevold et al., 2012). Post-stroke fatigue may interfere with rehabilitation (Glader, Stegmayr, & Asplund, 2002), return to work and daily activities and compromise independence (Andersen, Christensen, Kirkevold, & Johnsen, 2012). Post-stroke fatigue is also a significant predictor of long-term mortality (Glader, Stegmayr, & Asplund, 2002; Naess & Nyland, 2013). Therefore post-stroke fatigue is of clinical significance.

Despite the multifaceted nature of fatigue, only a few studies have examined the association between fatigue and cognition (Raji, Al Snih, Ostir, Markides, & Ottenbacher, 2010; Samper-Ternent, Al Snih, Raji, Markides, & Ottenbacher, 2008). Evidence shows that 50-70% of stroke survivors perform poorly in neuropsychological tests (Hochstenbach et al., 1998; Rasquin et al., 2002). Cognitive impairment is observed in many stroke survivors and includes impairment of memory (Novitzke, 2008), attention (Barker-Collo et al., 2010), concentration (Rasquin et al., 2002) mental speed (Winkens et al., 2006), cognitive control (Li et al., 2013), language (Pedersen et al., 2004), visual perception (Jutai et al., 2003), and executive functioning (Poulin, Korner-Bitensky, Dawson, & Bherer, 2012).

Neuropsychologists have suggested a distinction between physical

and mental fatigue, with the former being concerned with physical manifestations of fatigue (such as the need to take a break between activities) and the latter with mental slowness (such as difficulty with concentration) (Chaudhuri & Behan, 2004). Mental fatigue is commonly reported and can hinder full recovery (Johansson et al., 2012). However, the relationship between post-stroke fatigue and cognitive impairment has rarely been examined. Some studies that address this question have not found any significant relationship between the two (Schepers et al., 2006; van Eijsden et al., 2012), whereas others have found that attention and speed of information processing were associated with fatigue after stroke (Appelros, 2006; Hubacher et al., 2012; Winkens, Van Heugten, Fasotti, & Wade, 2009).

Systematic reviews are currently the most efficient method of reviewing the existing literature and justifying further research (Moher, Liberati, Tetzlaff, & Altman, 2009). There is a systematic review (Ponchel, Bombois, Bordet, & Hénon, 2015) that investigated factors associated with fatigue, including cognition, however there was no previous review examining the relationship between cognition and fatigue after stroke.

2.3 Objective

The aim was to review the correlation between the severity of fatigue, as assessed on questionnaire measures, and cognitive abilities after stroke in adults.

2.4 Methods

The review was based on the PRISMA Statement for systematic reviews (Moher et al., 2009) and followed the guidelines provided by the Centre for Reviews and Dissemination (CRD; Centre for Review and Dissemination, 2009).

2.4.1 Type of Participants

Studies were included if: (1) their sample included stroke patients, or at least 75% of participants were stroke patients. If stroke patients were less than 75%, studies were included if they reported or provided

separate data for the stroke patients. Stroke was defined as a clinical syndrome of presumed vascular origin, typified by rapidly developed clinical signs of focal or global disturbance of cerebral functions, lasting more than 24 hours with no apparent cause other than vascular origin, as provided by the World Health Organisation (Aho et al., 1980). Subarachnoid haemorrhage (SAH) was not included because it requires different management from stroke (i.e., surgical operation) (Bederson et al., 2009; Sacco et al., 2013) and if a study included both stroke and SAH patients, it was included only if 75% of them were stroke patients or if separate data were available; (2) the sample included adults aged 18 years or over, or in the case that children were included only if separate results were available for those aged 18 years and over.

2.4.2 Type of Studies

Studies were included if they: (3) used the term "fatigue". Studies that assessed concepts related to fatigue, such as exhaustion, lack of energy, vitality or tiredness, were included if they reported these to be aspects of fatigue. Frailty was not considered as fatigue in this review because the term is highly associated with old age and natural ageing processes rather than as an explicit disease symptom. Despite the fact that fatigue might be a symptom of frailty, these two are distinctive (Avlund, 2013); (4) included an assessment of fatigue that provided a quantitative score of at least three response categories. The reason, is that a yes/no or agree/disagree format would only give information regarding the presence of fatigue and not allow correlations with severity of fatigue to be examined. If the study evaluated tiredness for example, but assessed it with any assessment other than a fatigue scale, it was not included. These fatigue assessments included questionnaires, rating scales, visual analogue and ranking scales. Furthermore, the SF-36 (Ware & Sherbourne, 1992) vitality subscale was considered as it is described as a measure of energy/fatigue. Studies which involved interviews on fatigue or ratings of fatigue as present or absent were not included; (5) reported on any aspect of cognition. This included any reference to memory, attention, spatial abilities, visual neglect, speed of information processing, mental flexibility, executive function, mental

slowness, orientation, concentration, cognitive control, decision making, problem solving, ataxia, apraxia, mental speed, reasoning and learning. Studies of language impairment were not included. People with language problems have difficulty completing cognitive assessments and are usually excluded from such studies (El Hachioui et al., 2013). Therefore, it was decided to not include papers that reported only patients with language impairment; (6) assessed cognition using an objective standardised quantitative measure. Studies using self-report assessments of cognition were not included as these have been shown to be more closely correlated with mood and confidence than cognitive function (Payne & Schnapp, 2014); (7) examined the relation between fatigue, as defined and specified in (3) and (4) above, and cognition, as defined and specified in (5) and (6) above. There were no restrictions regarding publication time or language. Translations were obtained for studies in languages other than English.

2.4.3 Exclusion Criteria

Systematic, narrative and literature reviews were not included.

2.4.4 Data Extraction and Quality Assessment

For each of the studies meeting the above criteria, one of the authors (CL) conducted the data extraction and the quality assessment, while the other (NL) checked the details. The extraction was concerned with: (1) participants characteristics (age, gender, type of stroke and time since stroke onset); (2) fatigue assessment methods; (3) cognitive assessment methods; (4) study design (settings and procedure); and (5) results (any association reported between fatigue and cognitive impairment). Quality assessment was conducted with the Critical Appraisal Skills Programme Checklists (CASP) quality assessment tool for cohort studies (CASP, 2014). CASP consists of 12 items that examine the context of the study results in relation to their validity, content and scientific contribution. It was chosen because it is the only tool available in a version for reviewing cohort studies as opposed to other commonly used lists. Each question was answered “yes”, “no” or “can’t tell”. In order to provide a quality index, a score of 1 was given for every “yes” answer and

0 for every "no" or "can't tell" answer. For the items that are open-ended (7, 8, 12) a point was given if the answer was in favour of the study. The results of the CASP scoring were categorised as following: 0-5= poor quality; 6-10=average quality; 11-16=high quality.

2.4.5 Data Synthesis and Correlation Classification

The correlation coefficients between fatigue and cognition were summarised. Correlations were considered statistically significant at the 5% level of significance. The classification of the strength of correlation varied. It is generally suggested that correlations from .1 to .3 are considered weak, from .4 to .6 moderate, .7 to .9 strong and 1 is a perfect correlation (Hatcher, 2003).

2.4.6 Search Methods for Identification of Studies

An electronic search for published studies was conducted in the following databases: EMBASE (1980-February, 2014), PsycInfo (1806-February, 2014), CINAHL (1937- February, 2014), MEDLINE (1946-February, 2014). The Ethos (UK dissertations; 1600- February, 2014) and the DART (European Theses Portal; 1999- February, 2014) databases were also searched for unpublished academic work in theses and dissertations.

The first four databases were searched with a separate strategy adjusted to the operating system of each database (see appendices, page 104 for strategies). The dissertation databases were searched using keywords and their associated terms or synonyms; the same keywords were used to form the other searches (see appendices, page 104 for key words). Finally, the reference lists of relevant systematic and narrative reviews and of the studies included, were further scanned for potential studies. The citation indexes of included studies were searched on Web of Science.

2.4.7 Study Selection

Potentially relevant papers were identified from their titles and abstracts based on the inclusion criteria. The full text versions of those that met the criteria were obtained. If it was not clear from the abstract

the full text was obtained, and if in doubt the authors were contacted for clarifications. Papers that met the criteria were reviewed and duplicates were removed using the Mendeley referencing system. The third author (NL) confirmed their eligibility and a decision was made as to which studies to include.

2.5 Results

The initial electronic search conducted in February 2014 identified 387 papers. After duplicates were removed (n=69), 319 papers were assessed against the criteria. At this stage, 310 were excluded for not including stroke patients (n=191), not including the term fatigue (n=25), not assessing fatigue (n=57), not considering any cognitive domain (n=13), not assessing cognition (n=4), not assessing the relationship between fatigue and cognition (n=19). One additional paper was excluded because its full text version was not accessible. Table 1 summarises all papers and the reason of their exclusion.

The reference lists of the included papers were scanned for potentially relevant papers missed in the initial searching phase; one paper (Naess, Nyland, Thomassen, Aarseth, & Myhr, 2005) was identified from the reference lists of five of the included papers (Hubacher et al., 2012; Johansson & Rönnbäck, 2012; Naess & Nyland, 2013; Park et al., 2009; Radman et al., 2012) and was included. One paper (Johansson & Rönnbäck, 2012) was identified by chance on the web and anone paper (Kutlubaev et al., 2013) was identified in the reference list of a narrative review; they were both included. These papers are summarised in table 2.

Table 1: Studies Identified by Searches and Their Reason for Inclusion/Exclusion

	Study	Database	Stroke/Humans/Adults	Mentions Fatigue	Includes Quantitative Fatigue Assessment	Mentions Cognition	Objective Quantitative Cognitive Assessment	Association Between Fatigue-Cognition	Status
1	Addy (2011)	PsycInfo	X	X	X	X	X	X	Excluded
2	Adeli, Drubach & MaChulda (2013)	EMBASE	X	X	X	X	X	X	Excluded
3	Agusti, Bonet, Arnau, Vidal & Laporte (2003)	EMBASE	X	X	X	X	X	X	Excluded
4	Ahlqwist, Bengtsson, Lapidus, Gergdahl & Schutz (1999)	MEDLINE	X	X	X	X	X	X	Excluded
5	Aisen et al. (2003)	EMBASE	X	X	X	X	X	X	Excluded
6	Alaama, Basharat & Nicolle (2012)	EMBASE	X	X	X	X	X	X	Excluded
7	Alberty, Sidney, Huot-Marchand, Hespel & Pelayo (2005)	EMBASE	X	X	X	X	X	X	Excluded
8	Alfano et al. (2012)	EMBASE	X	X	X	X	X	X	Excluded
9	Andrew & Grieve (2008)	Ethos/DART	X	X	X	X	X	X	Excluded
10	Appelros (2006)	EMBASE	✓	✓	X	X	X	X	Excluded
11	Araujo, da Silva, da Conceicao, de Santana & Vasconelos (2012)	CINAHL	X	X	X	X	X	X	Excluded
12	Armstrong et al. (2010)	EMBASE	X	X	X	X	X	X	Excluded
13	Askim et al. (2012)	EMBASE	✓	✓	✓	✓	✓	X	Excluded
14	Attal et al. (2002)	EMBASE	✓	X	X	X	X	X	Excluded

	Study	Database	Stroke/Humans/Adults	Mentions Fatigue	Includes Quantitative Fatigue Assessment	Mentions Cognition	Objective Quantitative Cognitive Assessment	Association Between Fatigue-Cognition	Status
15	Aujouannet, Bonifazi, Hintzy, Vuillerme & Rouard (2006)	MEDLINE	X	X	X	X	X	X	Excluded
16	Avila-Funes et al. (2012)	PsycInfo/ EMBASE	X	X	X	X	X	X	Excluded
17	Barbour & Mead (2012)	EMBASE	✓	✓	X	X	X	X	Excluded
18	Barrett et al. (2011)	EMBASE	✓	✓	X	X	X	X	Excluded
19	Beatty, Orbelo, Sorocco & Ross (2003)	EMBASE	X	X	X	X	X	X	Excluded
20	Berggren (2012)	DART	X	X	X	X	X	X	Excluded
21	Bernsmeier, Nickel, Bingisser & Kim (2010)	EMBASE	X	X	X	X	X	X	Excluded
22	Bhalla et al. (2013)	EMBASE	X	X	X	X	X	X	Excluded
23	Blanc-Garin (1994)	PsycInfo	X	X	X	X	X	X	Excluded
24	Blume & Harris (2003)	EMBASE	X	X	X	X	X	X	Excluded
25	Bogousslavsky (2010)	EMBASE/MEDLINE	✓	X	X	X	X	X	Excluded
26	Boshier, Wilton & Shakir (2003)	EMBASE	X	X	X	X	X	X	Excluded
27	Botella et al. (1995)	MEDLINE	X	X	X	X	X	X	Excluded
28	Boutin-Lester & Gibson (2002)	EMBASE	X	X	X	X	X	X	Excluded
29	Bowling et al. (2013)	EMBASE	✓	✓	X	X	X	X	Excluded
30	Boy et al. (2011)	EMBASE	✓	X	X	X	X	X	Excluded
31	Breeher, Gerr & Fuortes (2013)	EMBASE	✓	✓	X	X	X	X	Excluded

	Study	Database	Stroke/Humans/Adults	Mentions Fatigue	Includes Quantitative Fatigue Assessment	Mentions Cognition	Objective Quantitative Cognitive Assessment	Association Between Fatigue-Cognition	Status
32	Brioschi et al. (2009)	EMBASE	X	X	X	X	X	X	Excluded
33	Buchman, Leurgans, Boyle, Schneider, Arnold, Bennett (2011)	EMBASE/MEDLINE	X	X	X	X	X	X	Excluded
34	Campailla, de Vanna & Poldrugo (1980)	MEDLINE	✓	X	X	X	X	X	Excluded
35	Cantarero et al. (2011)	EMBASE	X	X	X	X	X	X	Excluded
36	Caplan & Gardner (2005)	EMBASE	X	X	X	X	X	X	Excluded
37	Carey et al. (2008)	EMBASE	✓	X	X	X	X	X	Excluded
38	Carlson, et al., (2006)	MEDLINE	X	X	X	X	X	X	Excluded
39	Carlsson, Papcke-Benson, Carnes, McBride & Stein (2002)	EMBASE	X	X	X	X	X	X	Excluded
40	Carlsson, Moller & Blomstrand (2004)	CINAHL/ MEDLINE	✓	✓	X	X	X	X	Excluded
41	Carlsson, Moller & Blomstrand (2003)	EMBASE/ MEDLINE	✓	✓	X	X	X	X	Excluded
42	Carlsson, Moller & Blomstrand (2009)	CINAHL/ MEDLINE	✓	✓	X	X	X	X	Excluded
43	Casas, Calamia & Tranel (2008)	EMBASE/ MEDLINE	X	X	X	X	X	X	Excluded
44	Cermak, et al., (1991)	EMBASE	✓	✓	X	X	X	X	Excluded
45	Chan & Lee (2005)	EMBASE	X	X	X	X	X	X	Excluded

	Study	Database	Stroke/Humans/Adults	Mentions Fatigue	Includes Quantitative Fatigue Assessment	Mentions Cognition	Objective Quantitative Cognitive Assessment	Association Between Fatigue-Cognition	Status
46	Chebotarev, Matiukhin & Naumova (1994)	MEDLINE	X	X	X	X	X	X	Excluded
47	Chen, Mann, Tomita & Burford (1998)	EMBASE	X	X	X	X	X	X	Excluded
48	Chia & Teo (2003)	EMBASE	X	X	X	X	X	X	Excluded
49	Chiocca et al. (2008)	EMBASE	X	X	X	X	X	X	Excluded
50	Choe, Jung, Baird & Grupen (2013)	EMBASE	✓	✓	X	X	X	X	Excluded
51	Choi-Kwon, Han, Kwon & Kim (2005)	EMBASE	✓	✓	✓	✓	✓	X	Excluded
52	Christensen et al. (2008)	EMBASE	✓	✓	✓	✓	X	X	Excluded
53	Claros-Salinas et al. (2010)	PsycInfo/ EMBASE/MEDLINE	X	X	X	X	X	X	Excluded
54	Clemens et al. (2012)	CINAHL	✓	✓	X	X	X	X	Excluded
55	Consoli et al. (2012)	EMBASE	✓	✓	X	X	X	X	Excluded
56	Coyle, Hopper & Coggan (1990)	MEDLINE	X	X	X	X	X	X	Excluded
57	Croquelois et al. (2005)	EMBASE	✓	✓	X	X	X	X	Excluded
58	Czepko, Orlowiejska & Danilewicz (1999)	MEDLINE	X	X	X	X	X	X	Excluded
59	Dam (2001)	EMBASE/ MEDLINE	✓	✓	✓	✓	✓	X	Excluded
60	de Coster, Leentjens, Lodder & Verhey (2005)	EMBASE	✓	✓	X	X	X	X	Excluded

	Study	Database	Stroke/Humans/Adults	Mentions Fatigue	Includes Quantitative Fatigue Assessment	Mentions Cognition	Objective Quantitative Cognitive Assessment	Association Between Fatigue-Cognition	Status
61	de Joode, Proot, Slegers, van Heugten, Verhey & van Boxtel (2012)	EMBASE/MEDLINE	✔	✔	X	X	X	X	Excluded
62	DeAngelis (2010)	EMBASE	X	X	X	X	X	X	Excluded
63	Dericioglu et al. (2013)	EMBASE	X	X	X	X	X	X	Excluded
64	Devereux (2010)	Ethos	X	X	X	X	X	X	Excluded
65	Di Summa & Iezzi (2013)	EMBASE	X	X	X	X	X	X	Excluded
66	Dixon (2012)	Ethos/DART	✔	✔	✔	X	X	X	Excluded
67	Djukic et al. (2011)	EMBASE	X	X	X	X	X	X	Excluded
68	Dobson, Leddy, Gangadharan & Giovannoni (2013)	EMBASE	X	X	X	X	X	X	Excluded
69	Dodge, Zitzelberger, Oken, Howieson & Kaye (2008)	EMBASE	X	X	X	X	X	X	Excluded
70	Domahs, Benke & Delazer (2011)	PsycInfo	✔	X	X	X	X	X	Excluded
71	Donnellan et al. (2013)	EMBASE/MEDLINE	✔	✔	X	X	X	X	Excluded
72	Dove, Vezzetti & Escobar (1994)	EMBASE	✔	X	X	X	X	X	Excluded
73	Dupont et al. (2010)	EMBASE	X	X	X	X	X	X	Excluded
74	Duschek et al. (2009)	EMBASE	X	X	X	X	X	X	Excluded
75	Elderkin-Thompson, et al., (2012)	EMBASE/MEDLINE	X	X	X	X	X	X	Excluded

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76	Enkvist (2013)	DART	X	X	X	X	X	X	Excluded
77	Erkinjuntti et al. (2008)	EMBASE	X	X	X	X	X	X	Excluded
78	Erkinjuntti et al. (2003)	EMBASE	X	X	X	X	X	X	Excluded
79	Erueti, Glasziou, Mar & van Driel (2012)	EMBASE	X	X	X	X	X	X	Excluded
80	Farner et al. (2009)	EMBASE	✓	X	X	X	X	X	Excluded
81	Faunt et al. (1995)	EMBASE	X	X	X	X	X	X	Excluded
82	Feng et al. (2013)	EMBASE	X	X	X	X	X	X	Excluded
83	Figg et al. (2009)	EMBASE	X	X	X	X	X	X	Excluded
84	Figueiredo, Sanders, Gorski, Vilas-Boas, & Fernandes, 2013)	EMBASE/MEDLINE	X	X	X	X	X	X	Excluded
85	Figueiredo, Pendergast, Vilas-Boas, & Fernandes (2013)	EMBASE	X	X	X	X	X	X	Excluded
86	Figueiredo, Toussaint, Vilas-Boas, & Fernandes (2013)	EMBASE	X	X	X	X	X	X	Excluded
87	Floel, Hummel, Duque, Knecht & Cohen (2008)	CINAHL	✓	✓	X	X	X	X	Excluded
88	French & Pedley (2008)	EMBASE	X	X	X	X	X	X	Excluded
89	Fulde (2001)	EMBASE	X	X	X	X	X	X	Excluded

	Study	Database	Stroke/Humans/Adults	Mentions Fatigue	Includes Quantitative Fatigue Assessment	Mentions Cognition	Objective Quantitative Cognitive Assessment	Association Between Fatigue-Cognition	Status
90	Gabrilove, Perez, Tomita, Rossi & Cleeland (2007)	EMBASE	X	X	X	X	X	X	Excluded
91	Gafarov, Gromova, Gagulin & Pilipenko (2005)	EMBASE	X	X	X	X	X	X	Excluded
92	Gandiga, Hummel &Cohe (2006)	EMBASE/ MEDLINE	✔	✔	✔	✔	✔	X	Excluded
93	Garcia-Pallares, Garcia-Fernandez, Sanchez-Medina, & Izquierdo (2010)	EMBASE	X	X	X	X	X	X	Excluded
94	Geevasinga, Coleman, Webster & Roger (2006)	EMBASE	X	X	X	X	X	X	Excluded
95	Gershon, Lai, Bode, Choi, Moy, Bleck, Miller, Peterman & Cella (2012)	EMBASE/MEDLINE	X	X	X	X	X	X	Excluded
96	Gibbs (2007)	Ethos	X	X	X	X	X	X	Excluded
97	Ginsberg (1985)	EMBASE	X	X	X	X	X	X	Excluded
98	Girard et al. (2005)	EMBASE	X	X	X	X	X	X	Excluded
99	Glader, Stegmayr & Asplund (2002)	CINAHL	✔	✔	✔	X	X	X	Excluded
100	Goble,et al.,(2007)	EMBASE	X	X	X	X	X	X	Excluded
101	Goller (2011)	Ethos	X	X	X	X	X	X	Excluded

	Study	Database	Stroke/Humans/Adults	Mentions Fatigue	Includes Quantitative Fatigue Assessment	Mentions Cognition	Objective Quantitative Cognitive Assessment	Association Between Fatigue-Cognition	Status
102	Gorelik & Tampieri (2012)	EMBASE	X	X	X	X	X	X	Excluded
103	Gorgoraptis et al. (2012)	EMBASE	✓	✓	X	X	X	X	Excluded
104	Gramigna (2007)	EMBASE/MEDLINE	✓	✓	✓	X	X	X	Excluded
105	Grant (1985)	MEDLINE	✓	✓	X	X	X	X	Excluded
106	Grant, Glandon, Elliott, Giger & Weaver (2004)	CINAHL/ EMBASE	X	X	X	X	X	X	Excluded
107	Gravely-Witte, Jurgens, Tamim & Grace (2010)	EMBASE	X	X	X	X	X	X	Excluded
108	Graziadio, Tomasevic, Assenza, Tecchio & Eyre (2012)	EMBASE	✓	✓	X	X	X	X	Excluded
109	Gustafsson & Turpin (2012)	EMBASE	✓	✓	X	X	X	X	Excluded
110	Hale & Piggot (2005)	EMBASE	✓	✓	X	X	X	X	Excluded
111	Halligan, Marshall, Wade (1993)	MEDLINE	✓	✓	X	X	X	X	Excluded
112	Hammer & Lindmark (2003)	EMBASE	✓	✓	X	X	X	X	Excluded
113	Hanger, Walker, Paterson, McBride & Sainsbury (1998)	CINAHL/ EMBASE	✓	✓	X	X	X	X	Excluded
114	Harboe, Greve, Beyer, Goransson, Tjensvoll, Maroni &Omdal (2008)	MEDLINE	X	X	X	X	X	X	Excluded

	Study	Database	Stroke/Humans/Adults	Mentions Fatigue	Includes Quantitative Fatigue Assessment	Mentions Cognition	Objective Quantitative Cognitive Assessment	Association Between Fatigue-Cognition	Status
115	Harciarek, et al., (2012)	EMBASE/MEDLINE	X	X	X	X	X	X	Excluded
116	Hedlund, Sojka, Lundstrom & Lindstrom (2012)	EMBASE	✓	X	X	X	X	X	Excluded
117	Henry, Ad, Martin, Hunt & Crippen (2009)	EMBASE	X	X	X	X	X	X	Excluded
118	Hermans, Marien & De Deyn (2011)	EMBASE	X	X	X	X	X	X	Excluded
119	Hochstenbach et al., (1998)	PsycInfo	✓	X	X	X	X	X	Excluded
120	Holt, Bull, Cashman & McGregor (2003)	EMBASE	X	X	X	X	X	X	Excluded
121	Hooper, MacKinnon & Wilson (1995)	EMBASE	X	X	X	X	X	X	Excluded
122	Hopkins & Weaver (2001)	EMBASE	X	X	X	X	X	X	Excluded
123	Hornery et al., (2007)	EMBASE	X	X	X	X	X	X	Excluded
124	Hsu et al., (2006)	MEDLINE	✓	✓	X	X	X	X	Excluded
125	Hu, Yuan & Lu (2013)	EMBASE/MEDLINE	X	X	X	X	X	X	Excluded
126	Hubacher et al. (2012)	PsycInfo/ EMBASE/MEDLINE	✓	✓	✓	✓	✓	✓	Included
127	Hummel et al. (2006)	EMBASE	✓	✓	✓	✓	X	X	Excluded
128	Hurwitz et al. (2012)	EMBASE	X	X	X	X	X	X	Excluded
129	Ikematsu & Kloos (2012)	EMBASE	X	X	X	X	X	X	Excluded
130	Ioannides et al. (2013)	EMBASE	X	X	X	X	X	X	Excluded

	Study	Database	Stroke/Humans/Adults	Mentions Fatigue	Includes Quantitative Fatigue Assessment	Mentions Cognition	Objective Quantitative Cognitive Assessment	Association Between Fatigue-Cognition	Status
131	Jasiukeviciene, et al., (2008)	MEDLINE	X	X	X	X	X	X	Excluded
132	Jatoi et al. (2005)	EMBASE	X	X	X	X	X	X	Excluded
133	Johansson, Bjuhr & Rönnbäck (2012)	PsycInfo/ EMBASE	X	X	X	X	X	X	Excluded
134	Johansson et al. (2012)	PsycInfo/ EMBASE/MEDLINE	✓	✓	✓	✓	✓	X	Excluded
135	Feigin et al. (2012)	CINAHL	✓	✓	✓	X	X	X	Excluded
136	Jones, et al., (2012)	EMBASE	X	X	X	X	X	X	Excluded
137	Kang, Baek, Kim & Paik (2009)	MEDLINE	✓	✓	X	X	X	X	Excluded
138	Kelly, et al., (2006)	MEDLINE	X	X	X	X	X	X	Excluded
139	Kelly, Tungol & Wesolowicz (2013)	EMBASE	X	X	X	X	X	X	Excluded
140	Kennedy (2011)	EMBASE	X	X	X	X	X	X	Excluded
141	Kim, Ohn, Yang, Park & Jung (2009)	EMBASE	✓	✓	X	X	X	X	Excluded
142	Kim (2012)	PsycInfo	✓	✓	✓	✓	✓	X	Excluded
143	Kinay, Dubeau, Andermann & Olivier (2004)	EMBASE	X	X	X	X	X	X	Excluded
144	Kobalava, Kotovskaya & Moiseev (2008)	EMBASE	X	X	X	X	X	X	Excluded
145	Kofler, Quirbach, Schauer, Singer & Saltuari (2009)	PsycInfo/EMBASE/MEDLINE	✓	X	X	X	X	X	Excluded

	Study	Database	Stroke/Humans/Adults	Mentions Fatigue	Includes Quantitative Fatigue Assessment	Mentions Cognition	Objective Quantitative Cognitive Assessment	Association Between Fatigue-Cognition	Status
146	Koopman, Uyttenboogaart, Vroomen, van der Meer, De Keyser & Luijckx (2009)	CINAHL/ EMBASE/MEDLINE	✓	✓	✓	✓	X	X	Excluded
147	Kornerup et al. (2010)	EMBASE	X	X	X	X	X	X	Excluded
148	Kozora, Arciniegas, Zhang & West (2007)	MEDLINE	X	X	X	X	X	X	Excluded
149	Krsmanovic et al. (2011)	EMBASE	✓	✓	X	X	X	X	Excluded
150	Kulmala, Nykanen & Manty (2013)	EMBASE	X	X	X	X	X	X	Excluded
151	Kumar, Singh, Saxena, Niaz, Josh, Chattopadhyay, Mechirova, Pella & Fedacko (2007)	EMBASE/MEDLINE	X	X	X	X	X	X	Excluded
152	Kurihara, Kawakita, Douzono & Nagasaka (2008)	EMBASE	X	X	X	X	X	X	Excluded
153	Kurillo, Zupan & Bajd (2004)	EMBASE	X	X	X	X	X	X	Excluded
154	Lagadec, (2012)	DART	✓	✓	✓	X	X	X	Excluded
155	Lai, Teel & Duncan (2001)	EMBASE	X	X	X	X	X	X	Excluded
156	Lamb, Anderson, Saling & Dewey (2013)	CINAHL/EMBASE	✓	✓	✓	✓	✓	X	Excluded

	Study	Database	Stroke/Humans/Adults	Mentions Fatigue	Includes Quantitative Fatigue Assessment	Mentions Cognition	Objective Quantitative Cognitive Assessment	Association Between Fatigue-Cognition	Status
157	Langer (1994)	EMBASE	✓	✓	X	X	X	X	Excluded
158	Lannfelt et al. (2008)	EMBASE	X	X	X	X	X	X	Excluded
159	Lehmann & Klieser (1997)	MEDLINE	X	X	X	X	X	X	Excluded
160	Lehmann, van der Crone, Grobe-Einsler & Linden (1993)	EMBASE/MEDLINE	X	X	X	X	X	X	Excluded
161	Leirdal, Sandbakk & Ettema (2013)	EMBASE	X	X	X	X	X	X	Excluded
162	Levy, Blizzard, Halligan & Stone (1995)	EMBASE/ MEDLINE	✓	✓	X	X	X	X	Excluded
163	Leyland-Jones et al. (2010)	EMBASE	X	X	X	X	X	X	Excluded
164	Liang (2004)	EMBASE	✓	X	X	X	X	X	Excluded
165	Liu & Thompson (2004)	EMBASE	X	X	X	X	X	X	Excluded
166	Llibre et al., (2014)	EMBASE	X	X	X	X	X	X	Excluded
167	Loetscher & Lincoln (2013)	CINAHL	✓	✓	X	X	X	X	Excluded
168	Lord, et al., (2006)	CINAHL/ EMBASE/ MEDLINE	✓	✓	✓	✓	✓	X	Excluded
169	LoVecchio, Pizon, Berrett & Balls (2007)	EMBASE	X	X	X	X	X	X	Excluded
170	Lund (2011)	DART	✓	✓	✓	✓	✓	X	Excluded
171	Lundqvist & Alinder (2008)	EMBASE/ MEDLINE	✓	✓	X	X	X	X	Excluded
172	Lyytinen et al. (2010)	EMBASE	X	X	X	X	X	X	Excluded
173	Madden, Nan, Briones & Waks (2012)	EMBASE	X	X	X	X	X	X	Excluded
174	Malagoni et al. (2010)	EMBASE	X	X	X	X	X	X	Excluded

	Study	Database	Stroke/Humans/Adults	Mentions Fatigue	Includes Quantitative Fatigue Assessment	Mentions Cognition	Objective Quantitative Cognitive Assessment	Association Between Fatigue-Cognition	Status
175	Mandelzweig, Goldbourt, Boyko, & Tanne (2006)	EMBASE	✓	✓	X	X	X	X	Excluded
176	Mark & Heilman (1997)	EMBASE/ MEDLINE	✓	✓	X	X	X	X	Excluded
177	Marshall, Grinnell, Heisel, Newall & Hunt (1997)	EMBASE	✓	✓	X	X	X	X	Excluded
178	Marson et al. (2007)	EMBASE	X	X	X	X	X	X	Excluded
179	Martinsson & Wahlgren (2003)	EMBASE	✓	✓	X	X	X	X	Excluded
180	Mattsson (2011)	DART	X	X	X	X	X	X	Excluded
181	May, Butt, Minor, Kolbinson & Tulloch (2003)	EMBASE	X	X	X	X	X	X	Excluded
182	Mead et al. (2007)	EMBASE	✓	✓	✓	X	X	X	Excluded
183	Mead, et al., (2012)	EMBASE/MEDLINE	✓	✓	X	X	X	X	Excluded
184	Medi et al. (2013)	EMBASE	X	X	X	X	X	X	Excluded
185	Medziavichius, Medziavichene & Zhaliunas (2005)	EMBASE	X	X	X	X	X	X	Excluded
186	Mepani et al. (2009)	EMBASE	X	X	X	X	X	X	Excluded
187	Metellus et al. (1999)	EMBASE	X	X	X	X	X	X	Excluded
188	Meyer, et al., (1997)	MEDLINE	X	X	X	X	X	X	Excluded
189	Michal et al. (2013)	EMBASE	X	X	X	X	X	X	Excluded

	Study	Database	Stroke/Humans/Adults	Mentions Fatigue	Includes Quantitative Fatigue Assessment	Mentions Cognition	Objective Quantitative Cognitive Assessment	Association Between Fatigue-Cognition	Status
190	Mills et al. (2012)	EMBASE	✓	✓	✓	X	X	X	Excluded
191	Milutinovic, Golubovic, Brkic & Prokes (2012)	EMBASE	X	X	X	X	X	X	Excluded
192	Mittenberg, Patton, Canyock & Condit (2002)	EMBASE	X	X	X	X	X	X	Excluded
193	Mohsenin & Valor (1995)	EMBASE/ MEDLINE	✓	✓	X	X	X	X	Excluded
194	Molnar (2008)	EMBASE	X	X	X	X	X	X	Excluded
195	Morais et al. (2012)	EMBASE	✓	✓	X	X	X	X	Excluded
196	Morton-Bours, Jacobs & Albers (2000)	MEDLINE	✓	✓	X	X	X	X	Excluded
197	Moulaert, Wachelder, Verbunt, Wade & van Heugten (2010)	EMBASE	X	X	X	X	X	X	Excluded
198	Mujika et al., (2012)	EMBASE	X	X	X	X	X	X	Excluded
199	Müller & Poulsen (2008)	CINAHL	✓	✓	X	X	X	X	Excluded
200	Naess & Nyland (2013)	EMBASE	✓	✓	✓	✓	✓	✓	Included
201	Naidech et al. (2013)	EMBASE	X	X	X	X	X	X	Excluded
202	Nakagaki, et al, (2005)	MEDLINE	X	X	X	X	X	X	Excluded
203	Nierenberg et al. (2009)	EMBASE	X	X	X	X	X	X	Excluded
204	Nyenhuis et al. (2004)	PsycInfo	✓	X	X	X	X	X	Excluded
205	Ogden, Mee & Utley (1998)	MEDLINE	X	X	X	X	X	X	Excluded
206	Ogden, Utley & Mee (1997)	MEDLINE	X	X	X	X	X	X	Excluded

	Study	Database	Stroke/Humans/Adults	Mentions Fatigue	Includes Quantitative Fatigue Assessment	Mentions Cognition	Objective Quantitative Cognitive Assessment	Association Between Fatigue-Cognition	Status
207	Oizumi, Laakso, Hirata, Fujiwara, Watanabe, Taki, Kojima, Sasaki & Sasaki (2013)	EMBASE	X	X	X	X	X	X	Excluded
208	Oldroyd, Gray, Carter, Harvey, Borland, Beastall & Cobbe (1995)	EMBASE/MEDLINE	X	X	X	X	X	X	Excluded
209	Ormstad, Verkerk, Aass, Amthor & Sandvik (2013)	EMBASE	✓	✓	X	X	X	X	Excluded
210	Oupra, Griffiths, Pryor & Mott (2010)	EMBASE	✓	X	X	X	X	X	Excluded
211	Park, Chun et al. (2009)	EMBASE/ MEDLINE	✓	✓	✓	✓	✓	✓	Included
212	Park, Ko et al. (2009)	EMBASE	X	X	X	X	X	X	Excluded
213	Parks et al. (2012)	EMBASE	✓	✓	✓	✓	X	X	Excluded
214	Passier, Post et al. (2011)	DART/MEDLINE	X	X	X	X	X	X	Excluded
215	Passier, Elisabeth & Agnes (2011)	EMBASE/DART	X	X	X	X	X	X	Excluded
216	Pearson-Fuhrhop, Minton, Acevedo, Shahbaba & Cramer (2013)	EMBASE	X	X	X	X	X	X	Excluded
217	Peltonen & Rusko (1993)	MEDLINE	X	X	X	X	X	X	Excluded
218	Peng, Xu & Wang (2005)	EMBASE	X	X	X	X	X	X	Excluded

	Study	Database	Stroke/Humans/Adults	Mentions Fatigue	Includes Quantitative Fatigue Assessment	Mentions Cognition	Objective Quantitative Cognitive Assessment	Association Between Fatigue-Cognition	Status
219	Perrier & Monteil (2004)	EMBASE	X	X	X	X	X	X	Excluded
220	Perrier, Korner-Bitensky & Mayo (2010)	EMBASE	✓	✓	✓	✓	✓	X	Excluded
221	Pestka, Billman, Alexander & Rosenbland (2002)	EMBASE	X	X	X	X	X	X	Excluded
222	Petrovic et al. (2012)	EMBASE	X	X	X	X	X	X	Excluded
223	Pinheiro Jr. & Andrade (2012)	EMBASE	X	X	X	X	X	X	Excluded
224	Poreisz, Boros, Antal & Paulus (2007)	EMBASE	✓	✓	✓	X	X	X	Excluded
225	Potts, Charlton & Smith (2002)	EMBASE	X	X	X	X	X	X	Excluded
226	Powell, Kitchen, Heslin & Greenwood (2004)	MEDLINE	X	X	X	X	X	X	Excluded
227	Prasad, Herman, Coyle, McDonough & Crosbie (2010)	EMBASE	✓	✓	✓	X	X	X	Excluded
228	Psycharakis, Cooke, Paradisis, O'Hara & Phillips (2008)	EMBASE/ MEDLINE	X	X	X	X	X	X	Excluded
229	Radman et al. (2012)	PsycInfo/ CINAHL/ EMBASE	✓	✓	✓	✓	✓	✓	Included
230	Rainer et al. (1997)	EMBASE	X	X	X	X	X	X	Excluded
231	Raji, Al Snih, Ostir, Markides & Ottenbacher (2010)	EMBASE	X	X	X	X	X	X	Excluded

	Study	Database	Stroke/Humans/Adults	Mentions Fatigue	Includes Quantitative Fatigue Assessment	Mentions Cognition	Objective Quantitative Cognitive Assessment	Association Between Fatigue-Cognition	Status
232	Rhodes, Monastersky, Tyagi & Coyne (2011)	EMBASE	X	X	X	X	X	X	Excluded
233	Rigby et al., (2009)	EMBASE/ MEDLINE	✓	✓	✓	✓	✓	X	Excluded
234	Ritchie et al. (2006)	EMBASE	X	X	X	X	X	X	Excluded
235	Robertson & North (1993)	PsycInfo/ EMBASE	✓	✓	X	X	X	X	Excluded
236	Robinson et al. (2008)	EMBASE	✓	X	X	X	X	X	Excluded
237	Robison et al. (2009)	EMBASE	✓	✓	X	X	X	X	Excluded
238	Rodholm, Starmark, Svensson & Von Essen (2001)	MEDLINE	X	X	X	X	X	X	Excluded
239	Roding, Lindstrom, Malm & Ohman (2003)	EMBASE	✓	✓	X	X	X	X	Excluded
240	Roffe et al. (2010)	PsycInfo/ CINAHL/ EMBASE/MEDLINE	✓	✓	X	X	X	X	Excluded
241	Rosenblum & Weiss (2010)	EMBASE	X	X	X	X	X	X	Excluded
242	Rosler et al. (1999)	EMBASE	X	X	X	X	X	X	Excluded
243	Rosness (2010)	EMBASE	X	X	X	X	X	X	Excluded
244	Rothwell, Boaden, Bamford & Tyrrell (2013)	CINAHL/ EMBASE/MEDLINE	✓	✓	X	X	X	X	Excluded
245	Rowe, Blanton & Wolf (2009)	EMBASE	✓	✓	X	X	X	X	Excluded
246	Salvarani et al. (2008)	EMBASE	X	X	X	X	X	X	Excluded
247	Samper-Ternent et al., (2008)	PsycInfo/ EMBASE	X	X	X	X	X	X	Excluded

	Study	Database	Stroke/Humans/Adults	Mentions Fatigue	Includes Quantitative Fatigue Assessment	Mentions Cognition	Objective Quantitative Cognitive Assessment	Association Between Fatigue-Cognition	Status
248	Schepers, Visser-Meily, Ketelaar & Lindeman (2006)	CINAHL/DART	✓	✓	✓	✓	✓	✓	Included
249	Schneider et al. (2006)	EMBASE	X	X	X	X	X	X	Excluded
250	Schwartz, Carlucci, Chambless & Rosamond (2004)	EMBASE	✓	✓	✓	X	X	X	Excluded
251	Seifert, Chollet & Rouard (2007)	EMBASE	X	X	X	X	X	X	Excluded
252	Selch et al. (2004)	EMBASE	X	X	X	X	X	X	Excluded
253	Seo et al., (2005)	EMBASE	X	X	X	X	X	X	Excluded
254	Sibon, Lassalle-Lagadec, Renou & Swendsen (2012)	EMBASE	✓	✓	✓	✓	✓	X	Excluded
255	Singer, Vallenceb, Cleary & Cooper (2013)	EMBASE	✓	X	X	X	X	X	Excluded
256	Sisson (1995)	CINAHL/ MEDLINE	✓	X	X	X	X	X	Excluded
257	Sisson (1998)	CINAHL	✓	✓	X	X	X	X	Excluded
258	Skånér, Nilsson, Sundquist, Hassler & Krakau (2007)	EMBASE/ MEDLINE	✓	✓	✓	X	X	X	Excluded
259	Soh, (2006)	Ethos	X	X	X	X	X	X	Excluded
260	Solberg et al., (2011)	MEDLINE	X	X	X	X	X	X	Excluded
261	Spalletta, Ripa & Caltagirone (2005)	EMBASE	✓	X	X	X	X	X	Excluded

	Study	Database	Stroke/Humans/Adults	Mentions Fatigue	Includes Quantitative Fatigue Assessment	Mentions Cognition	Objective Quantitative Cognitive Assessment	Association Between Fatigue-Cognition	Status
262	Stangier, et al., (2009)	MEDLINE	X	X	X	X	X	X	Excluded
263	Starr, Whalley, Inch, White & Hadley (1994)	EMBASE	X	X	X	X	X	X	Excluded
264	Steele, Moore, Nugent, Riley, Campbell & Nicholls (1997)	MEDLINE	X	X	X	X	X	X	Excluded
265	Stewart, Tomiak, Shamji, Maziak & MacLeod (2004)	EMBASE	X	X	X	X	X	X	Excluded
266	Stirn, Jarm, Kapus & Strojnik (2011)	MEDLINE	X	X	X	X	X	X	Excluded
267	Stone (2005)	EMBASE	✓	X	X	X	X	X	Excluded
268	Sundin, Jansson & Norberg (2000)	CINAHL	✓	X	X	X	X	X	Excluded
269	Sutorova, Kratky & Adamkov (1987)	MEDLINE	COULD NOT BE ACCESSED						Excluded
270	Tachimura, Fujita, Yoneda & Wada (2000)	EMBASE	✓	X	X	X	X	X	Excluded
271	Tanaka, Toyonaga & Hashimoto (2011)	EMBASE	✓	✓	X	X	X	X	Excluded
272	Tanaka et al. (2011)	CINAHL	✓	✓	✓	✓	✓	X	Excluded
273	Tang et al. (2010)	EMBASE/MEDLINE	✓	✓	✓	✓	✓	✓	Included
274	Tannir et al. (2006)	EMBASE	X	X	X	X	X	X	Excluded
275	Thavichachart et al. (2006)	EMBASE	X	X	X	X	X	X	Excluded

	Study	Database	Stroke/Humans/Adults	Mentions Fatigue	Includes Quantitative Fatigue Assessment	Mentions Cognition	Objective Quantitative Cognitive Assessment	Association Between Fatigue-Cognition	Status
276	Thijs, Felt-Bersma & ten Kate (1982)	EMBASE	X	X	X	X	X	X	Excluded
277	Thompson & Ryan (2009)	CINAHL	✓	✓	X	X	X	X	Excluded
278	Thompson et al., (2002)	EMBASE	X	X	X	X	X	X	Excluded
279	Tierney et al. (2009)	EMBASE	X	X	X	X	X	X	Excluded
280	Tistad (2012)	DART	✓	✓	X	X	X	X	Excluded
281	Tobiasch & Chrostek (1981)	EMBASE/ MEDLINE	X	X	X	X	X	X	Excluded
282	Tokmakova et al. (2007)	MEDLINE	X	X	X	X	X	X	Excluded
283	Toraldo, Laiacona & Pagani (2012)	EMBASE	✓	X	X	X	X	X	Excluded
284	Tsai et al. (2013)	EMBASE	X	X	X	X	X	X	Excluded
285	Tsalis et al., (2012)	EMBASE/MEDLINE	X	X	X	X	X	X	Excluded
286	Turhan et al. (2006)	EMBASE	X	X	X	X	X	X	Excluded
287	Tyson et al. (2006)	EMBASE	X	X	X	X	X	X	Excluded
288	van de Port et al., (2008)	CINAHL/ EMBASE	✓	✓	✓	✓	✓	X	Excluded
289	van de Port et al., (2012)	EMBASE	✓	✓	✓	✓	✓	X	Excluded
290	van de Port et al., (2006)	DART/ MEDLINE	✓	✓	✓	✓	✓	X	Excluded
291	Van den Burg et al. (1985)	PsycInfo	X	X	X	X	X	X	Excluded
292	Van Der Veldt et al. (2008)	EMBASE	X	X	X	X	X	X	Excluded
293	van der Zee et al., (2013)	EMBASE	✓	✓	✓	X	X	X	Excluded
294	van Wijk (2006)	DART	✓	✓	✓	✓	✓	X	Excluded

	Study	Database	Stroke/Humans/Adults	Mentions Fatigue	Includes Quantitative Fatigue Assessment	Mentions Cognition	Objective Quantitative Cognitive Assessment	Association Between Fatigue-Cognition	Status
295	van Eijsden, van de Port, Visser-Meily & Kwakkel (2012)	EMBASE	✓	✓	✓	✓	✓	✓	Included
296	Van Zandvoort et al. (1998)	EMBASE/ MEDLINE	✓	✓	X	X	X	X	Excluded
297	van Zomeren, ten Duis, Minderhoud & Sipma (1998)	EMBASE/ MEDLINE	X	X	X	X	X	X	Excluded
298	Vargo (2011)	EMBASE/MEDLINE	X	X	X	X	X	X	Excluded
299	Visser-Meily, Rhebergen, Rinkel, Van Zandvoort & Post (2009)	EMBASE	X	X	X	X	X	X	Excluded
300	Walker & Paez (2013)	EMBASE	X	X	X	X	X	X	Excluded
301	Wendel et al., (2008)	EMBASE/ MEDLINE	✓	X	X	X	X	X	Excluded
302	Widar, Ek & Ahlstrom (2004)	EMBASE	✓	✓	X	X	X	X	Excluded
303	Williams, Weinberger, Harris, Clark & Biller (1999)	MEDLINE	✓	X	X	X	X	X	Excluded
304	Winkens, Van Heugten, Fasotti, Duits & Wade (2006)	CINAHL/ EMBASE	✓	✓	X	X	X	X	Excluded
305	Winkens, Van Heugten, Fasotti & Wade (2009)	PsycInfo/ CINAHL/ EMBASE/MEDLINE	✓	✓	✓	✓	✓	✓	Included
306	**Winkens, Van Heugten, Wade, Habets & Fasotti (2009)**	EMBASE/CINAHL	✓	✓	✓	✓	✓	X	Excluded

	Study	Database	Stroke/Humans/Adults	Mentions Fatigue	Includes Quantitative Fatigue Assessment	Mentions Cognition	Objective Quantitative Cognitive Assessment	Association Between Fatigue-Cognition	Status
307	Winward, Sackley, Metha & Rothwell (2009)	CINAHL/ EMBASE	X	X	X	X	X	X	Excluded
308	Wohlrab, Frances & Sullivan (2006)	EMBASE	X	X	X	X	X	X	Excluded
309	Wolfe et al. (2009)	EMBASE	X	X	X	X	X	X	Excluded
310	Wu, Liu, Zhang, Li & Wang (2008)	EMBASE	✔	✔	✔	X	X	X	
311	Yamanaka et al. (2011)	EMBASE	X	X	X	X	X	X	Excluded
312	Yang & Kong (2013)	EMBASE	✔	✔	✔	✔	✔	X	Excluded
313	Yoshimura, Abe & Terao (1994)	EMBASE	X	X	X	X	X	X	Excluded
314	Yoshino et al. (2013)	EMBASE	X	X	X	X	X	X	Excluded
315	Youmans (2012)	EMBASE	✔	✔	X	X	X	X	Excluded
316	Zajicek et al. (2005)	EMBASE	X	X	X	X	X	X	Excluded
317	Zakharov (2010)	EMBASE/MEDLINE	X	X	X	X	X	X	Excluded
318	Zwinkels, Geusgens, van de Sande, & van Heugten (2004)	PsycInfo/ CINAHL	✔	X	X	X	X	X	Excluded
	Papers Excluded Because of Each Criterion		191	26	57	13	4	19	

Table 2: Studies Identified after the Initial Search

	Study	Source	Stroke/Humans/Adults	Mentions Fatigue	Includes Quantitative Fatigue Assessment	Mentions Cognition	Objective Quantitative Cognitive Assessment	Association Between Fatigue-Cognition	Status
319	Johansson & Rönnbäck (2012)	Web	√	√	√	√	√	√	Included
320	Naess, Nyland, Thomassen, Aarseth & Myhr (2005)	Reference Lists	√	√	√	√	√	√	Included
321	Kutlubaev et al. (2013)	Reference Lists of A Review	√	√	√	√	√	√	Included

Conducting a search on Web of Science of the citation indexes of these 11 papers identified a further 149 papers which were also assessed against the inclusion criteria. There were no duplicates among these 149 papers, however there were some duplicates of papers already identified in the initial search (n=57), which were removed. Of the remaining 92 papers, none met the criteria and were excluded for either not having stroke patients (n=12), not using the term fatigue (n=16), not assessing fatigue (n=25), not including any cognitive domain (n=26), not assessing cognition (n=0) or not assessing the relationship between fatigue and cognition (n=13). Table 3 summarizes all papers and the reason of their exclusion. Figure 1 outlines the study selection process. In total, 11 studies fulfilled the inclusion criteria. Tables 4, 5, 6, 7 and 8 summarize these studies.

Table 3: Papers Generated from Searching Citation Index of Included Papers

Cited In		Cited In	Stroke /Humans/Stroke Patients/Adults	Mentions Fatigue	Includes Quantitative Fatigue Assessment	Mention Cognition	Objective Quantitative Cognitive Assessment	Association Between Fatigue - Cognition	Status
Kutlubaev et al., (2013)	1	Acciarresi et al., (2014)	✓	✓	X	X	X	X	Excluded
	2	Michael (2004)	✓	✓	✓	X	X	X	Excluded
	3	Pihlaja, et al., (2014)	✓	✓	✓	✓	✓	X	Excluded
Naess, Nyland, Thomassen, Aarseth, & Myhr, (2005)	4	Brainin & Pinter (2012)	✓	✓	X	X	X	X	Excluded
	5	Flinn & Stube (2010)	✓	✓	X	X	X	X	Excluded
	6	Harbison, Walsh & Kenny (2009)	✓	✓	✓	X	X	X	Excluded
	7	Johansson, Kottorp, Lee, Gay & Lerdal (2014)	✓	✓	✓	X	X	X	Excluded
	8	Knoflach et al. (2012)	✓	✓	✓	X	X	X	Excluded
	9	Kutlubaev & Akhmadeeva (2010)	✓	✓	✓	✓	✓	X	Excluded
	10	Lerdal & Gay (2013)	✓	✓	✓	✓	✓	X	Excluded
	11	Lewis et al. (2011)	✓	✓	✓	X	X	X	Excluded
	12	Maaijwee, et al., (2014)	✓	X	X	X	X	X	Excluded
	13	Naess (2009)	✓	X	X	X	X	X	Excluded

		Cited In	Stroke /Humans/Stroke Patients/Adults	Mentions Fatigue	Includes Quantitative Fatigue Assessment	Mention Cognition	Objective Quantitative Cognitive Assessment	Association Between Fatigue - Cognition	Status
	14	Naess, Beiske & Myhr (2008)	✓	✓	✓	X	X	X	Excluded
	15	Naess et al., (2006)	✓	✓	✓	X	X	X	Excluded
	16	Ormstad, Verkerk, Amthor & Sandvik (2014)	✓	✓	✓	X	X	X	Excluded
	17	Paolucci (2013)	✓	✓	X	X	X	X	Excluded
	18	Townend, Brady & McLaughlan (2007)	✓	X	X	X	X	X	Excluded
Park et al., (2009)	19	Bakken, Kim, Finset & Lerdal (2012)	✓	✓	✓	✓	✓	X	Excluded
	20	Buijck et al., (2012)	✓	X	X	X	X	X	Excluded
	21	Butt et al. (2013)	X	X	X	X	X	X	Excluded
	22	Cereda, Manconi & Bassetti (2012)	✓	✓	X	X	X	X	Excluded
	23	Duncan, Wu & Mead (2012)	✓	✓	X	X	X	X	Excluded
	24	Gustafsson & McKenna (2010)	✓	X	X	X	X	X	Excluded
	25	Hansson, et al., (2013)	✓	X	X	X	X	X	Excluded

		Cited In	Stroke /Humans/Stroke Patients/Adults	Mentions Fatigue	Includes Quantitative Fatigue Assessment	Mention Cognition	Objective Quantitative Cognitive Assessment	Association Between Fatigue - Cognition	Status
	26	Hsieh et al., (2012)	✓	X	X	X	X	X	Excluded
	27	Morris et al., (2013)	✓	X	X	X	X	X	Excluded
	28	Nabavi et al. (2013)	X	X	X	X	X	X	Excluded
	29	Robinson et al., (2011)	✓	✓	✓	X	X	X	Excluded
	30	White et al. (2012)	✓	✓	X	X	X	X	Excluded
	31	Widerström-Noga & Finlayson (2010)	✓	✓	X	X	X	X	Excluded
	32	Zedlitz, Fasotti & Geurts (2011)	✓	✓	✓	X	X	X	Excluded
Schepers, Visser-Meily, Ketelaar, & Lindeman, (2006)	33	Berthier et al. (2013)	✓	X	X	X	X	X	Excluded
	34	Brodtmann & van de Port (2013)	✓	✓	X	X	X	X	Excluded
	35	Kutlubaev & Mead (2012)	✓	✓	X	X	X	X	Excluded
	36	Sáez-Francàs, et al., (2013)	X	X	X	X	X	X	Excluded
	37	Andersen, et al., (2012)	✓	✓	✓	✓	✓	X	Excluded

		Cited In	Stroke/Humans/Stroke Patients/Adults	Mentions Fatigue	Includes Quantitative Fatigue Assessment	Mention Cognition	Objective Quantitative Cognitive Assessment	Association Between Fatigue - Cognition	Status
	38	Annoni et al., (2008)	✓	✓	X	X	X	X	Excluded
	39	Anton, Miller & Townson (2008)	X	X	X	X	X	X	Excluded
	40	Boyko et al. (2013)	✓	✓	✓	X	X	X	Excluded
	41	Brola, Ziomek & Czernicki (2007)	✓	✓	X	X	X	X	Excluded
	42	Brusse et al., (2011)	X	X	X	X	X	X	Excluded
	43	Cantor et al. (2012)	X	X	X	X	X	X	Excluded
	44	Choi-Kwon & Kim (2011)	✓	✓	X	X	X	X	Excluded
	45	Colle et al., (2006)	✓	✓	X	X	X	X	Excluded
	46	Crosby et al., (2012)	✓	✓	✓	X	X	X	Excluded
	47	Damush et al., (2007)	✓	X	X	X	X	X	Excluded
	48	Erickson, Gharbawie & Whishaw (2007)	X	X	X	X	X	X	Excluded
	49	Flinn & Stube (2010)	✓	✓	X	X	X	X	Excluded
	50	Gencay-Can & Can (2012)	X	X	X	X	X	X	Excluded

		Cited In	Stroke /Humans/Stroke Patients/Adults	Mentions Fatigue	Includes Quantitative Fatigue Assessment	Mention Cognition	Objective Quantitative Cognitive Assessment	Association Between Fatigue - Cognition	Status
	51	Green & King (2009)	✓	X	X	X	X	X	Excluded
	52	Green & King (2010)	✓	X	X	X	X	X	Excluded
	53	Jaracz, Mielcarek & Kozubski (2007)	✓	✓	✓	X	X	X	Excluded
	54	Johansson et al., (2010)	X	X	X	X	X	X	Excluded
	55	Duncan, Kutlubaev, Dennis, Greig & Mead (2012)	✓	✓	X	X	X	X	Excluded
	56	Duncan, Wu, et al. (2012)	✓	✓	X	X	X	X	Excluded
	57	Hoang et al. (2012)	✓	✓	✓	X	X	X	Excluded
	58	Kirkevold et al., (2012)	✓	✓	X	X	X	X	Excluded
	59	Kouwenhoven, Gay, Bakken & Lerdal (2013)	✓	✓	✓	X	X	X	Excluded
	60	Lerdal et al. (2009)	✓	✓	X	X	X	X	Excluded
	61	Lerdal & Kottorp (2011)	✓	✓	✓	X	X	X	Excluded
	62	Lerdal et al. (2011)	✓	✓	✓	✓	✓	X	Excluded

		Cited In	Stroke /Humans/Stroke Patients/Adults	Mentions Fatigue	Includes Quantitative Fatigue Assessment	Mention Cognition	Objective Quantitative Cognitive Assessment	Association Between Fatigue - Cognition	Status
	63	Leung et al. (2010)	✓	X	X	X	X	X	Excluded
	64	Levine & Greenwald (2009)	✓	X	X	X	X	X	Excluded
	65	Lewis et al. (2011)	✓	✓	✓	X	X	X	Excluded
	66	McGeough et al. (2009)	✓	✓	X	X	X	X	Excluded
	67	Mead et al. (2011)	✓	✓	✓	X	X	X	Excluded
	68	Naess et al., (2012)	✓	✓	✓	X	X	X	Excluded
	69	Olai, Borgquist & Svärdsudd (2012)	✓	✓	X	X	X	X	Excluded
	70	Ormstad, Aass, Amthor, Lund-Sørensen & Sandvik (2011)	✓	✓	✓	X	X	X	Excluded
	71	Ormstad et al., (2012)	✓	✓	✓	X	X	X	Excluded
	72	Russell, Dempster & Donnelly (2010)	✓	✓	✓	✓	✓	X	Excluded
	73	Schepers et al. (2009)	✓	✓	✓	✓	✓	X	Excluded
	74	Snaphaan et al., (2011)	✓	✓	✓	✓	✓	X	Excluded

		Cited In	Stroke/Humans/Stroke Patients/Adults	Mentions Fatigue	Includes Quantitative Fatigue Assessment	Mention Cognition	Objective Quantitative Cognitive Assessment	Association Between Fatigue - Cognition	Status
	75	Sieh, Meijer & Visser-Meily (2010)	X	X	X	X	X	X	Excluded
	76	Tang et al. (2010)	✓	✓	✓	X	X	X	Excluded
	77	Thompson & Ryan (2009)	✓	X	X	X	X	X	Excluded
	78	Tseng & Kluding (2009)	✓	✓	✓	X	X	X	Excluded
	79	van de Port, Kwakkel, Bruin & Lindeman (2007)	✓	✓	✓	X	X	X	Excluded
	80	van de Port et al., (2007)	✓	✓	✓	✓	✓	X	Excluded
	81	van de Port, Visser-Meily et al., (2007)	X	X	X	X	X	X	Excluded
	82	Vuletic, Lezaic & Morovic (2011)	✓	✓	✓	X	X	X	Excluded
	83	Wachelder et al. (2009)	X	X	X	X	X	X	Excluded
	84	Warren (2008)	✓	X	X	X	X	X	Excluded
	85	Yorkston et al., (2010)	✓	✓	X	X	X	X	Excluded
	86	Zedlitz et al., (2012)	✓	✓	✓	X	X	X	Excluded

		Cited In	Stroke /Humans/Stroke Patients/Adults	Mentions Fatigue	Includes Quantitative Fatigue Assessment	Mention Cognition	Objective Quantitative Cognitive Assessment	Association Between Fatigue - Cognition	Status
Tang et al., (2010)	87	Carod-Artal (2012)	✓	✓	X	X	X	X	Excluded
	88	Kutlubaev, Duncan & Mead (2012)	✓	✓	X	X	X	X	Excluded
	89	Miller et al. (2013) [also cited in Schepers]	✓	✓	✓	✓	✓	X	Excluded
	90	Tang, Lu, Mok, Ungvari & Wong (2011)	✓	✓	✓	✓	✓	X	Excluded
Winkens, Van Heugten, Fasotti, & Wade, (2009)	91	Winkens, Van Heugten, Fasotti & Wade (2011)	✓	✓	X	X	X	X	Excluded
	92	Winkens, Van Heugten, Wade, Habets & Fasotti (2009)	✓	✓	✓	✓	✓	X	Excluded
	Excluded	12	16	25	26	0	13		

Note: The new search revealed 149 papers of which, 57 were already considered in the first search. The table summarizes the rest 92; The studies of: Hubacher et al., (2012); Halvor Naess & Nyland, (2013); van Eijsden, van de Port, Visser-Meily, & Kwakkel, (2012) and Johansson & Rönnbäck, (2012) have not been cited in other papers according to web of knowledge. All papers citing Radman et al., (2012) overlapped with other papers so they are included in the other authors' index.

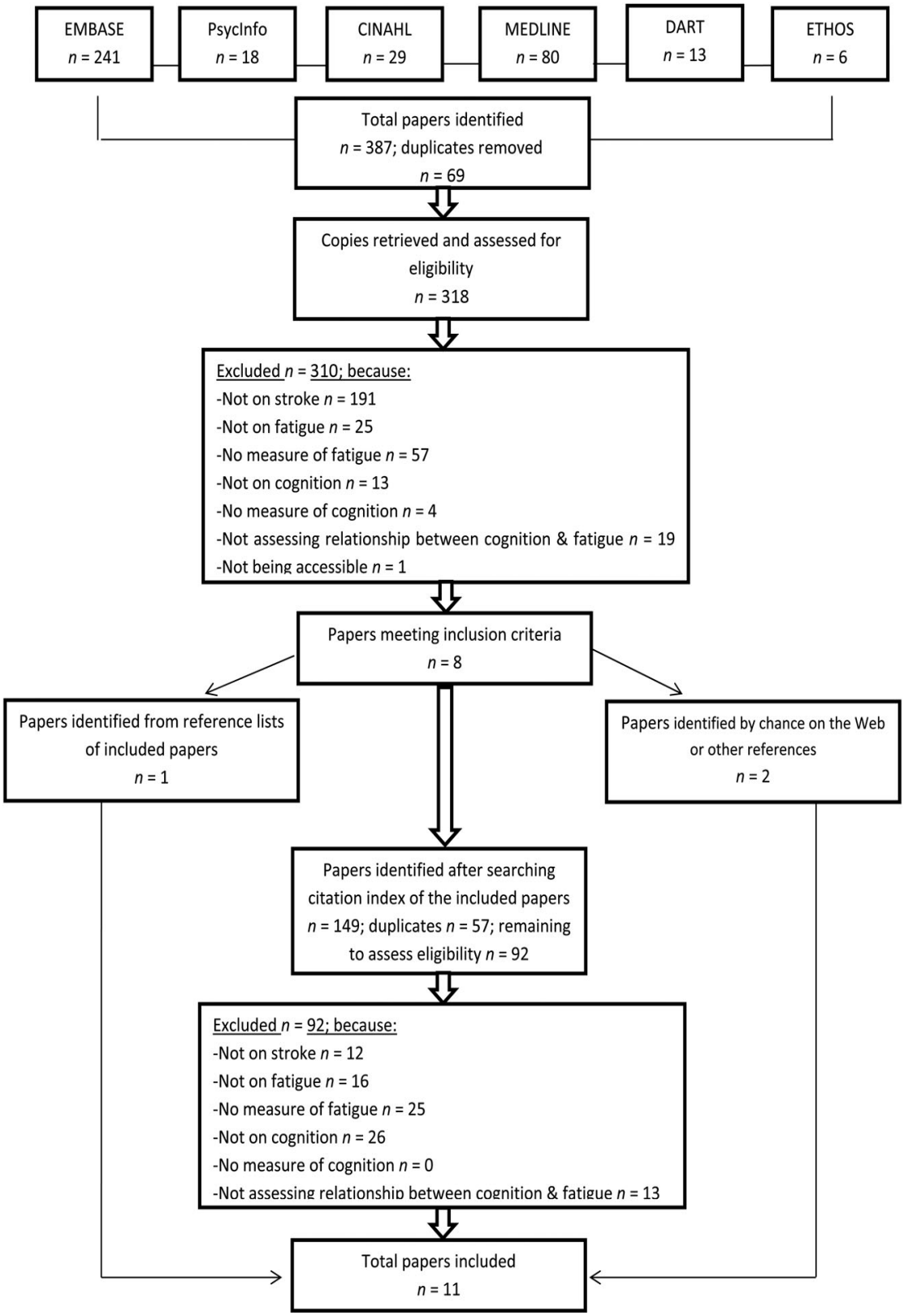

Diagram 1: Study Flow

2.5.1 Demographic Characteristics

Overall, the studies provided data on 1597 participants post-stroke 982 men (62%) and 615 women (38%). Generally, the studies had a small sample and only two (Tang et al., 2010; van Eijsden et al., 2012) had more than 200 participants. Of the total 809 (51%) participants had ischemic stroke, 197 (12%) haemorrhagic stroke and 591 (40%) were unspecified; 206 (13%) participants had a recurrent stroke whereas the rest had a first stroke. Of the total 331 (22%) participants suffered a right hemisphere stroke, 270 (18%) a left hemisphere stroke and 35 (2.3%) were non-lateralised bilateral 4 (0.3%), subcortical 20 (1.3%), brainstem 3 (0.2%), cerebellum 3 (0.2%), or other 5 (0.3%). Four studies (Kutlubaev et al., 2013; Naess et al., 2005; Naess & Nyland, 2013; Tang et al., 2010) did not provide information on lateralisation and one study (Winkens, Van Heugten, Fasotti, Wade, et al., 2009) reported missing data for 852 participants (57%). Two participants had suffered a sub-arachnoid haemorrhage (SAH) (0.1%).

Five hundred and thirty eight (36%) of the participants had a major comorbidity, as reported by five studies (Johansson & Rönnbäck, 2012; Naess et al., 2005; Naess & Nyland, 2013; Park et al., 2009; Schepers et al., 2006). Four studies mentioned hypertension, hypertonia, diabetes mellitus and cardiovascular diseases, migraine and depression, whereas one did not specify these. Seven studies did not report comorbidities.

Sample sizes ranged from 24 to 458. The mean age in studies ranged from 47.2 (SD= 8.3) to 66.2 (SD=11.7) years (median values ranged from 47.8 to 70.5). The time since stroke onset at recruitment ranged from 7 days to 18 years with one study (Hubacher et al., 2012) not reporting this information.

One study (Tang et al., 2010) reported a median of 5 years (range 0-25) and another (Johansson & Rönnbäck, 2012) a mean of 14.8 years (SD=2.8) years spent in education, and information from three other studies (Naess & Nyland, 2013; Hubacher et al., 2012; Winkens, Van Heugten, Fasotti, & Wade, 2009) indicated that 150 participants had attended higher, 16 secondary and 15 primary education. Five studies did not provide relevant information on education. The proportion of married

participants was reported in five studies and ranged from 27 to 83%. Six studies did not report marital status (Hubacher et al., 2012; Johansson & Rönnbäck, 2012; Naess et al., 2005; Radman et al., 2012; Winkens, Van Heugten, Fasotti, & Wade, 2009).

Table 4: Participants` Demographic Characteristics

Study	N	Age	Gender	Marital Status	Education	Country
Hubacher et al. (2012)	31	59.9±10.30	81%±19%	NS	Secondary: 5±16 College: 20±65 University: 2±7	Switzerland & Germany
Johansson & Rönnbäck (2012)	24	54.2±7.0	45.8%±54.1%	NS	Years spent in education: 14.8±2.8	Sweden
Kutlubaev et al. (2013)	107	70.5[a]	62%±38%	NS	NS	UK
Naess & Nyland (2013)	190	47.2±8.3	57%± 43%	Married: 27%	Higher education: 86%	Norway
Naess, Nyland, Thomassen, Aarseth & Myhr (2005)	192	47.8[a]	57.3%±46.3	NS	Higher education: 29.7%	Norway
Park et al. (2009)	40	59.9±11.8	65%±35%	With partner: 82.5%	NS	Korea
Radman et al. (2012)	109	51.1±13.8	66%±34%	NS	NS	Switzerland
Schepers, Visser-Meily, Ketelaar, & Lindeman (2006)	167	56.4±11.4	59%±41%	With partner: 73.7%	NS	Netherlands
Tang et al. (2010)	458	66.2±11.7	61.6%±38.4%	Married: 74.6%	Years spent in education: 5[a]	Hong Kong
van Eijsden, van de Port, Visser-Meily & Kwakkel (2012)	242	57.1±10.3	64.9%±35.1%	With partner: 82.8%	NS	Netherlands
Winkens, Van Heugten, Fasotti & Wade (2009)	37	54.8±12.1	70.27%±29.72%	NS	Primary: 40.5% Secondary: 29.8% Higher: 29.8%	Netherlands

Note: N= Number of Participants; Males±females; Mean±SD; NS: Not Specified.

Table 5: Participants' Medical Characteristics

Study	Stroke Type	Previous Stroke	Comorbidities	Time Since Stroke Onset	Source
Hubacher et al. (2012)	90%±10%	First: 23±74 Second: 4±13 Third: 2±7	NS	NS	8 Rehabilitation Centres
Johansson & Rönnbäck (2012)	SAH:2; Left: 3; Right: 6; Brainstem: 3; Cerebellum: 3	16.6%	Hypertonia (% NS)	6.1±7.1 years	Hospital & Community
Kutlubaev et al. (2013)	30%±8.4%	42%	NS	1 month	Hospital
Naess & Nyland (2013)	Ischaemic	No	Myocardial Infarct: 47%; Diabetes: 65%	18 years	Community Database
Naess et al. (2005)	Cerebral Infarction	Yes, 9.4%	Depression: 38.6%; Migraine: 17.9%; Myocardial Infarction: 10.0% ; Angina Pectoris: 5.8%; Diabetes Mellitus:11.1%; Hypertension: 35.8%	6 years	Hospital Registry
Park et al. (2009)	62.5%±37.5%	No	Hypertension: 72.5%;Diabetes mellitus: 32.5%;Cardiac disease: 17.5%	37.2±27.4	Rehabilitation Centre
Radman et al. (2012)	NS	No	No	7 days	Acute Stroke Unit
Schepers et al. (2006)	68.9%±31.1%	No	55.1% (NS what comorbidities)	1 year post-stroke	4 Rehabilitation Centres
Tang et al. (2010)	NS	Recurrent: 21.4%	No	3 months	Acute Stroke Unit
van Eijsden et al. (2012)	80.9%±19.1	Recurrent: 9.5%	NS	97.0±46.9	Rehabilitation Centre
Winkens et al. (2009)	83.78%±16.21%	Previous: 32.4%	No	234±160	5 Rehabilitation Centres

Note: Ischemic±Haemorrhagic; Mean±SD; NS: Not Specified.

2.5.2 Settings, Design and Quality Assessment

Time since stroke onset at baseline assessment ranged from 7 days to 18 years. Six studies had a follow-up in their design and two did not (Park et al., 2009; Tang et al., 2010), however one of the longitudinal studies (Naess & Nyland, 2013) only recorded mortality at follow-up, with no data available at that time. Time of follow-up ranged from 2 weeks to 1 year post-stroke. Seven studies were single centre and four studies were multicentre. Two studies were conducted in Asia (Park et al., 2009; Tang et al., 2010) and the rest were conducted in Western Europe. Ten studies were considered to be of high quality according to the CASP list (table 6).

Table 6: Baseline Fatigue and Follow-Up Fatigue and Cognitive Impairment Values

Study	Fatigue Score	Follow-Up
Hubacher et al. (2012); QI: 14	FSS: 3.00±0.32; FSMC-S: 42.29±3.06; FSMC-C:19.63±1.61; FSMC-M: 22.67±1.74; MFIS: 26.79±3.86	4 weeks: FSS: 3.73±0.39; FSMC-S:52.92±4.18; FSMC-C:24.92±2.12; FSMC-M:28.00±2.21; MFIS:32.21±4.27
Johansson & Rönnbäck (2012); QI: 14	MFS: 18.4±4.9	No
Kutlubaev et al. (2013); QI: 14	FAS_1: 23[a]	1 month
Naess & Nyland (2013); QI: 14	FSS:4.0±1.6	On mortality; no data available
Naess et al. (2005); QI: 14	FSS:4.14±1.65	No
Park et al. (2009); QI: 13	FSS: 3.6±1.5	No
Radman et al. (2012); QI: 13	FAI: 3.2±1.8	1 year FAI: 3.3±1.7 Cognitive impairment: 34.3%
Schepers et al.(2006); QI: 14	FSS:4.1±1.3	6 Months FSS: 4.5±1.2; 1 Year: FSS: 4.7±1.3; MMSE: 11.4% Impaired
Tang et al. (2010); QI: 14	FSS: 3.1±1.4; SF-36: 64.6±21.3	No
van Eijsden et al. (2012); QI: 9	FSS: 4.1±1.7	24 weeks: FSS: 4.1±1.7
Winkens et al. (2009); QI: 13	FSS: 3.5±1.5 MSQ: 34.5±20.5	2 weeks: MSQ: 44.3±18.6

Note: FAS1: Fatigue Assessment Scale; FAS2: verbal fluency task; FAI: Fatigue Assessment Instrument; FSS: Fatigue Severity Scale; MFS: Mental Fatigue Scale; SAMFS: Self-Assessment for Mental Fatigue Scale; SF-36: Short Form (36) Health Survey; MFIS: Modified Fatigue Impact Scale; FSMC: Fatigue Scale for Motor and Cognitive Function (C: Cognitive Subscale; M: Motor Subscale; S: Sum score); MSQ: Mental Slowness Questionnaire; MMSE: Mini Mental State Examination; Mean±SD.

2.5.3 Fatigue

Seven studies used one assessment of fatigue and three used more than one instrument (Hubacher et al., 2012; Tang et al., 2010; Winkens, Van Heugten, Fasotti, & Wade, 2009). Eight studies used the Fatigue Severity Scale (fatigue severity; FSS) (Krupp et al., 1989); the remaining studies each used a different scale (see table 6).

In the eight studies using the FSS, the mean fatigue score ranged

from 3.1 (SD=1.4) to 4.1 (SD=1.7). Three studies (Hubacher et al., 2012; Johansson & Rönnbäck, 2012; Winkens, Van Heugten, Fasotti, & Wade, 2009) measured cognitive fatigue whereas eight only reported overall fatigue. Three of the six longitudinal studies reported that fatigue remained stable over time whereas three studies (Schepers et al., 2006; Winkens, Van Heugten, Fasotti, & Wade, 2009; Hubacher et al., 2012) reported that fatigue increased over time (table 6). According to cut-off scores, 900 (57%) participants were not fatigued and 697 (44%) participants were fatigued.

2.5.4 Cognitive Impairment

Seven studies used the Mini Mental State Examination (MMSE; Folstein, Folstein, & McHugh, 1975) (Naess & Nyland, 2013; Park et al., 2009; Tang et al., 2010; van Eijsden et al., 2012). Three studies used the Trail Making Test-Parts A and B (mental flexibility, visual search, speed of information processing and executive functions) (Army Individual Test Battery, 1944) (Johansson & Rönnbäck, 2012; Schepers et al., 2006; Winkens, Van Heugten, Fasotti, Wade, et al., 2009) to assess executive function. The rest are summarised in table 7.

The mean score on the MMSE across three studies (Naess & Nyland, 2013; Park et al., 2009; van Eijsden et al., 2012) ranged from 28.0 (SD=1.7) to 28.2 (SD=2.1). Three studies (Kutlubaev et al., 2013; Schepers et al., 2006; Tang et al., 2010) reported that median on the MMSE ranged from 27 to 28. One study (Naess et al., 2005) reported that the majority of their participants scored ≥28 on the MSSE. The mean scores in the studies that used Trail Making Test ranged from 40.4 to 62.8 for Task A and from 83.7 to 153.9 for Task B with median of 123 for task B. All scores are presented in table 7.

Table 7: Cognitive Assesments and Their Scores

Study	Tests & Ability	Score
Hubacher et al. (2012); QI: 14	Verbal & visual short & long term memory, speed of information processing, working memory and executive functions	SRT-LTS: -0.41±1.52; SRT-CLTR: -0.36±1.27; SRTDR: -1.10±1.80; 10/36 spatial recall test: 0.24±1.15; 10/36; DR: 0.16±1.30; SDMT: -1.14±1.46; WLG: -1.39±0.87; PASAT: -1.11±1.33
Johansson & Rönnbäck (2012); QI: 14	attention, verbal fluency, motor speed, divided attention, visual scanning, reading speed, mouse clicks, speed of information processing, working memory	TMT: A 40.4±15.0; B 83.7±28.4; C 98.3±45.2; D 167.0±58.4; D 1.5±1.4; DSC 62.61±0.6; DS Total 14.3±4.0 [Forward 8.3±2.0; Backward 6.0±2.2]; FAS_2 38.0±15.1; Reading Speed 2.8±0.68; Mouse Clicks 39.4±8.3; Mouse Clicks & Counting Digits 36.4±8.8; Computer Errors 4.1±2.9
Kutlubaev et al. (2013); QI: 14	orientation, attention, memory, calculation, language, construction functions	MMSE: 27¤
Naess & Nyland (2013); QI: 14	orientation, attention, memory, calculation, language, construction functions	MMSE: 28.2±2.1
Naess et al. (2005); QI: 14	orientation, attention, memory, calculation, language, construction functions	MMSE: 73% (140 participants) = 28; 19% (37 participants)= 25-27; 8% (15 individuals)= <25
Park et al. (2009); QI: 13	orientation, attention, memory, calculation, language, construction functions	MMSE: 28.15±2.95
Radman et al. (2012); QI: 13	Stroop, phasic alert, divided attention, D2, letter fluency, non-verbal directed fluency, digit span, Corsi blocks; Rey auditory verbal memory ;sustained attention, long term memory; executive functions	30.3% showed abnormal performance
Schepers et al.(2006); QI: 14	orientation, attention, memory, calculation, language, construction functions, motor speed, complex visual scanning	MMSE: 28.0 ₸; TMT-B: Time:123.0₸; Correct Connections 24.0₸
Tang et al. (2010); QI: 14	orientation, attention, memory, calculation, language, construction functions	MMSE: 27₸
van Eijsden et al. (2012); QI: 9	orientation, attention, memory, calculation, language, construction functions	MMSE: 28.0±1.7
Winkens et al. (2009); QI: 13	memory, attention, reaction time, speed of information processing	TMTA 62.8±38.1; TMTB 153.9±112.8; Stroop 1 66.2±25.5; Stroop 2; 89.4±42.8; Stroop 3 156.3±74.0; SRTT 0.51±0.58; AVLT 40.1±11.6; SDMT Written 28.4±10.4; SDMT Verbal; 35.9±11.6 ;PASAT 35.3±9.6

Note: MMSE: Mini Mental State Examination; BRBN: Brief Repeatable Battery of Neuropsychological Tests; ; TMT-A: Trail Making Test-part A; TMT-B: Trail Making Test-part B; TMT-C: trail making tests plus months; TMT-D: trail making tests plus months and days of the week; SRT-LTS : Selective Reminding Test – Long-Term Storage; SRT-CLTR : Selective Reminding Test – Consistent Long-Term Retrieval; SRT-DR : Selective Reminding Test – Delayed Recall; 10/36-DR: Spatial Recall Test – Delayed Recall; SDMT: Symbol Digits Modalities Test; PASAT: Paced Auditory Serial Addition Test; Digit Span: Digit Span; DSC: Digit Symbol Coding; WLG: Word List Generation; AVLT: Auditory Verbal learning Test; SRTT: Simple Reaction Time Task; Mean±SD; Median₸; Mean□.

2.5.5 Correlations Between Fatigue and Cognition After Stroke

Table 8 summarises the correlations between measures of fatigue and measures of cognitive function. Seven studies (Kutlubaev et al., 2013; Naess et al., 2005; Naess & Nyland, 2013; Park et al., 2009; Schepers et al., 2006; Winkens, Van Heugten, Fasotti, & Wade, 2009; van Eijsden et al., 2012) found no significant correlation ($p<.05$) between cognitive variables and fatigue whereas four found significant correlations

(Hubacher et al., 2012; Johansson & Rönnbäck, 2012; Radman et al., 2012; Tang et al., 2010). The correlation between cognition and fatigue after stroke ranged from r= -0.36 to 0.54 (table 8). Significant correlations were found with Symbol Digit in two studies (Hubacher et al., 2012; Johansson & Rönnbäck, 2012) (-.44, -.52, -.59) and with speed of information processing in two studies (Hubacher et al., 2012; Johansson & Rönnbäck, 2012) (r= -0.50-0.46). Significant correlations were also found with Selective Reminding Test (SRT) (verbal memory) and Word List Generation (WLG) (semantic verbal fluency). The Modified Fatigue Impact Scale (MFIS) cognitive sub-scale revealed four significant correlations with the cognitive tests, whereas the motor sub-scale was only correlated with mental speed. The cognitive sub-scale of the Fatigue Scale for Motor and Cognitive Function (FSMC) revealed four significant correlations with the cognitive tests, whereas the motor sub-scale revealed three.

Of the 77 correlation coefficients calculated, 21 were significant and 56 were not. Overall, the above coefficients suggest that there is an association between concentration, sustained attention, speed of information processing, memory retrieval and verbal fluency and fatigue after stroke, but not with global cognitive impairment.

Table 8: Correlations between Fatigue and Cognitive Measurements

Study	Correlations							
Hubacher et al. (2012)	r	FSS	MFIS	MFIS-C	MFIS-M	FSMC-S	FSMC-C	FSMC-M
	SRT-LTS	-0.18	-0.36*	-0.38*	-0.29	-0.35	-0.39*	-0.36
	SRT-CLTR	-0.16	-0.39*	-0.38*	-0.34	-0.31	-0.36*	-0.22
	SRTDR	-0.28	-0.30	-0.33	-0.22	-0.27	-0.34	-0.17
	10/36 spatial recall	-0.08	-0.14	-0.05	-0.22	-0.34	-0.26	-0.39*
	10/36 DR	-0.18	-0.14	-0.08	-0.22	-0.32	-0.26	-0.34
	SDMT	-0.23	-0.44*	-0.45*	-0.39*	-0.52*	-0.54*	-0.43*
	WLG	-0.14	-0.41*	-0.41*	-0.31	-0.20	-0.33	-0.05
	PASAT	-0.21	-0.17	-0.25	-0.08	-0.50 *	-0.44*	-0.44*
Johansson & Rönnbäck (2012)	DSC: R= -0.59* Number of Errors in Computer Test: r= 0.46*							
Kutlubaev et al. (2013)	0.62 ρ							
Naess & Nyland (2013)	-0.08 r							
Naess et al. (2005)	>0.05, non-significant							
Park et al. (2009)	-0.10 ρ							
Radman et al. (2012)	Significant relationships between sustained & divided attention, long-term memory, executive functions and fatigue (Values NS)*							
Schepers et al.(2006)	-MMSE: .03 r -TMT-B: Time: 0.03; Correct Connections: -0.03 r							
Tang et al. (2010)	SF-36: 0.145 r *							
van Eijsden et al. (2012)	0.104 ſ **							
Winkens et al. (2009)	MSQ: TMTA 0.05; TMTB 0.09; Stroop 1 -0.13; Stroop 2 0.01; Stroop 3 -0.21; SRTT -0.04; AVLT -0.02; SDMT Written 0.16; SDMT Verbal 0.09; PASAT -0.28							

Note: FAS1: Fatigue Assessment Scale; FAS2: verbal fluency task; FAI: Fatigue Assessment Instrument; FSS: Fatigue Severity Scale; MFS: Mental Fatigue Scale; SAMFS: Self-Assessment for Mental Fatigue Scale; SF-36: Short Form (36) Health Survey; MFIS: Modified Fatigue Impact Scale; FSMC: Fatigue Scale for Motor and Cognitive Function (C: Cognitive Subscale; M: Motor Subscale; S: Sum score); MMSE: Mini Mental State Examination; BRBN: Brief Repeatable Battery of Neuropsychological Tests; ; TMT-A: Trail Making Test-part A; TMT-B: Trail Making Test-part B; TMT-C: trail making tests plus months; TMT-D: trail making tests plus months and days of the week; SRT-LTS : Selective Reminding Test – Long-Term Storage; SRT-CLTR : Selective Reminding Test – Consistent Long-Term Retrieval; SRT-DR : Selective Reminding Test – Delayed Recall; 10/36-DR: Spatial Recall Test – Delayed Recall; SDMT: Symbol Digits Modalities Test; PASAT: Paced Auditory Serial Addition Test; Digit Span: Digit Span; DSC: Digit Symbol Coding; WLG: Word List Generation; AVLT: Auditory Verbal learning Test; SRTT: Simple Reaction Time Task; MSQ: Mental Slowness Questionnaire; ſ: p value <0.2; Significant correlation*; r: Pearson's Correlation; ρ: Spearman's

Correlation ; ∞: Regression Value; NS: Not Specified; All p values are set to 0.05 unless otherwise specified

2.6 Discussion

The majority of the correlations between cognition and fatigue after stroke were not significant (p>.05). Only four of the 11 studies revealed significant correlations between fatigue and divided attention, sustained attention, speed of information processing, long-term memory and concentration. The studies revealed either non-significant or weak to moderate correlations. Non-significant or weak significant correlations between cognition and fatigue could potentially be attributed to participants in the sample having low levels of fatigue or minimal cognitive impairment. With regard to fatigue, the majority of the studies used the FSS to measure fatigue. The mean fatigue score across the studies was 4 on the FSS, indicating that fatigue was low in their samples. Four out of eight studies reported a mean FSS of 4.0 or slightly above all of which were only just above the cut-off (eg. 4.1). The Fatigue Assessment Instrument (FAI), classifies severe fatigue as any score above 4 (Radman et al., 2012). The studies that used FAI reported a mean of 3.2, also a low level of fatigue.

The majority of the studies used the MMSE (Folstein et al., 1975). Of these, three reported a mean score of around 28, and the rest (three) reported a median of 27 or 28 which shows that the majority of the participants did not have dementia. That indicates that the majority of participants (88%) were not considered to be cognitively impaired on the MMSE. The MMSE is a screening assessment of global cognitive status (Folstein et al., 1975) and does not assess adequately executive functions, visuospatial functions and attention (Radman et al., 2012; Woodford & George, 2007). It is therefore not suitable for assessing cognitive impairment after stroke which frequently affects these functions (Cumming et al., 2013). It is also well recognised that the MMSE is not sensitive to cognitive impairment after stroke (Blake et al., 2002; Nys et al., 2005) and many of the participants in the studies that used the MMSE may have been misclassified as not impaired. Therefore the majority of the studies used an insensitive test of cognition and this may compromise

the assessment of the relationship between cognition and fatigue. The results are similar to these of another systematic review (Ponchel et al., 2015) which examined the effect of cognitive disorders on post-stroke fatigue.

Of the 21 significant correlation coefficients (plus unspecified number of correlations from Radman et al., 2012), 18 came from the same study (Hubacher et al., 2012) which used the FSMC and the MFIS that consider cognitive manifestations of fatigue. These scales may be better at assessing cognitive aspects of fatigue because they were developed with this aim. Therefore such scales are more likely to correlate significantly with cognitive impairment. For instance, the MFIS includes items such as: "I have been forgetful" (targeting memory), "I had trouble concentrating" (which targets attention), and "My thinking has been slowed down" (speed of information processing) and the FSMC items such as: "My powers of concentration decrease considerably when I'm under stress" (attention) and "During episodes of exhaustion, I am noticeably more forgetful" (memory). When the scores are separated for cognitive and motor sub-scales within the scales (table 8) of the 18 significant correlations, 8 are attributed to the cognitive components of fatigue being correlated with cognitive impairment. More general fatigue scales such as the FSS, did not reveal such relationships. This could be due either to the cognitive measures used (mostly the MMSE in these studies) or to the fact that the FSS does not measure cognitive components of fatigue. Fatigue scales that consider cognitive symptoms may reflect subjective cognitive complaints rather than fatigue. Only two studies (Radman et al., 2012; Tang et al., 2010) revealed a significant association between fatigue and cognition without measuring the cognitive aspects of fatigue (the former used the FAI and the latter the SF-36: vitality).

The results seem to be in accordance with studies in other medical conditions. For instance, studies in cancer patients undergoing chemotherapy (Castellon et al., 2004; Tchen et al., 2003; Vardy, 2008), HIV/AIDS patients (Millikin et al., 2002), multiple sclerosis patients (Jougleux-Vie et al., 2014; Kinsinger et al., 2010; Middleton et al., 2006) and patients with traumatic brain injury, (Johansson, Berglund, & Rönnbäck, 2009) have reported that subjective mental fatigue was

associated with subjective cognitive performance but not with objective cognitive performance. The majority of the significant correlations in this review, were from a study that assessed mental fatigue as a cognitive complaint (Hubacher et al., 2012). All these indicate that there may be a a significant relationship between subjective cognitive impairment and fatigue, but not with cognitive ability. Therefore, it is essential to assess general fatigue as well as perceived cognitive fatigue and to compare their relationship with cognitive impairment.

Most studies used more than one measures of fatigue or cognition and produced inconsistent results. For example, Winkens et al., (2009) used both TMT-A and B and Paced Auditory Serial Addition Test (PASAT) to measure speed of information processing, and both PASAT and the Symbol Digits Modalities Test (SDMT) to measure working memory, speed of information processing and sustained attention. None of the above tests was significantly correlated with the Mental Slowness Questionnaire (MSQ), as a measure of fatigue.

The inconsistency of the measures makes the interpretation of results difficult. Hubacher et al., (2012) used three scales of fatigue and correlated each of them with all eight subtests of the Brief Repeatable Battery of Neuropsycholocal Tests (BRB-N) battery. Some of the correlations were significant while others were not. Sustained attention was measured by SDMT and PASAT. The latter was significantly correlated with the FSMC, however when sustained attention was measured with SDMT, it was not significantly associated with any of the fatigue scales. The authors acknowledged that the PASAT is also a measure of working memory and SDMT a measure of mental speed. It is therefore unclear which components were, or were not associated in each correlation. It is difficult to conclude whether cognitive domains were significantly associated with fatigue, or whether the lack of significant relationship was due to the measures used. There is a need for more studies with more appropriate measures for fatigue and cognition.

It appears that fatigue scales that measure general fatigue symptoms rather than cognitive subcomponents, would be more appropriate in measuring fatigue to assess evidence of an association with cognitive impairment. The majority of the studies, did not include

cognitive tests because their objective was not to measure and associate cognitive impairment with fatigue. They mostly used global cognitive status assessments such as the MMSE as screening measures for participant inclusion/exclusion to the study. Therefore it would appear that tests that are designed to address specific cognitive impairments would be more appropriate. A combination of a general fatigue scale with a domain-specific cognitive measure is more likely to assess accuratelly the relationship between fatigue and cognitive impairment after stroke.

Most of the studies were of good quality according to the CASP guidelines, however one did not provide correlation coefficient values (Radman et al., 2012) and another (van Eijsden et al., 2012) was considered of moderate quality because there was not sufficient information nor justification as to why they excluded individuals with limited mobility and the significance level was .2 which is higher than the conventionally used level of .05. Some studies did not report some information (see table 4). After establishing contact with authors of the two papers (Radman et al., 2012; van Eijsden et al., 2012), they were unable to provide the correlation coefficients.It is possible that no significant associations were found because there is no significant relationship between cognition and fatigue post-stroke. However, there are other possible explanations for why the studies did not reveal significant associations between fatigue and cognitive impairment after stroke. For instance, 538 (36%) of the participants had major comorbidities (such as diabetes mellitus, cardiac disease and hypertension), which could significantly affect the experience of fatigue. Fatigue is very common in cardiac disease (Casillas, Damak, Chauvet-Gelinier, Deley, & Ornetti, 2006), but cognitive impairment is not. If, for instance, participants' fatigue was due to the comorbid condition and not the stroke, yet their cognitive impairment was attributed to their stroke, then this would mask any association between cognitive impairment and fatigue.

Another consideration is that some studies assessed fatigue within a month of the acute phase (Radman et al., 2012; Schepers et al., 2006), whereas others assessed it within the chronic phase (Johansson & Rönnbäck, 2012; Naess et al., 2005; Naess & Nyland, 2013; Winkens,

Van Heugten, Fasotti, Wade, et al., 2009). However, there is conflicting evidence with regard to time of fatigue onset. Some studies reported fatigue being related to the acute phase (Choi-Kwon et al., 2005; Christensen et al., 2008), while other studies have argued that fatigue is a long-term issue. For instance, Schepers et al., (2006) reported that fatigue tends to increase over time, while van de Port, Kwakkel, Schepers, Heinemans, & Lindeman, (2007) found that fatigue peaks at approximately 12 months post-stroke. The results of the systematic review did not reveal any specific pattern. Fatigue was similar across studies and scores did not differ significantly according to time of assessment. The three highest scores according to FSS (4.7; 4.1 and 4.0) were spread out across the acute (4.7), middle (4.1) and chronic phase of stroke (4.0). Lower scores were also found in the acute, middle and chronic phase. When comparing data between baseline and follow-up assessments within the same longitudinal studies (Hubacher et al., 2012; Radman et al., 2012; Schepers et al., 2006; van Eijsden et al., 2012; Winkens, Van Heugten, Fasotti, Wade, et al., 2009), a pattern emerges suggesting that fatigue tends to increase to some extent over time. Cognitive impairment tends to decrease over time (Danovska et al., 2012) and so any relationship between the two would be expected to be negative. Given that the time of onset and peak of fatigue is controversial, the fact that the above studies considered different time frames does not allow conclusive interpretations.

Overall, the papers had limitations. Most of them did not make it clear which type of correlation they used and therefore it is not possible to assess whether the statistical analyses followed were appropriate (parametric vs non-parametric). The majority of the studies had very small samples with only two having more than 200 individuals (Tang et al., 2010; van Eijsden et al., 2012).

Despite the exclusion of papers on people with SAH, one paper (Park et al., 2009) was included because it indicated there were only a few participants with the condition. The authors were contacted regarding the percentage of the participants with SAH but there was no response. The paper was included on the basis that sub-arachnoid haemorrhage is far less common than other stroke types and on the assumption that the

proportion of people with SAH would be low. Two studies (Naess et al., 2005; Naess & Nyland, 2013) mentioned an age range between 15 and 49 years. The review was focused on papers reporting on adult samples. After contacting the authors, only one participant was 17 years old at the baseline and 30 at the follow-up, and therefore these papers were included.

This systematic review had limitations. It did not include studies that analysed their data with logistic regression. The inclusion criterion for the fatigue scales was that the scale had at least three response categories, which means that studies that used no/yes for the presence of fatigue were excluded. This means that the review may have missed studies with information on the presence of fatigue rather than severity and its association to cognitive impairment. However, only one study with such analysis was detected (Appelros, 2006) and the relationship between fatigue (yes/no) and cognition (MMSE) was not significant (p= .16) which is consistent with the results the majority of the studies included.

Another potential limitation is that more gerontological, medical and social sciences orientated databases such as AgeLine and Science Direct, would have identified more papers; However, it is likely that the databases searched identified the majority of studies on the topic because they provided results drawn from medical, psychological and nursing journals. Another imitation is that due to the nature of their search engines, some dissertation databases could not be searched in a systematic way identical to the one used in this review. The searching strategy included two thesis databases; but these would not include all dissertations (one is only for the UK and the other only for Europe). Two studies were identified either by chance (Johansson & Rönnbäck, 2012) or through the reference list of other papers (Naess, Nyland, Thomassen, Aarseth, & Myhr, 2005). Therefore it is possible that other suitable studies were not included.

Despite no language restriction, the use of English terms in the search strategies limited the results to papers that had an abstract and key words in English. Therefore, some papers in other languages may have been missed.

2.7 Author's Conclusion

The findings of this review demonstrated that there was no evidence of a significant association between fatigue and global cognitive status after stroke. However, there was some evidence to suggest that attention, memory and speed of information processing may be significantly associated with fatigue.

Future studies should incorporate the use of both domain-specific and global cognitive tests, and investigate the association with general fatigue and cognitive fatigue scales. Furthermore, future studies could also include both subjective ratings of cognition and objective cognitive tests and examine their relationship to both general and cognitive fatigue scales.

In summary, more studies are needed with measures that are sensitive to cognitive impairment after stroke and with fatigue scales that do not address cognitive components of fatigue. This will enable a more accurate investigation of the relationship between fatigue and cognitive impairment after stroke.

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APPENDICES-Searching Strategies and Keywords

EMBASE (Ovid) 1980-17/November, 2013

1. stroke$.mp. or exp cerebrovascular accident/ (271510)
2. ischemic stroke$.mp. or exp brain ischemia/ (113089)
3. haemorrhagic stroke$.mp. (1045)
4. brain infarction$.mp. or exp brain infarction/ (49404)
5. cerebrovascular accident$.mp. or exp cerebrovascular accident/ (67011)
6. (intracranial embolism and thrombosis).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword] (31)
7. stroke/ or exp lacunar stroke/ or brain ischemia/ or brain infarction/ (206625)
8. cerebral clot$.mp. (6)
9. exp basal ganglion hemorrhage/ (363)
10. brain thrombosis.mp. or exp occlusive cerebrovascular disease/ (23537
11. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 (359046)
12. chronic fatigue syndrome/ or Fatigue Severity Scale/ or Fatigue Impact Scale/ or fatigue.mp. or exp fatigue/ (146693)
13. tiredness$.mp. or exp fatigue/ (124398)
14. (weariness$ or exhaustion$).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword] (16067)
15. mental fatigue.mp. (688)
16. 12 or 13 or 14 or 15 (158894)
17. cognitive impairment$.mp. or exp cognitive defect/ (108029)
18. cognitive deficit$.mp. (16405)
19. exp memory/ or cognitive decline$.mp. (179299)
20. cognitive function$.mp. (44117)
21. exp cognition/ or exp executive function/ or memory/ or task performance/ (1201781)
22. exp attention/ or mental function/ or thinking/ or mental control.mp. (135934)

23. mental performance/ or mental effort$.mp. (10912)

24. learning/ or working memory/ or mental speed.mp. (136711)

25. mental concentration/ (1816)

26. reasoning.mp. or decision making/ or thinking/ or problem solving/ (183037)

27. exp information processing/ (953035)

28. 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 (2125771)

29. 11 and 16 and 28 (791)

30. limit 29 to human (705)

31. limit 30 to (article or report)

32. limit 31 to (adult <18 to 64 years> or aged <65+ years>) (214)

PsycINFO 1806-18/November, 2013

1. exp Cerebrovascular Accidents/ or exp Cerebral Ischemia/ or stroke$.mp. (23183)

2. ischemic stroke$.mp. (2738)
3. exp Hemorrhage/ or exp Cerebral Hemorrhage/ or haemorrhagic stroke$.mp. (2268)
4. 1 or 2 or 3 (24709)
5. exp Fatigue/ or exp Chronic Fatigue Syndrome/ (7082)
6. tiredness$.mp. or exp Fatigue/ (6579)
7. slowness.mp. (782)
8. (weariness$ or exhaustion$).mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures] (4580)
9. exp Fatigue/ or exp Chronic Fatigue Syndrome/ or mental fatigue.mp. (7263)
10. 5 or 6 or 7 or 8 or 9 (12558)
11. exp Cognitive Impairment/ (21030)
12. exp Cognition/ or exp Cognitive Processes/ or exp Cognitive Ability/ or exp Memory/ or cognitive function$.mp. (419921)
13. exp Sustained Attention/ or exp Attention/ (48803)
14. exp Reasoning/ (20019)
15. exp Cognitive Impairment/ or exp Concentration/ or mental concentration.mp. (22212)
16. information processing.mp. (24350)
17. exp Executive Function/ (5625)
18. 11 or 12 or 13 or 14 or 15 or 16 or 17 (476729)
19. 4 and 10 and 18 (28)
20. limit 19 to human (27)
21. limit 20 to "300 adulthood <age 18 yrs and older>" (18)

22. limit 21 to ("0100 journal" or "0110 peer-reviewed journal" or "0120 non-peer-reviewed journal" or "0130 peer-reviewed status unknown" or "0400 dissertation abstract" or "0500 electronic collection") (18)

CINAHL (EBSCO) 1937-19/November, 2013

1. (MH "Fatigue Syndrome, Chronic") OR (MH "Fatigue") (11143)
2. "tiredness" (670)
3. "weariness" (33)
4. "exhaustion" (2.726)
5. "slowness" (170)
6. "mental fatigue" (127)
7. (S1 OR S2 OR S3 OR S4 OR S5 OR S6) (14243)
8. (MH "Stroke, Lacunar") OR (MH "Stroke") OR (MH "Cerebral Ischemia") OR (MH "Basal Ganglia Hemorrhage") OR (MM "Basal Ganglia Cerebrovascular Disease+") OR (MH "Intracranial Embolism and Thrombosis") OR (MH "Stroke Units") OR (MH "Cerebrovascular Disorders") (44364)
9. "ischemic stroke" (4979)
10. "haemorrhagic stroke" OR (MH "Stroke Patients") (2560)
11. S8 OR S9 OR S10 (46040)
12. (MH "Thinking") OR (MH "Problem Solving") OR (MH "Learning") OR (MH "Memory") (33807)
13. (MH "Attention") OR "attention" (50246)
14. "concentration" (28061)
15. "mental speed" OR (MH "Distraction") (858)
16. "information processing" OR (MH "Information Processing (Iowa NOC)") OR (MH "Cognitive Ability (Iowa NOC)") (1414)
17. "executive function" (1478)
18. "mental effort" (56)
19. "mental control" (31)
20. "cognitive impairment" (7092)
21. (S12 OR S13 OR S14 OR S15 OR S16 OR S17 OR S18 OR S19 OR S20) (116346)
22. S7 AND S11 AND S21 (36)
23. Limit 22 to humans (29)

MEDLINE (Ovid) 1946-18/November, 2013

1. Stroke, Lacunar/ or exp Stroke/ or stroke$.mp. (193119)
2. exp Cerebrovascular Disorders/ or post-stroke.mp. (277248)
3. Cerebral Infarction/ or Brain Ischemia/ or ischemic stroke$.mp. or "Intracranial Embolism and Thrombosis"/ (69915)
4. haemorrhagic stroke$.mp. (683)
5. poststroke.mp. (2517)
6. 1 or 2 or 3 or 4 or 5 (357293)
7. Fatigue/ or Mental Fatigue/ or Fatigue Syndrome, Chronic/ or fatigue.mp. (66154)
8. (tiredness$ or weariness$).mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept, rare disease supplementary concept, unique identifier] (2683)
9. 7 or 8 (68060)
10. Mild Cognitive Impairment/ or cognitive impairment$.mp. (29475)
11. cognitive deficit$.mp. (11593)
12. exp Memory/ (102051)
13. exp Attention/ (60274)
14. exp Cognition/ or reasoning.mp. or exp Decision Making/ or exp Problem Solving/ (253163)
15. cognitive function$.mp. (31450)
16. information processing.mp. (14385)
17. concentration.mp. or exp Attention/ (1158244)
18. 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 (1513500)
19. 6 and 9 and 18 (131)
20. limit 19 to humans (125)
21. limit 20 to ("young adult (19 to 24 years)" or "adult (19 to 44 years)" or "young adult and adult (19-24 and 19-44)" or "middle age (45 to 64 years)" or "middle aged (45 plus years)" or "all aged (65 and over)" or "aged (80 and over)") (88)
22. limit 21 to (case reports or classical article or clinical trial or controlled clinical trial or evaluation studies or introductory journal article or journal article or multicenter study or randomized controlled trial or "scientific integrity review" or validation studies) (80)

DART (1999) & Ethos (1600) /November, 2013

1. Stroke
2. Cerebrovascular disease/accident/condition
3. Haemorrhagic stroke
4. Ischemic stroke
5. Lacunar stroke
6. Poststroke/post-stroke/after stroke
7. Fatigue
8. Tiredness
9. Weariness
10. Exhaustion
11. Chronic Fatigue Syndrome
12. Mental fatigue
13. Slowness
14. Cognitive Impairment
15. Cognitive deficit/function
16. Mental performance/effort
17. Mental/cognitive control
18. Mental concentration
19. Memory
20. Attention
21. Thinking
22. Learning
23. Reasoning
24. Decision making
25. Problem solving
26. Mental speed

**Combined with AND/OR when appropriate.*