Research Article
Volume 7:4, 2020
DOI: 10.37421/ijn.2020.7.366

International Journal of Neurorehabilitation

ISSN: 2376-0281 Open Access

Use of the National Agency for Automotive Safety and Victims' Aid Score Original (NASVA score-O) as an Evaluative Measure for Patients in an Unresponsive Wakefulness State

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Abstract

Objective: The National Agency for Automotive Safety and Victims' Aid score original (NASVA score-O) is an evaluative assessment for patients in an unresponsive wakefulness state (UWS). The objective was to examine the difficulty of each sub-item of the NASVA score-O and its suitability for the assessment of patients in a UWS.

Methods: The participants were 134 patients in a UWS (96 men, 38 women; age range at admission, 9-83 years). The scaled NASVA score-O, an outfit mean square (MNSQ), and an infit MNSQ for each sub-item using Rasch modeling were calculated. The 48 sub-items were arranged in order of the score of the item measures, and a difficulty map was created. The suitability of the 48 sub-items was analyzed using the outfit and the infit MNSQs.

Results: Ten sub-items were classified as misfits, and the item measure of five sub-items was -5.1 points.

Conclusions: Medical staff and family members may be able to set suitable short-term goals and adapt caregiving methods to the recovery process using the difficulty map. It is necessary to remove 10 misfit sub-items, modify the questions, or create an interpretation manual and to reanalyze it without the five sub-items with negative points.

Keywords: Difficulty map • Evaluative measure • Unresponsive wakefulness state • Rasch analysis • Recovery process

Introduction

A traumatic brain injury (TBI) due to motor vehicle accidents can cause an unresponsive wakefulness state (UWS). Higashi et al. reported that in 41% of patients with a UWS, a TBI was the causative factor [1]. Similarly, a survey in the Netherlands reported that, in 45% of patients in a UWS, a TBI was the causative factor [2]. Progress in acute medical care has resulted in a higher incidence of survival of patients with a TBI. Coronado et al. reported that the annual mortality rates of motor vehicle-related TBI decreased significantly among vehicle occupants from 3.7 to 2.0 per 100,000 population between 1997 and 2007 [3]. Though there have been medical advances for patients in a UWS, whether they are effective remains unclear. An evaluative measure that monitors the recovery process and examines the effectiveness of treatments in patients in a UWS is therefore needed [4].

Several scales have been developed to assess the level of consciousness. The Glasgow coma scale (GCS) and the Japan Coma Scale (JCS) are widely used to assess the level of consciousness and coma in Japan [5,6]. These scales are used to classify the severity of acute consciousness disorder and determine how to treat it. The JFK Coma Recovery Scale-Revised (CRS-R) is intended for diagnosis, rehabilitation and longer-term planning, and monitoring of patient progress and treatment effectiveness. However, the CRS-R was established to discriminate patients in a minimally conscious state from those in a vegetative state [7]. Thus, no suitable evaluative measure that monitors the recovery process of patients in a UWS and examines the effectiveness of treatments is currently available.

The National Agency for Automotive Safety and Victims' Aid (NASVA) score original (score-O) is an evaluative assessment developed for patients in a UWS [8]. The score has been used as a standard assessment in the centers since 2005 to diagnose the severity of the UWS and to predict prognosis [8-11]. The NASVA score-O might be able to detect changes in symptoms of patients in a UWS. However, the degree of difficulty of each sub-item in the NASVA score-O is not clear. The objective of this study was to examine the difficulty of each sub-item on the NASVA score-O and its suitability for the assessment of patients in a UWS.

Methods

This was a retrospective, multicenter study conducted to examine a new concept of the NASVA score-O as an evaluative measure. The Medical Ethics Committee of Kizawa Memorial Hospital (29-020) and Kohnan Hospital approved this study, and it was carried out in accordance with the Declaration of Helsinki (as revised in Brazil, 2013).

Participants

The participants included 146 patients (104 men, 42 women; mean ± standard deviation (SD) age at admission, 37.3 ± 19.9 years; age range at admission, 9–83 years) who were admitted to one of three Medical Centers for Prolonged Traumatic Brain Dysfunction between June 2012 and June 2014. These centers are run by the NASVA for patients in a UWS due to motor vehicle accidents. Hospitalization criteria of the centers included: 1) diagnosis of a UWS due to a motor vehicle accident, and 2) requirement for treatment and nursing at all times [8-11]. Participants with missing scores for any NASVA sub-items were excluded.

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Received 13 April, 2020; **Accepted** 04 May, 2020; **Published** 11 May, 2020

Outcome measures

The NASVA score-O is an evaluative measure developed for patients in a UWS based on the definition of the UWS provided by the Japan Neurosurgical Society [10]. The score includes multiple responses to 6 items: motor response (I), ingestion (II), fecal/urinary function (III), visual recognition (IV), vocalization/utterance (V), and response to call/oral commands (VI). Each unit consists of 1 to 3 sub-items, each of which is assigned a point value indicating severity: 10 points, very severe (10); 9 points, severe (9); 7 points, moderate (7); 5 points, mild (5); 0 points, very mild (0). There are 48 sub-items, and total scores range from 0 to 60, with lower scores representing a better level of consciousness (Table 1) [8]. In this study, the raw score (RS) that was evaluated using binary scores, as either the participant performs each sub-item or not, was used, and the 48 sub-items were totalled.

Statistical analysis

Mean ± SD values were used for descriptive statistics, and absolute numbers and percentages were used for categorical variables. The following values were calculated using Rasch modeling: 1) a scaled score (SS) of the NASVA score-O; 2) an item measure for each sub-item; 3) an outfit mean square (MNSQ) for each sub-item; and 4) an infit MNSQ for each sub-item. First, the 48 sub-items were arranged according to the score order of the item measures, and a difficulty map for the NASVA score-O was created. The range of item measures was from 0 to 100, and a higher score indicated higher difficulty. Second, the outfit and infit statistics were used to examine whether each of the 48 sub-items fit the recovery process of patients in a UWS [11]. The outfit MNSQ is sensitive to unexpected behavior by persons on items far from the person's proficiency level; the infit MNSQ is sensitive to unexpected behavior affecting responses to items near the person's proficiency measure. In this study, sub-items with an outfit or infit MNSQ >1.5 points were considered poor-fitting [12,13]. Rasch modeling was conducted using Winsteps (ver. 3.62.1, Linacure JM, Winsteps Com., Chicago, IL, USA).

Illustrative case: A 44-year-old man

This patient was brought to an emergency hospital after a motor vehicle accident. On that occasion, his GCS score was 4/15 points (eye-opening (E) 1–verbal performance (V) 1–motor responsiveness (M) 2), and findings included anisocoria and loss of light reflex. A right acute subdural hematoma and diffuse brain swelling were confirmed by computed tomography (CT), and he underwent burr-hole evacuation to remove the subdural hematoma (Figure 1A).

He was transferred to the Medical Center for Prolonged Traumatic Brain Dysfunction to continue treatment on the 354th day after the accident. He was diagnosed with TBI and a UWS at admission to the center. Figure 1B shows the CT scan of his head at admission. He had spastic quadriplegia, and his comorbidities were symptomatic epilepsy and hydrocephalus treated with a shunt. He had his final assessment on the 1003rd day after admission.

Results

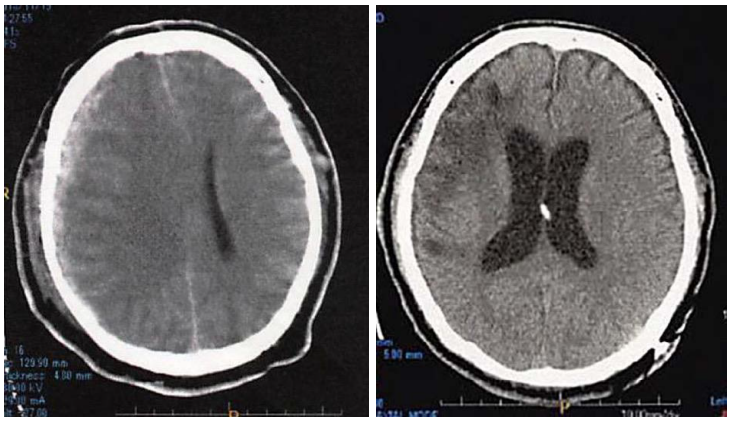
Based on the inclusion criteria, 134 patients in a UWS were included in this analysis; 12 patients who had missing data for the NASVA sub-scores were excluded. The mean age of participants at the time of the accident was 37.0 ± 20.2 years, the age range at the time of the accident was 9–80 years, and the mean time from the accident to admission to the center was 307.5 ± 284.6 days. Table 2 shows participants' characteristics at admission.

Table 3 shows the SS for the NASVA score-O that was translated from the RS. The RS range was 0–48, and the SS range was 0–100, with higher scores representing a better level of consciousness. The SS was not calculated when the RS values were ≥ 44 points, because the analysis software "Winsteps" has a built-in function that automatically removes extreme values.

Table 4 shows the item measure and the outfit and infit MNSQ values of each sub-item. The item measure indicated the difficulty degree of each subitem. The usual range was 0–100, but 5 sub-items (I-10, II-10, III-10, IV-10, and VI-10) had calculated values lower than 0, and the outfit and infit MNSQ values were the estimated minimum measure. The 48 sub-items were arranged according to the score order of the item measures, and a difficulty map for the NASVA score-O was created (Figure 2). The range of the difficulty degree was -5.1 to 91.6, and V-0-B was the most difficult sub-item for patients in a UWS.

Table 1. The national agency for automative safety and victims aid score original (NASVA Score-0).

Severity of disturbance (Point)	Very severe (10)	Severe (9)	Moderate (7)	Mild (5)	Very mild (0)
Motor Response	Neither motor response to pain not spontaneous movement	Reflex to pain or aimless spontanoues movement	Withdrawal from pain or aimful voluntary movement without any command-obeying	Partial/occasional aimful voluntary movement with command-obeying	Body rotation on bed or driving of wheel chair
Ingestion	No oral ingestion (neither mastication nor swallowing complete tube feeding)	A. Mostly tube feeding B. Mastication or saliva swallowing. C. Occasional oral ingestion of juices or puddings	A. Mastication or most swallowing (no mastication) and occassional choking even if caregivers help with ingestion. B. Oral ingestion (requires occassional tube feeding)	A. Independent swallowing (Inadequate mastication). B. Oral ingestion with help (requires modified diets). C. Brings food to mouth partially.	Partial independent oral ingestion using spoon
Fecal/Urinary function	Complete incontinence without any movements/signs for defecation/urination	Complete incontinence with occassional obscure movement/signs for defecation/urination	Incontinence with consistent movements/signs for defecation/urination	A. Continence by regular defecation/urination. B. Occassional incontinence with consistent movement/signs for defecation/urination.	Continence except for night
Visual recognition	Eye opening without blink reflex	A. Eye opening with blink reflex. B. No eye-tracking and no focus.	A. Face rotation to voice stimuli. B. Eye tracking to moving stimuli, and gaze at TV without understanding contents.	A. Change of facial expression when recognizing faces of family and friends. B. Change of facial expression when watch favourite pictures.	A. Reading simple words. B. Understanding figures. C. Watching TV and laughing.
Vocalization/Utterance	A. No vocalization/utterance. B. No mouth movement if intubated	A. Groan/Maon, but no words. B. Aimless mouth movement if intubated.	A. Incomprehensible words. B. Occassional inappropriate reply to call. C. Reply using mouth movement to call, if intubated	A. Occassional inappropriate words. B. Reply to call name. C. Imitational mouth movement if intubated.	A. Appropriate words for question. B. Appropriate mouth movement for question if intubated.
Response to call/oral commands	No response to call	Aimless spontaneous movement to call	Occasional aimful voluntary movement to call, but no command obeying	Occasional command-obeying	Complete command-obeying



(A) (B)

Figure 1. Computed tomography (CT) scan of the head of the illustrative case. (A) at the accident. (B) at admission to the medical center for prolonged traumatic brain dysfunction.

(A) A right acute subdural hematoma is confirmed by CT, right-to-left midline shift is prominent due to contusion, and the right lateral ventricle is crushed. This image is not clear because of motion artifacts. (B) The subdural hematoma and cerebral edema have disappeared, but acute brain contusion remains. Brain atrophy has been progressing, and the ventricles have been expanding. The high absorption area in the center is a shunt used for the treatment of hydrocephalus.

Table 2. Characteristics of participants in an unresponsive wakefulness state at admission (n=134).

Characteristics	(n=134)
Age, y, mean ± SD (range)	37.9 ± 20.3 (9 - 83)
Sex, n (%)	
Male	96 (71.6)
Female	38 (28.4)
Diagnosis, n (%)	
Traumatic brain injury	126 (94.0)
Hypoxic encephalopathy	3 (2.2)
Traumatic occlusive cerebrovascular disease	1 (0.7)
Traumatic brain injury and hypoxic encephalopathy	4 (3.0)
Paralysis, n (%)	
Yes	132 (98.5)
No	2 (1.5)
Comorbidities, n (%)	
Symptomatic epilepsy	50 (37.3)
Hydrocephalus with a shunt	11 (8.2)
Hydrocephalus without a shunt	4 (3.0)
Symptomatic epilepsy and hydrocephalus with a shunt	20 (14.9)
Symptomatic epilepsy and hydrocephalus without a shunt	1 (0.7)
Subdural hygroma	1 (0.7)
Paroxysmal supraventricular tachycardia	1 (0.7)
Stroke	1 (0.7)
None	45 (33.6)
NASVA score-O, /60 points, mean ± SD	46.4 ± 15.2

Table 3. The scaled scores for the NASVA score-O.

RS (Points)	SS (Points)	SE	RS (Points)	SS (Points)	SE	RS (Points)	SS (Points)	SE
0	0.0E	11.6	15	47.4	2.9	30	67.2	2.8
1	8.8	7.0	16	48.9	2.9	31	68.5	2.8
2	15.2	5.6	17	50.3	2.9	32	69.8	2.9
3	19.7	5.0	18	51.6	2.9	33	71.2	2.9
4	23.6	4.7	19	53.0	2.8	34	72.6	2.9
5	27.0	4.4	20	54.3	2.8	35	74.1	3.0
6	30.1	4.2	21	55.6	2.8	36	75.6	3.1
7	32.9	3.9	22	56.9	2.8	37	77.3	3.2
8	35.3	3.7	23	58.2	2.8	38	79.1	3.4
9	37.5	3.5	24	59.5	2.8	39	81.2	3.7

10	39.4	3.4	25	60.7	2.8	40	83.7	4.1
11	41.2	3.2	26	62.0	2.8	41	87.0	4.8
12	42.9	3.1	27	63.3	2.8	42	92.1	6.5
13	44.5	3.1	28	64.6	2.8	43	100.0E	11.3
14	46.0	3.0	29	65.9	2.8			

Note: NAVSA score-O, National Agency for Automotive Safety and Victims' Aid score original; RS, the raw score was the total value of 48 sub-items that were evaluated using binary scores as either a participant performs it or not. The range of the RS was 0-48 with a higher score representing a better level of consciousness; SS, the scaled score; SE, standard error, the analysis software "Winsteps" has a built-in function that automatically removes extreme values, the SS was not calculated when the RS values were ≥ 44 points.

Table 4. The item measure and the outfit and the infit MNSQ values for each sub-item of the NASVA score-O.

Sub-item	Item measure (Difficulty degree)	Outfit MNSQ	Infit MNSQ
I-10	-5.1	Minimum estimated measure	
I-9	14.3	2.30	1.03
I-7	38.4	0.40	0.82
I-5	44.6	0.23	0.60
I-0	60.2	0.53	0.96
II-10	-5.1	Minimum estimated measure	
II-9-A	31.3	2.80	1.90
II-9-B	35.4	3.66	2.31
II-9-C	40.8	1.95	1.74
II-7-A	53.8	1.40	1.05
II-7-B	57.7	0.32	0.73
II-5-B	59.3	0.23	0.66
II-5-A	60.2	0.42	0.88
II-5-C	63.4	0.23	0.66
II-0	65.0	0.28	0.78
III-10	-5.1	Minimum estimated measure	
III-9	40.2	2.43	1.37
III-7	53.0	0.86	1.50
III-5-A	69.6	1.29	1.67
III-5-B	71.1	1.71	1.58
III-0	83.7	0.35	0.73
IV-10	-5.1	Minimum estimated measure	
IV-9-A	18.4	0.27	0.81
IV-(9)-B	27.2	0.43	0.81
IV-7-A	34.2	0.27	0.55
IV-7-B	36.6	0.23	0.50
IV-5-A	42.7	0.46	0.63
IV-5-B	48.6	0.53	1.06
IV-0-A	57.7	0.22	0.65
IV-0-B	61.0	0.51	0.99
IV-0-C	70.4	2.61	1.92
V-10-A	14.3	0.37	1.06
V-10-B	19.2	2.39	1.19
V-9-A	40.2	0.55	0.97
V-9-B	46.6	0.73	1.30
V-7-A	54.5	0.23	0.60
V-7-B	54.5	0.23	0.60
V-7-C	54.5	0.23	0.60
V-5-C	56.9	0.19	0.56
V-5-B	57.7	0.20	0.57
V-5-A	58.5	0.50	0.72
V-0-A	61.8	0.28	0.54
V-0-B	91.6	3.06	1.42
VI-10	-5.1	Minimum estimated measure	
VI-9	24.2	0.26	0.69
VI-7	37.2	0.22	0.47
VI-5	43.3	0.29	0.68
VI-0	65.0	0.68	1.05

NAVSA score-O, National Agency for Automotive Safety and Victims' Aid score original; MNSQ, mean square.

The following 10 sub-items were classified as misfits for the recovery process of patients in a UWS: II-9-B (outfit MNSQ: 3.66, infit MNSQ: 2.31), V-0-B (3.06, 1.42), II-9-A (2.80, 1.90), IV-0-C (2.61, 1.92), III-9 (2.43, 1.37), V-10-B (2.39, 1.19), I-9 (2.30, 1.03), II-9-C (1.95, 1.74), III-5-B (1.71, 1.58), and III-5-A (1.29, 1.67). The item measures of the following 5 sub-items were -5.1 points: I-10, II-10, III-10, IV-10, and VI-10 (Table 4).

Illustrative case: A 44-year-old man (continued)

His performance and scaled score are shown on the difficulty map (Figures 3 and 4). At admission, he could perform 26 of 48 sub-items on the NASVA. His NASVA score-O was 42 points, and his scaled score was 62.0 points (Figure 3). At the final assessment, he could perform 42 of 48 sub-items, his

Figure 2. The difficulty map of the NASVA score-O. The abbreviations for each sub-item are shown in Table 1. NAVSA score-O, National Agency for Automotive Safety and Victims' Aid score original.

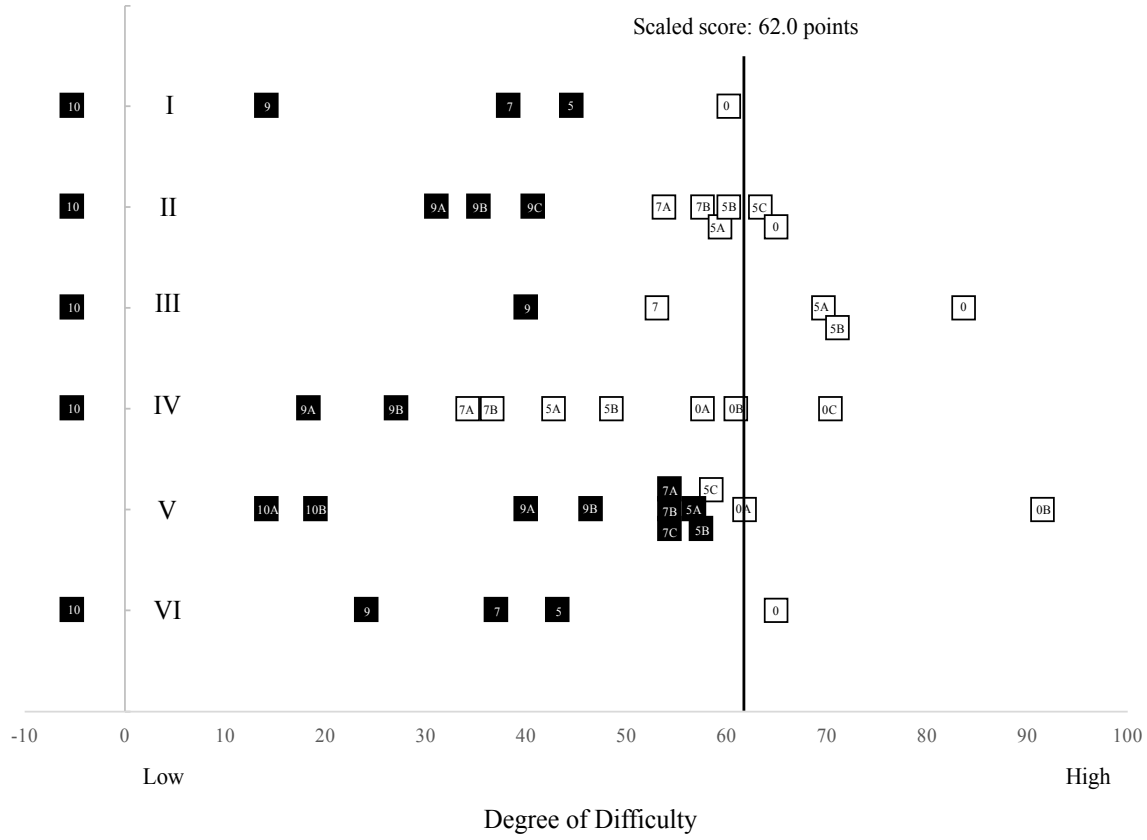


Figure 3. The difficulty map of the NASVA score-O of the illustrative case at admission. His scaled score is 62.0 points, ■: able to perform item, □: unable to perform item. The abbreviations for each sub-item are shown in Table 1. NAVSA score-O, National Agency for Automotive Safety and Victims' Aid score original.

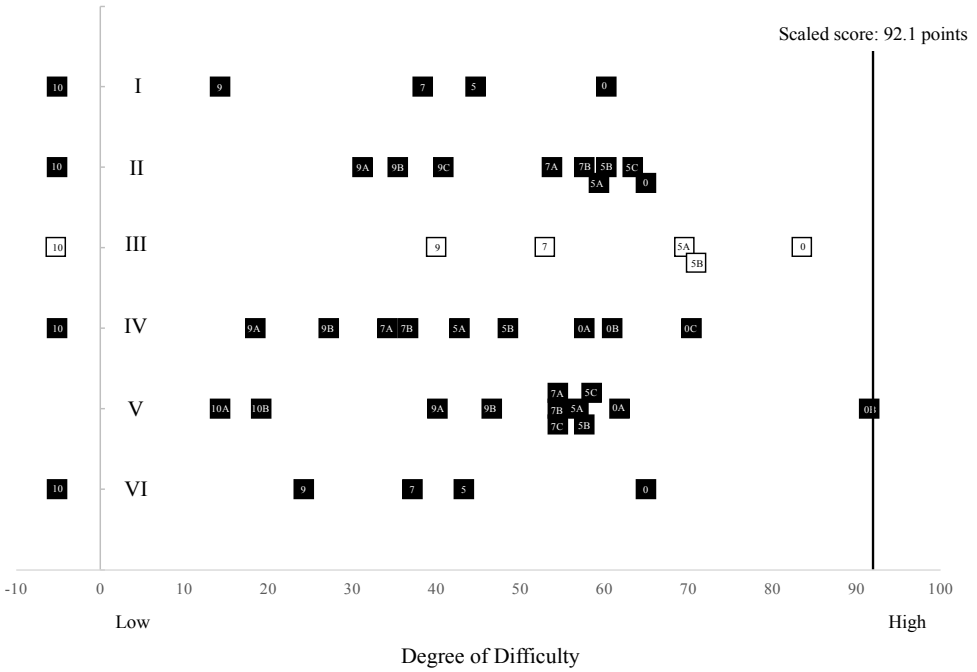


Figure 4. Difficulty map of the NASVA score-O of the illustrative case at the final assessment. His scaled score is 92.1 points, ■: able to perform item, □: unable to perform item. The abbreviations for each sub-item are shown in Table 1. NAVSA score-O, National Agency for Automotive Safety and Victims' Aid score original.

NASVA score-O was 10 points, and his scaled score was 92.1 points (Figure 4). The change in his NASVA score-O from admission to the final assessment was -32.0 points, and the change in his scaled score was 30.1 points.

Discussion

The difficulty of each sub-item of the NASVA score-O and its suitability to the assessment concept of this score were examined. The 48 sub-items were arranged according to the score of the item measures, and a difficulty map for the NASVA score-O was created. Because the performance of patients with UWS and their scaled scores could be shown on the map, it might be possible to monitor their recovery process and examine the effectiveness of treatment using the map.

The scaled score of an illustrative case and his performance on the difficulty map are shown in (Figures 3 and 4). His scaled score was 62.0 points at admission, and thus he might be able to perform sub-items with a difficulty score ≤ 62.0 points. Sub-items with a difficulty score ≤ 62.0 points that he could not perform might be suitable actions to set as short-term goals for rehabilitation at admission. Furthermore, it was suggested that sub-items with a difficulty score slightly higher than 62.0 points might be suitable for short-term goals as well. At the final assessment, his scaled score improved 30.1 points to reach 92.1 points, and he could perform all sub-items except for faecal/urinary function. The area of the brain responsible for this function might have been severely damaged by the accident; thus, improving this function should not be an aim, but other functions should be chosen for the next short-term goal. By using the difficulty map, medical staff and family members may be able to determine suitable short-term goals and offer specific adaptive care to improve the recovery process.

Ten sub-items were misfits in the NASVA score-O because their outfit or infit MNSQ values were -1.5 points [12]. The outfit MNSQ becomes higher when there are many outliers in the population [12,13]. The infit MNSQ becomes higher when the achievement rate is low for subjects with high ability, or the achievement rate is high for subjects with low ability [12,13]. In II-9-B "mastication or saliva swallowing" (3.66, 2.31), it might be difficult to assess these items. For instance, an evaluation may indicate that the subject swallowed, when in fact it was an involuntary laryngeal movement. Furthermore, it might not be suitable to assess this concept of the NASVA score-O, because its outfit value was high. In V-0-B "appropriate mouth movement for question if intubated" (3.06, 1.42), it was unclear whether the mouth movement was appropriate for the question or not. In II-9-A "mostly tube feeding" (2.80, 1.90), III-9 "complete incontinence with occasional obscure movement/signs for defecation/urination" (2.43, 1.37), and II-9-C "occasional oral ingestion of juices or puddings" (1.95, 1.74), the results might depend on the interpretation of the tester, because the sub-items included vague expressions such as "mostly" or "occasionally." In IV-0-C "watching TV and laughing" (2.61, 1.92), it was unclear whether the subject understood the content and laughed. In V-10-B "no mouth movement if intubated" (2.39, 1.19), there was room for interpretation of mouth movement. Item I-9 "reflex to pain or aimless spontaneous movement" (2.30, 1.03) two conditions were listed, so it was ambiguous whether a subject had to fulfill one or both conditions. In III-5-B "occasional incontinence with consistent movement/signs for defecation/urination" (1.71, 1.58) and III-5-A "continence by regular defecation/urination" (1.29, 1.67), it was unclear whether a subject really performed these functions. Thus, it is necessary to remove, modify, or create an interpretation manual for these 10 sub-items of the NASVA score-O. The NASVA score-O might then become a more suitable evaluative measure for patients in a UWS.

Furthermore, five sub-items had negative values. Because the degree of difficulty ranged from 0 to 100, the range of the item measure must be the same [12,13]. These sub-items might not be adaptable to the recovery process of patients in a UWS. Future studies need to re-analyze the NASVA score-O without these five sub-items.

The major strengths of this study were the multi-institutional joint research collaboration and the use of the NASVA score-O, a standard assessment used in the centers since 2005 to diagnose the severity of the UWS and to predict prognosis. However, this study has several limitations. First, participants only included patients in a UWS who were admitted to one of three Medical Centers for Prolonged Traumatic Brain Dysfunction. Therefore, these findings cannot be generalized to other patients in a UWS. Second, the findings were not reanalyzed without the five items with measure values of negative points or by using a modified NASVA score-O excluding the 10 misfit items. Additional studies are therefore needed before the NASVA score-O can be used as an evaluative measure to monitor the recovery process of patients in a UWS and to examine the effectiveness of treatment.

Conclusions

The 48 sub-items were arranged according to the score of the item measures, and a difficulty map for the NASVA score-O was created. Because the performance of patients in a UWS and their scaled scores could be determined using the map, medical staff and family members might be able to set suitable short-term goals and adapt caregiving methods to the recovery

process using the difficulty map. Furthermore, it is necessary to remove 10 misfit sub-items, modify the questions, or create an interpretation manual and to reanalyze it without the five sub-items with negative points. When the NASVA score-O is modified according to the above findings, it might become a suitable evaluative measure that monitors the recovery process of patients in UWS and examines the effectiveness of treatments.

Acknowledgments

This work was supported by JSPS KAKENHI Grant Number 18K10771.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Author Contributions

ET: study concept and design, interpretation of data, statistical analyses, drafting the article. **TT:** study concept and design, critical revision of the article for important intellectual content. **JS:** translation from the NASVA score-O Japanese version, data collection, critical revision of the article for important intellectual content. **YN and CH:** data collection, critical revision of the article for important intellectual content. **IK:** study concept and design, interpretation of data, statistical advice, and critical revision of the article for important intellectual content. Sponsor's role: the funding agencies did not have any role in the design of the study, execution of the interventions, analyses, interpretation of the data, or the decision to submit results.

References

1. Higashi, K, Sakata, Y, Hatano, M, and Abiko, S, et al. "Epidemiological studies on patients with a persistent vegetative state." *J Neurol Neurosurg Psychiatry* 40(1977):876-885.
2. Braakman, R, Minderhoud, JM, and Gelpke, GJ. "The prognosis of the vegetative state following severe brain injury." *Nederlands tijdschrift voor geneeskunde* 129(1985):2406-2409.
3. Coronado, VG, Xu, L, Basavaraju, SV, and McGuire, LC, et al. "Surveillance for traumatic brain injury-related deaths-United States, 1997-2007." *Morbidity and mortality weekly report Surveillance summaries* (Washington, DC: 2002) 60(2011):1-32.
4. Kirshner, B, and Guyatt, G. "A methodological framework for assessing health indices." *J Chronic Dis* 38(1985):27-36.
5. Teasdale, G, and Jennett, B. "Assessment of coma and impaired consciousness. A practical scale." *Lancet* (London, England) 2(1974):81-84.
6. Ohta, T, Waga, S, Handa, W, and Saito I, et al. "New grading of level of disordered consiousness (author's transl)." *No shinkei geka Neurological surgery* 2(1974):623-627.
7. Giacino, JT, Kalmar, K, and Whyte, J. "The JFK Coma Recovery Scale-Revised: measurement characteristics and diagnostic utility." *Arch Phys Med Rehabil* 85(2004):2020-2029.
8. Nobuo, Oka. "Role of the National Agency for Automotive Safety and Victims' Aid. Focused on the activity of four Ryogo Centers and two Affiliated Hospitals." *J Hokkaido Brain Res Foundation* 20(2010):15-22.
9. http://www.nasva.go.jp/sasaeru/ryougo.html
10. http://www.nasva.go.jp/sasaeru/pdf/pamphlet.pdf
11. Tetsuhito, Shizuka. "Rasch Modeling for Objective Measurement" Suita: Kansai University Press; 2007, pp: 165-166, 312-317.
12. http://www.winsteps.com/winman/table13_1.htm.
13. Johnson, AP. "Notes on a suggested index of item validity: The U-L index." *J Educ Psychol* 42(1951):499-504.

How to cite this article: Takano E, Teranishi T, Shinoda J, Nagamine Y, Honda C, Kondo I. "Use of the National Agency for Automotive Safety and Victims' Aid Score Original (NASVA score-O) as an Evaluative Measure for Patients in an Unresponsive Wakefulness State". Int J Neurorehabilitation Eng 7 (2020) doi: 10.37421/ijn.2020.7.366