

1), 2)
1) 2) 2)

Abstract

Development of a Fatigue Symptom Checklist for Commercial Drivers: An Experimental Trial

Kyoung-Ok Park, Myung Sun Lee, Sang Hyuk Jung¹⁾, In Seok Kim²⁾, Young A Oh²⁾

Department of Health Education in Ewha Womans University, Department of Preventive Medicine of Ewha Womans University²⁾, Samsung Traffic Safety Research Institute³⁾

Objectives: Fatigue is a primary human factor for decreased job performance in the workplace. It is well documented that drowsiness is a typical symptom of fatigue and is closely associated with commercial drivers' safety and well-being. However, few studies have been conducted to develop or validate fatigue symptom instruments for a working population. The main purpose of this study was to develop a general fatigue checklist and a driving fatigue checklist for Korean commercial drivers.

Methods: A total of 287 bus drivers in a commercial transportation company participated in a self-administered survey that was designated Study 1. Based on the statistical results of Study 1, a focus meeting with 16 professional consultants was conducted to revise the fatigue symptom instrument for Study 2. In Study 2, 288 commercial drivers (156 bus drivers and 132 truck drivers) participated in the revised questionnaire survey. All collected responses were entered into a SPSS worksheet and the data analysis was conducted using SPSS software 11.1. The exploratory factor analysis used in this study followed the principle component factoring rule and the varimax rotation method for factor extraction. The criteria for item selection were an Eigen value of 1.0 or greater, a communality score of .50 or greater, and no 'fence rider' property over the extracted factors.

Results: Through Study 1, the consultant meeting, and Study 2, a general fatigue checklist was developed with a total of 3 factors and 11 items, and a driving fatigue checklist was developed with 2 factors and 10 items. The 3 factors of the general fatigue checklist were physical fatigue, psychological fatigue, and chronic tiredness. The two factors of the driving fatigue

checklist were physical fatigue and perceptive and functional fatigue.

Conclusions: The primary contents of general fatigue were different from those of driving fatigue according to the two fatigue instrument factors developed in this study. The primary fatigue symptoms of the commercial driving population were identified as physical fatigue and perceptive and functional fatigue.

Key Words: Fatigue symptom, Commercial driver, Instrument, Checklist, Workplace

10% 가
 20% 가
 가 가
 , Maycock
 OECD 가 (1997) McCartt(1996)
 가 가 4 (Horne
 가 Reyner, 1995).
 (WHO, (National Highway Traffic Safety Adminis-
 2004). tration: NHTSA, 2000, 2001)
 11.5%가
 5
 12%가
 (, 1998).
 가 가 , 가 가
 가 가 (Ax , 2001).
 (, 1998).
 가 83.5% , 1995), Nelson(1997)
 가 가
 가 가 .
 0.3~0.5% 가 가
 0.3% 가
 9% 가 (Chronic Fatigue Symptoms; CFS)
 (Fuhrer Wessely, 1995; Ax ,
 가 (, 1998; Fuller Morrison, 1998, p 175).
 2002).
 Brown(1997) 가 가 ,

70%
가 (Yoshitake, 1971) 30

(Yoshitake, 1971; Carskadon
Dement, 1987; Buysse, 1989; Hart , 1990;
Johns, 1991; Beurskens , 2000), 30

(, 1996).
가

(Milosevic, 1997; Nillson , 1997).

가 (, 1993; , 2000). 가

가

(, 1997; , 1998;
, 1999; , 1999).

가

1.

가

2

가,

1)

(, 1991; , 1996; 4
, 1999; , 2002),

가

가

(Yoshitake,
1971), 20 Checklist Individual
Strength(CIS-20R; Beurskens , 2000), Centers
for Disease Control and Prevention(CDC)

8가 (Fuller

Morrison, 1998), Nisenbaum (1998), ; ' ' 4 (Beu-
 8 rskens , 2000). 가
 57 . 1988 CDC
 가 가 8
 (Chronic Fatigue Syndrome)
 Nisenbaum (1998) 8가
 (, 1999),
 .
 5 , ' 2)
 ' 5 ' 1 ,
 가 가
 (Table 1).
 30
 10 3 ,
 , (1995), (1997), Milosevic(1997)
 (1998) Nillson(1997)
 . CIS- 25
 20R
 20 ' ; ' ; ' 가 ,

Table 1. Initial fatigue symptom item resources used in this study

Instrument	Item	Construct
General fatigue symptoms		
Japanese Society of Occupational Hygiene (Yoshitake, 1971)	30	Concentration disorder, drowsiness, physical fatigue
CIS20R (Beurskens et al., 2000)	20	Subjective fatigue, activity, energy, concentration
CDC Index of chronic fatigue syndrome(Fuller & Morrison, 1998)	8	Chronic fatigue symptoms
Chronic fatigue symptoms (Nisenbaum et al., 1998)	8	Chronic fatigue symptoms
Driving fatigue symptom		
Driving fatigue scale (Milosevic, 1997)	14	Fatigue symptoms for long-distance driving
Driving fatigue symptoms (Nillson, 1997)	17	Physical fatigue for driving

가

(3)

SPSS 11.1

Milosevic(1997)

(Exploratory Factor Analysis;
(Confirmatory Factor

14

Nillson(1997)
17

EFA)
Analysis; CFA)

6:4

5

, 6

가

, '5

'5

'1

, 4

가

(Table 1).

2.

(Principle Component Analysis)

1) 1

(1)

(varimax)

1

2003

(Cohen Cohen, 1983).

가

가

287

1.0

가

Eigen

287

43.6

28 ,

가 62

90%

가

가 3.7%

2%

(commu-
nality)
coeffient)

(factor

(2)

0.5

0.5

(fence rider)

2003 가

2

2) 2

1

(1)

1

2

. 2

1

, 1

, 2

가

57

가

5

가

, 336

2

16 3 2004
가 48 가
156 48
132 288
가 2 1
70% 30
40 77%가 (varimax)
60%
5-15 가 50% 3 set
set
10 가
20% 80%
가 10 5 50% set
1 43%
58%, 30%
3
가 80.5%
5.4%,
12.5%가 1
(2)
2
1 2
가
가
2 1
18 3
11 2
5
가
가
(3)
SPSS 11.1
. 2

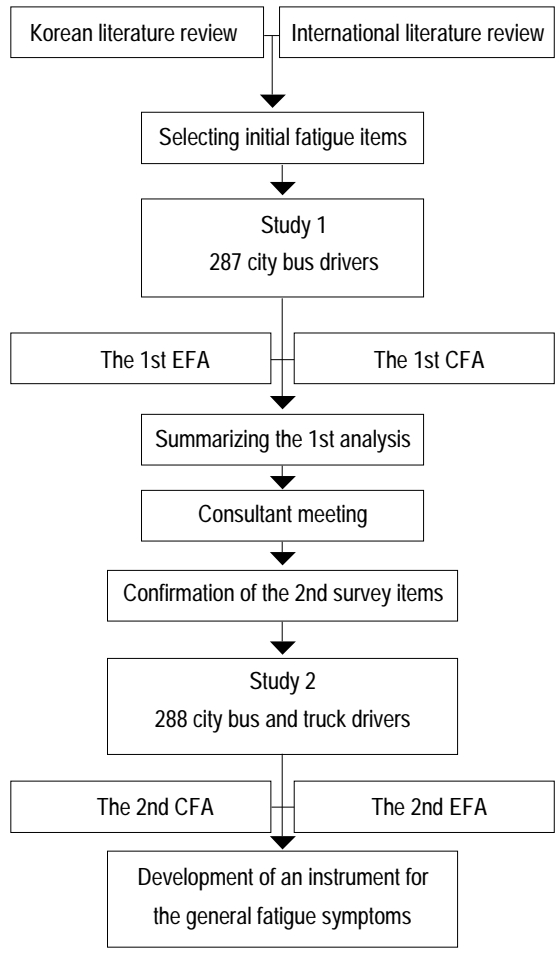


Fig. 1. The research process of this study

1. 1
1) 57
가 (weight) 39 4 14
3 data set 0.5 가 60% 0.5 1 1.0 14 가
가 1 4 (Table 2). 1 6:4 , 6 , 4 , 16 4
16 , 2
0.6

Table 2. Communalities and factor coefficients of the selected general fatigue items (14 items) in the final exploratory factor analysis of Study 1

Items	Communalities	Factor1	Factor2	Factor3	Factor4
1. I have pain in shoulder and neck	0.676				0.731
2. I have muscle pain	0.745				0.757
3. I have pain in leg and foot	0.658				0.741
4. I am active in everything	0.770			0.812	
5. I feel like doing all kinds of nice things	0.770			0.869	
6. I do work quite a lot within a day	0.666			0.788	
7. I am easily depressed	0.670		0.739		
8. I have trouble concentrating	0.710		0.780		
9. I easily forget something	0.746		0.826		
10. I often make mistakes	0.659		0.752		
11. I do not feel fresh after sleeping	0.700	0.799			
12. Physical tiredness lasts longer than a day	0.700	0.785			
13. I have unexplained severe fatigue	0.747	0.744			
14. I feel exhausted	0.681	0.736			
Eigen values		5.471	1.927	1.368	1.024

가
가
14 1 가 10 , 2 (Table 3).
가 1 6:4
4 , 6 , 2 , 10 ,
1 4 , 2 4 4
, 3 3 , 4 3 .
1 10
2 , 3 1 가
, 4 .
2, 3, 4 .
1 5
, 1
, 2
가
2)
25 가
, 15 2
10 . 2.
60%
0.5 1 , ,

Table 3. Communalities and factor coefficients of the selected driving fatigue items (10 items) in the final exploratory factor analysis of Study 1

Item	Communalities	Factor1	Factor2
1. I have low back pain	.593	.768	
2. I have pain in legs	.736	.847	
3. I have pain in foot	.595	.535	
4. I have pain in joints	.614	.720	
5. I have muscle pain	.591	.691	
6. I frequently hesitate in difficult situations	.536		.502
7. It is difficult to concentrate	.540		.662
8. It is hard to carefully observe traffic signs and signals	.699		.836
9. I make technical mistakes in driving operations	.754		.843
10. I am not comfortable to move fast	.668		.718
Eigen values		4.703	1.324

가 , 3 , 3
 4가 , 1) , 가
 , 2) , 3) 가 ,
 , 4) 3 가
 4가 가 (response
 bias)가 가
 , 1 , 1 , 가
 , 1 , 1 , 가
 , 2 1 1 , 1
 , 2 2 3
 , 3.2 , 1) 6
 18 , 4 가 11 2 2
 2 1 가 11 2 6
 , 2 3 2 11
 가 1 가 2
 1:1 6 data set
 3
 Eigen value 1.0
 가 가 11 0.6
 , 1 , 4 가 Table 4 2

가
 3 1
 5 2 2
 가 7 11 가 가
 . 1 ,
 3 1 11
 2 (internal reliability)
 가 Cronbach's .902
 2 .867,
 . 2 .816, .854
 2
 Table 5 2)
 11 2
 11 0.6 4
 0.7 2 10
 3
 , , 5 , 4 data set
 3 , 3

Table 4. The process of item selection and factor analysis for general fatigue symptoms in Study 2

Data set No.	Sample size of EFA:CFA	Exploratory factor analysis (EFA)		Confirmatory factor analysis (CFA)	
		Item # problematic in communalities	Item # problematic in factor coefficient	Item # problematic in communalities	Item # problematic in factor coefficient
1	1:1	5, 8, 10, 12, 14	5, 8, 14, 17	6, 7, 8, 14, 17	6, 7, 8, 14, 17
2	1:1	1, 6, 7, 17	7, 9, 10, 14, 17	8, 14, 17	2, 5, 8, 9, 10, 11, 14, 17
3	1:1	8, 17	2, 5, 8, 11, 14, 17	6, 7, 14, 17	6, 7, 8, 14, 17
The 1st item deletion		6, 7, 8, 14, 17 (5 items)			
4	1:1	5	2		11
5	1:1	1, 5		2, 5	
The 2nd item deletion		2, 5 (2 items)			
6	Total sample	NA	NA	confirmed	confirmed

* NA : not applicable

0.7

Eigen value 1.0 2

10

가 5

0.595 0.6 5 가

0.595 0.6 Eigen value가

가

Table 6

2 가 가

가

1 10 1 10

11 (internal reliability)

가 Cronbach's .924

3 가

11 Cronbach's 가 .909, Cronbach's

, 10 가 .893

가

Table 7

10

11 0.6 가

Table 5. Communalities and factor coefficients of the general fatigue items in the final confirmatory factor analysis in Study 2

Item	Cronbach 's	Communalities	Factor1	Factor2	Factor3
1. I do not want to say anything		.615			.718
2. I feel angry	.816	.813			.867
3. I am easily irritated		.795			.846
4. I have unexplained severe fatigue		.716		.726	
5. Physical tiredness lasts longer than a day	.854	.799		.833	
6. I do not feel fresh after sleeping		.781		.794	
7. I have pain in shoulder and neck		.728	.706		
8. I have uncomfortable throat		.644	.691		
9. I have low back pain	.867	.675	.794		
10. I have pain in leg joints (knee)		.695	.796		
11. I have muscle pain		.616	.715		
Eigen values			4.911	1.105	1.002

(1995)

, Nelson(1997)

가

Table 6. The process of item selection and factor analysis for driving fatigue symptoms in Study 2

Data set No.	Sample size of EFA:CFA	Exploratory factor analysis (EFA)		Confirmatory factor analysis (CFA)	
		Item # problematic in communalities	Item # problematic in factor coefficient	Item # problematic in communalities	Item # problematic in factor coefficient
1	1:1		11		11
2	1:1		11		5, 11
3	1:1		11		8, 11
The 1st item deletion			11 (1 item)		
4	Total sample	NA	NA	confirmed	confirmed

* NA: not applicable

Table 7. Communalities and factor coefficients of the driving fatigue items in the final confirmatory factor analysis in Study 2

Item	Cronbach 's	Communality	Factor1	Factor2
1. I am not comfortable to move fast		.761	.813	
2. I frequently hesitate in difficult situations		.842	.891	
3. It is difficult to concentrate	.909	.804	.854	
4. I make technical mistakes in driving operations		.700	.790	
5. It is hard to carefully observe traffic signs and signals		.595	.709	
6. I have pain in legs		.736		.807
7. I have pain in foot		.741		.811
8. I have muscle pain	.893	.674		.704
9. I have pain in joints		.766		.794
10. I have low back pain		.618		.745
Eigen values			4.110	1.001

Hancock Desmond(2001)가

, Matthews Desmond(1997)

. Hancock Desmond(2001) 가

가

,
(, ,)
(,)

30

Rosekind (1996)

10가

가

. , Hancock Desmond(2001)

가가

가

가

가

가

(Park, 1995; Mitler Miller, 1996).

(Yoshitake, 1971)

가

11 가

가

, 7

4

가

3

2

가 가

4

1 가 .

3. 2

(well-being)

156

132

288

6

11

3

:

4

10

2

, 1

287

가

가

1

, 2

288

2

2

가

가

. VDT

가

1995;3:158-77.

1. 1

1993.

4

17

2

1998; 10(1):105-15.

10

2. 1

, 14

2002;177-80.

300

1999. 가
- 1989.
- 1999.
- 1998.
- 1991.
- 1998;10(2):214-26.
- 1996;24(4):868-77.
- 1995;7(2): 270-8.
- 1997.
- 2000.
- 1997;9(1): 26-39.
- 2002.
- 1999, pp. 10-11.
- Ax S, Gregg V, Jones D. Chronic fatigue syndrome: Illness attributions and perceptions of control. *Homeostasis*. 1998;39:44-51.
- Ax S, Gregg V, Jones D. Coping and illness cognitions: Chronic fatigue syndrome. *Clin Psychol Rev* 2001;21:161-82.
- Beurskens AJ, Bultmann U, Kant I, Vercoulen JH, Bleijenberg G, Swaen GM. Fatigue among working people: validity of a questionnaire measure. *Occup Environ Med* 2000;57:353-7.
- Brown ID. Prospects for technologic countermeasures against driver fatigue. *Accid Anal Prev* 1997;29(4):525-31.
- Buysse D. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. *Psychiatry Res* 1989;28:193-213.
- Carskadon M, Dement WC. Daytime sleepiness: quantification of behavioral state. *Neurosci Biobehav Rev* 1987;11:307-17.
- Cohen J, Cohen P. Applied multiple regression/correlation analysis for the behavioral sciences. (2 ed.) Hillsdale, NJ: Lawrence Erlbaum 1983.
- Fuhrer R, Wessely S. The epidemiology of fatigue and depression: A French primary care study. *Psychol Med* 1995;25:895-905.
- Fukuda K, Straus S, Hickie I, Sharpe M, Dobbins J, Komaroff A. The chronic fatigue syndrome: A comprehensive approach to its definition and study. *Ann Intern Med* 1994; 121:959.
- Fuller N, Morrison R. Chronic fatigue syndrome: Helping patients cope with this enigmatic illness. *Postgrad Med* 1998;103:175.
- Hancock D, Desmond E. Stress, workload, and fatigue. Mahwah: New Jersey, Lawrence Erlbaum Publishers 2001. 455-76.
- Hart KH, Freel MI, Milde FK. Fatigue. *Nurs Clin North Am* 1990;25(4):967-76.
- Horne J, Reyner L. Sleep related vehicle accidents. *Br Med* 1995;310:565-7.
- Johns MW. A new method of measuring daytime sleepiness: the Epworth Sleepiness Scale. *Sleep* 1991;14:540-5.
- Matthews G, Desmond PA. Personality and multiple dimensions of task-induced fatigue: A study of simulated driving. *Pers Individ Dif* 1998;25:443-58.
- Maycock GA. Sleepiness and driving: the experience of UK car drivers. *J Sleep Res* 1995;220(5) :220-37.
- Maycock GA. Sleepiness and driving: The experience of U.K. car drivers. *Accid Anal Prev* 1997; 29(4):453-62.
- McCartt A. The scope and nature of the drowsy driving problem in the New York state. *Accid Anal Prev* 1996;28 (4):511-7.
- Milosevic S. Drivers' fatigue studies. *Ergonomics* 1997;40(3):381-9.
- Mitler M, Miller J. Methods of testing for sleeplessness. *Behav Med* 1996;21:171-83.
- Nisenbaum R, Reyes M, Mawle, AC, Reeves WC. Factor analysis of unexplained severe fatigue and interrelated symptoms. *Am J Epidemiology* 1998;148(1):72-7.
- Nelson TM. Fatigue and hazardous environment. *Accid Anal Prev* 1997;29(4):489-502.
- NHTSA. Effects of Sleep Schedules on Commercial Motor Vehicle Driver Performance 2000.
- NHTSA. A Motor Carrier's Guide to Improving Highway Safety 2001.
- Nilsson T, Nelson TM, Carlson D. Development of fatigue symptoms during simulated driving.

Accid Anal Prev 1997;29(4):479-88.
 Park A. Characteristics of crashes attributed to the driver having fallen asleep. *Accid Anal Prev* 1995;27(6):769-75.
 Rosekind MR, Gander PH, Gregory KB, Smith RM, Miller DL, et al. Managing fatigue in operational settings 1: Physiological considerations and countermeasures. *Behav Med* 1996;21:157-65.
 Surawy C, Hackmann A, Hawton K, Sharpe M.

Acyclovir treatment of the chronic fatigue syndrome. *Behav Res Ther* 1995;33:535-44.
 Yoshitake H. Relations between the symptoms of fatigue and the feeling of fatigue. *Ergonomics* 1971;14:175-86.
 Wessley S. The epidemiology of chronic fatigue syndrome. *Epidemiol Rev* 1995;13(1):139-51.
 WHO. World report on road traffic injury prevention. Switzerland: WHO/The World Bank 2004.

< >

1. 11

	1. 가 .
	2. .
	3. 가
	4.
	5.
	6. .
	7. 가 .
	8. .
	9. 가 .
	10. 가 .
	11. .

2. 10

	1. .
	2. .
	3. .
	4.
	5. 가 .
	6. 가 .
	7. .
	8. .
	9. .
	10. 가 .
