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Compensation for Occupational Neurological and Mental Disorders

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Standards for the recognition of occupational diseases (ODs) in Korea were established in 1954 and have been amended several times. In 2013, there was a significant change in these standards. On the basis of scientific evidence and causality, the International Labour Organization list, European Commission schedule, and compensated cases in Korea were reviewed to revise the previous standards for the recognition of ODs in Korea. A disease-based approach using the International Classification of Diseases (10th version) was added on the previous standards, which were agent-specific approaches. The amended compensable occupational neurological disorders and occupational mental disorders (OMDs) in Korea are acute and chronic central nervous system (CNS) disorders, toxic neuropathy, peripheral neuropathy, manganese-related disorders, and post-traumatic stress disorder. Several agents including trichloroethylene (TCE), benzene, vinyl chloride, organotin, methyl bromide, and carbon monoxide (CO) were newly included as acute CNS disorders. TCE, lead, and mercury were newly included as chronic CNS disorders. Mercury, TCE, methyl n-butyl ketone, acrylamide, and arsenic were newly included in peripheral neuropathy. Post-traumatic stress disorders were newly included as the first OMD. This amendment makes the standard more comprehensive and practical. However, this amendment does not perfectly reflect the recent scientific progress and social concerns. Ongoing effort, research, and expert consensus are needed to improve the standard.

Keywords: Neurological; Mental; Psychiatric; Occupational; Compensation; Korea; Amendment; Standard; Criteria

INTRODUCTION

Neurological disorders are disorders of the central and peripheral nervous systems. Functional or structural abnormalities in the brain, spinal cord, or other nerves can cause these disorders. The World Health Organization (WHO) determined that neurological disorders affected about one billion people worldwide in 2006 (1). Although the central nervous system (CNS), which consists of the brain and the spinal cord, is protected by bones and a blood-brain barrier, it is very susceptible to physical and chemical damage. The peripheral nervous system (PNS) including neurons, the neural networks, and nerves is vulnerable to chemical and structural damage. The classification of neurological disorders is given in "Chapter VI: Diseases of the nervous system" of the International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10) by the WHO (2). Occupational neurological disorders (ONDs) can be defined as the neurological disorders that are caused or aggravated by occupational exposure including physical and chemical agents.

Mental disorders are defined by a combination of emotions, actions, thoughts, and perceptions. Although the standard criteria are widely used, the definition, assessment, and classification of mental disorders are still variable. Over a third of the people in most countries are estimated to meet the diagnostic criteria for mental disorders (3). The classification of the mental disorders is given in "Chapter V: Mental and behavioral disorders" of the ICD-10 by the WHO (2), and the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) (or DSM-V since May 2013) by the American Psychiatric Association. Occupational mental disorders (OMDs) can be defined by the mental disorders that are caused or aggravated by occupational exposure including physical agents, chemical agents, and psychological stressors.

The standards for the recognition of occupational diseases (ODs) were originally defined in the Established Rule of the Ministry of Labor (MOL). Then, the standards were moved to and called the Enforcement Rules of the Industrial Accident Compensation Insurance (ER-IACI) Act in 1994. Although the IACI Act was revised several times until 2008, there was not much change when compared to the first version of the ER-IACI Act. Because the standards were based on hazardous agents, clinicians excluding occupational physicians acquainted with disease nomenclature were not familiar with the occupational com-

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pensation system. Further, there were no psychiatric diseases in the list of diseases in the standards. These problems made Korean neurologists and psychiatrists feel that the occupational disease compensation was not their work area. The amendment of the Enforcement Decree of IACI Act (ED-IACIA) in 2013 introduced significant changes in the standards for the recognition of ODs including ONDs and OMDs in Korea. In this article, we outline the history of compensable ONDs and OMDs and explain the process of and the major changes introduced by the amendment, and future directions.

MATERIALS AND METHODS

The procedure for amending the specific recognition criteria for ODs in the ED-IACIA and the Enforcement Decree of the Labor Standard Act (ED-LSA) is described in Song et al. (4).

RESULTS

History

Historically, there have been many descriptions of neuro-toxicity internationally, which include lead poisoning described by Greek physicians before 1 BC, the homicidal use of arsenic by Nero, and the recent outbreak of organic mercury poisoning in Minamata and glue-sniffers neuropathy caused by hexacarbons (5).

The OD compensation system in Korea is based on the IACI Act and its Enforcement Decree (ED). The IACI Act is a specific act covered by the Labor Standard Act (LSA) and its ED. Because the LSA and the IACI Act are based on hazardous agents, there have been few changes in them since they were first formulated. The LSA in Korea was established in 1954. In the first LSA, 38 hazardous agents and their health effects were defined. In the ED-LSA, Article 44 defines the scope of ODs in Schedule 5. Although thus far, several amendments have been made to the LSA, there has been no distinctive amendment of ONDs and OMDs. Since its first establishment in 1982 with six compensable ODs, the IACI Act has been amended many times. The criteria for the recognition of ODs are described in Article 34 of ED Schedule 5. Each OND and OMD is distributed according to the hazardous agents in Korea. Before we review the history of ONDs and OMDs in Korea, we would like to introduce their international status. The International Labour Organization (ILO) listed ODs in 1919. The ILO list of ODs was most recently revised in 2010 (6). The European Commission (EC) published information notices on ODs in 2009. Annexure I of the publication contains the European Schedule of Occupational Diseases (7). A comparison of the ILO and EC schedules is given in Table 1.

Because the ILO list is based on agents, there are no clear occupational neurological disorders in the list. In the ILO list, ONDs are distributed across agents. There is one OMD in the ILO list, which is post-traumatic stress disorder. In the EC schedule, there are two specific diseases for OND, which are encephalopathy and polyneuropathy due to organic solvents.

Compensated Occupational Neurological Disorders in Korea

The major compensated ONDs in Korea are as follows: 1) multiple cerebral infarction and peripheral neuropathy caused by carbon di-sulfide (CS_2), 2) cerebral demyelinated disease due to complex organic solvents, 3) central nervous system problems caused by acetonitrile, 4) peripheral neuropathy caused by acrylamide, 5) strabismus due to 6th cranial nerve palsy caused by phosphorus trioxide (P_4O_6), 6) cerebellar ataxia caused by organic solvents, 7) demyelination of cerebral white matter and Parkinson's syndrome caused by manganese, 8) amyotrophic lateral sclerosis (ALS) caused by organic solvents and heavy metals, 9) central and peripheral neuritis caused by methyl bromide, 10) acute and/or chronic organic solvent intoxication due to organic solvents including toluene and styrene, 11) peripheral neuropathy by n-hexane, and 12) central and peripheral neuropathy due to lead and mercury.

The past situation of compensated ONDs in Korea was well

Table 1. A comparison of occupational disease list between International Labour Organization and European Commission focusing on neurological and mental disorders

International Labour Organization (2010)	European Commission (2009)
1. Occupational diseases caused by exposure to agents arising from work activities, 1.1. Diseases caused by chemical agents (40 specific agents + a broad remark such as others), 1.2. Diseases caused by physical agents (6 specific agents + a broad remark such as others), 1.3. Biological agents and infectious or parasitic diseases (8 specific agents + a broad remark such as others)	1. Diseases caused by the following chemical agents (54 specific agents) 135. Encephalopathies due to organic solvents that do not come under other headings 136. Polyneuropathies due to organic solvents that do not come under other headings
2. Occupational diseases by target organ systems, 2.1. Respiratory diseases (11 specific diseases + a broad remark such as others), 2.2. Skin diseases (3 specific diseases + a broad remark such as others), 2.3. Musculoskeletal disorders (7 specific diseases + a broad remark such as others), 2.4. Mental and behavioral disorders (1 specific disease + a broad remark such as others): Post-traumatic disorder	2. Skin diseases caused by substances and agents not included under other headings (9 specific agents + a broad remark such as others)
3. Occupational cancer, 3.1. Cancer caused by the following agents (20 specific agents + a broad remark such as others	3. Diseases caused by the inhalation of substances and agents not included under other headings (19 diseases of respiratory system and cancers)
4. Other diseases, 4.1. Miners' nystagmus, 4.2. Other.	4. Infectious and parasitic diseases (5 specific agents + a broad remark such as others)
	5. Diseases caused by following physical agents (18 specific agents/diseases)

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described in Kim and Kang (8). Although the ONDs compensated in Korea have been published before (8), it is worth republishing them for Korean physicians (Table 2).

In the case of CNS disorders, four major hazardous agents have been reported in Korea, namely inorganic mercury, carbon disulfide, methyl bromide, and mixed solvents. Several cases of CNS problems due to organotin, acetonitrile, and carbon monoxide have been reported. In the case of PNS disorders, workers have been compensated for peripheral neuritis due to n-hexane, 2,5-hexanedion, mixed solvents, and acrylamide. Other compensated PNS disorders were anosmia, sixth cranial nerve palsy, and reflex sympathetic dystrophy. Anosmia cases were caused by mixed solvents, chloride, and metal working fluids. A case of reflex sympathetic dystrophy was exposed to pesticide. Compensated occupational neurodegenerative disorders were Mn-induced Parkinsonism and ALS. Compensated Parkinsonism cases were those of welders, ferromanganese ore crushing workers, and painters. Two cases of ALS exposed to organic solvents and lead had been compensated in Korea up to 2008. There were more cases since 2009. Table 3 shows the recent statistics of ONDs and OMDs in Korea since 2009. Table 3 also shows the ONDs and OMDs claimed during 2009-2012.

Table 3 does not specify the specific disorders and agents. We asked the Korea Workers' Compensation & Welfare Service (COMWEL) for details on the Table 3. Two out of the three cases of chronic toxic neuropathy claims were compensated since 2009. One of the three cases of anosmia claims and the only case of a trigeminal nerve palsy claim have been compensated since 2009. Two of the eight cases of Parkinsonism claims and one manganese intoxication case were compensated. No dystonia case has been compensated by IACI since 2009.

Compensated Occupational Mental Disorders in Korea

Korea does not publish official statistical records for OMDs. Choi and Kang reported on the OMDs that have won compensation in Korea (9). The major compensated OMDs in Korea were as follows: "personality and behavioral disorders due to brain disease, damage, and dysfunction," "other mental disorders due to brain damage and dysfunction and due to physical diseases," "reactions to severe stress and adjustment disorders," and "depressive episodes." The major OMDs due to accidental injuries during 2001-2003 in Korea (1,350 cases, 50.8%) with the ICD-10 code were "F00-F09 organic disorders, including symptomatic mental disorders," followed by "F40-F48 neurotic, stress-related, and somatoform disorders" (805 cases, 30.3%) and "F30-F39 mood (affective) disorders" (257 cases, 9.7%). A total of 515 cases of non-accidental OMDs were identified during 2001-2003. The major non-accidental OMDs were F00-F09 (organic disorders, including symptomatic mental disorders) (53.2%), followed by F30-F39 (mood/affective disorders) and F40-F48 (neurotic, stress-related, and somatoform disorders).

COMWEL started to classify occupational mental disorders as dependent diseases from 2005. Table 4 shows the current situation of the compensation for OMDs, which was not caused by other brain injuries or agents but by psychological trauma or job stress. 166 cases were compensated by IACI from the 529 claimed cases between 2005 and 2012. The approval rate of OMDs was 31.4%. The most common OMD was the adjustment disorder (43 cases), followed by depression (33 cases), post-traumatic stress disorder (PTSD, 29 cases), acute stress response (ASR, 28 cases), anxiety disorder (12 cases), and others (21 cases). However, considering that PTSD and ASR are very similar diseases based on acute psychologically traumatic events, the two diseases could be classified in the same category.

Table 2. Compensated occupational neurological disorders in Korea until 2008

Cause	Year*	No. of cases	Industry	Job
Inorganic mercury	1984	1	Thermometer manufacturing	Inspection and packing
	1987	8	Fluorescent lamp	Vacuum exhausting and sealing
	1988	1	Precision instrument manufacturing	Infusion of mercury
	2000	3	Chemical manufacturer	Extraction of silver from waste film
Carbon disulfide	1987-2008	950†	Viscous rayon manufacturer	Various job including spinning
Mixed solvent	1991-2008	16	Various	Painting, cleaning
Methyl bromide	200, 2001, 2007, 2008	10	fumigation	sealing and injection
Organotin	2006	1	Petrochemicals	Cleaning of the polymerization tank
Acetonitrile	1995	2	Chemical manufacturer	Mixing & pouring
Carbon monoxide	2008	1	Service	Building guardian

*Year of investigation; †It included disorders that were not neurological (reprinted with permission).

Table 3. Compensated and non-compensated occupational neurological disorders in Korea during 2009-2012

Year	2009			2010			2011			2012. October		
Compensation	Yes	No	Total	Yes	No	Total	Yes	No	Total	Yes	No	Total
Number	2	6	8	4	9	13	0	4	4	1	1	2

Table 4. The current situation of occupational mental disorders (unit: cases)

Disorders		Year							
		2005	2006	2007	2008	2009	2010	2011	2012
Disorders	Claimed	50	82	78	62	59	67	56	75
	Compensated	26	26	24	19	13	14	12	32
	Depression	6	7	9	0	2	2	3	4
	Adjustment disorders	9	5	8	5	2	3	2	9
	Acute stress disorder	0	9	1	4	2	2	3	7
	Post-traumatic stress disorder	1	2	2	7	3	5	2	7
	Anxiety disorder	6	0	1	2	1	1	0	1
	Others	4	3	3	1	3	1	2	4

Source: Workers' Compensation Welfare Service.

Details of current revision focusing on occupational neurological disorders and occupational mental disorders

Problems of the Previous Version of Standards for the Recognition of Occupational Neurological Disorders and Occupational Mental Disorders

Because the Korean occupational compensation system based on the IACI Act relies on hazardous agents, from a clinician's point of view, it is difficult to determine ODs without knowing the patient's exposure to specific agents. Eighteen neurological diseases or syndromes based on 11 hazardous agents were described in the previous version of the ED-IACIA Article 34 Schedule 3. Diseases classified by the ICD-10 code, common name diseases, and hazardous agents were mixed in the previous schedule. Further, because of the agent-specific approach of the previous system, the vague disease notion included several specific diseases.

In the meantime, among the above mentioned agents or diseases, acrylamide, phosphorus trioxide, methyl bromide, organotin, and ALS have never been included in the scheduels of ED-LSA or ED-IACIA. Further, organic lead and organic mercury have been excluded from the previous list.

PTSD requires a traumatic event before the disease occurrence. Job-related trauma can cause or aggravate PTSD, resulting in decreased work performance. Early detection and proper management of PTSD in the workplace reduce the impacts of PTSD on work performance and improve the prognosis of the disorder. These aspects implied the inclusion of this disorder in the list. Not only PTSD but also MDs were not included in the previous list.

Major Points of Revision in the Previous List of Occupational Neurological Disorders and Occupational Mental Disorders

CNS impairment in the previous system was divided into acute and chronic CNS disorders (G96, ICD-10) by distinctive symptoms. Organotin, methyl bromide, and CO, which have been compensated as agents for acute CNS disorders in Korea, need to be included in the list of acute CNS disorders. Because specific agents have broad systemic disorders not confined in the list of CNS disorders, such as benzene, organic solvents, and CS_2, they need to remain in the agent-specific list. Because acute CNS disorders require short-term massive exposure, no specific exposure levels have been described.

Table 5. Comparisons of occupationally compensable neurological and mental disorders between previous disease category and revised disease category

Previous classification	Revised classification (ICD-10 code)
Central nervous system impairment	Acute central nervous system disorder (G96) Chronic central nervous system disorder (G96) Chronic toxic neuropathy (G92)
Peripheral neuropathy	Peripheral neuropathy (G62) Anosmia (R43.0) Trigeminal nerve palsy (G50)
Parkinsonism	Parkinsonism (G22) Dystonia (G24): manganese-induced
Manganese-induced psychosis	Manganese-induced psychosis (Manganism, T572)
None	Post-traumatic stress disorder (F43.1)

As chronic toxic neuropathy related with organic solvents is included in ICD-10 and have a historical background, the classification term of chronic toxic neuropathy was retained.

PTSD is a type of anxiety disorder having a clear causal relationship with traumatic stressors. In the case of this disorder, it is relatively easy to evaluate work-relatedness and define clear diagnostic criteria. The ILO and some European countries have also included PTSD in their regulation for the OD list. Table 5 shows a comparison between the previous disease category and the revised disease category.

Revised List of Occupational Neurological Disorders and Occupational Mental Disorders

The authors describe articles related to revised ONDs and OMDs according to the LSA and the IACI Act.

1) Enforcement Decree of the Labor Standard Act (Schedule 5, revised 2013.6.28)

In Section C "Chemical agents-related diseases," various chemical agents related to ONDs are described. Such chemicals are lead, mercury, manganese, arsenic, organotin, CS_2, CO, benzene, organic solvents including toluene and xylene, and aromatic and aliphatic hydrocarbons. No specific disease has been described in the ED of the LSA.

2) Enforcement Decree of the IACI Act (Schedule 3, revised 2013.6.28)

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1. Neurological and mental disorders
   A. Disorders of CNS by exposure to organic solvents including toluene, xylene, styrene, cyclo-hexane, n-hexane, trichloroethylene, and others. However, the diseases caused by other causes, including traumatic brain injury, epilepsy, alcohol intoxication, drug intoxication, atherosclerosis, and others are not included.
   B. Peripheral neuropathy
      a) Peripheral neuropathy due to organic solvents including toluene, xylene, styrene, cyclo-hexane, trichloroethylene, methyl n-butyl-ketone, and others; acrylamide; arsenic; and others. However, the diseases caused by other causes including diabetes mellitus, alcohol intoxication, spine injury, drug intoxication, nerve entrapment, and others are not included.
      b) Trigeminal nerve palsy due to trichloroethylene within 3 months after the cessation of exposure. However, the diseases caused by other causes including viral infection, cancer, and others are not included.
      c) Anosmia exposed to cadmium and its compounds due to at least a 2-yr exposure.
   C. Disorders of CNS, peripheral neuropathy, or muscle paralysis due to exposure to lead or its compounds (organic lead is excluded).
   D. Disorders of CNS or peripheral neuropathy due to exposure to mercury or its compounds. However, the diseases caused by other causes including cerebral palsy or alcohol intoxication are not included.
   E. Parkinsonism, dystonia, or manganese psychosis due to exposure to manganese or its compounds for at least 2 months. However, the diseases caused by other causes including cerebral vascular disease, encephalitis or its sequela, multiple sclerosis, Wilson's disease, spinocerebellar degeneration, peripheral neuritis due to cerebral syphilis, and others are not included.
   F. Post-traumatic stress disorder due to psychological trauma related to work
11. Chemical-induced diseases including acute intoxication
   A. Acute intoxication
      1) Acute intoxication symptoms or signs including the diseases of CNS due to temporary massive exposure to vinyl chloride, organotin, methyl bromide, or CO
      5) Acute intoxication symptoms or signs including headache, dizziness, nausea, vomiting, chest oppression, excited state, seizure, delirium, and coma due to temporary massive exposure to benzene
      6) Acute intoxication symptoms or signs including decreased consciousness, seizure, delirium, and arrhythmia due to temporary massive exposure to organic solvents including toluene, xylene, styrene, cyclo-hexane, n-hexane, trichloroethylene, and others
      11) Acute intoxication symptoms or signs including skin ulcer, mucous membrane irritation symptom, seizure, pulmonary edema, disorders of CNS, and disorders of autonomous nerve system due to exposure to phosphorous or its compounds
   H. At least one of the below items due to exposure to CS_2
      1) At least 2-yr work history of exposure to CS_2 (concentration: around 10 ppm)
         a) At least one of the following items: Micro-aneurism in the retina, multiple cerebral infarctions, or glomerular sclerosis. However, the diseases caused by other causes including diabetes mellitus, hypertension, vascular disease, and others are not included.
         b) At least two of the following items: Retinal disorders other than micro-aneurism, peripheral polyneuritis, optic neuritis, coronary heart disease, disorders of CNS, and mental disorders. However, the diseases caused by other causes including diabetes mellitus, hypertension, vascular disease, and others are not included.
         c) At least one of b) and one of the following items: Disorders of kidney, liver, hematopoietic system, and reproductive system; sensory neural hearing loss; and hypertension.
      2) Acute onset of mental disorders including decreased consciousness, delirium, schizophrenia, and bipolar disorder due to exposure to CS_2 (concentration: above 20 ppm) for at least 2 weeks
      3) Acute intoxication signs including decreased consciousness due to exposure to massive or high concentration of CS_2

DISCUSSION

This amendment of standards for the recognition of ODs is a significant change since its first establishment in 1954. Because of the agent-based approach used in the previous version, clinicians including neurologists and psychiatrists were not familiar with compensable ONDs and OMDs. In the amendment made in 2013, the disease-specific approach using the ICD-10 code was included in ONDs and OMDs. Acute and chronic CNS disorders; toxic neuropathy; peripheral neuropathy; and manganese-related disorders including Parkinsonism, dystonia, and manganese-induced psychosis are examples of these changes.

Several neurotoxic agents were included in the amendment. Further, ALS and PTSD were considered for inclusion in the new list. Both these diseases have cases that have been compensated in Korea. Because it is difficult for primary physicians to precisely diagnose ALS and to reach a consensus for the causal relationship between exposure and disease, in the end, ALS was not included in the list. More epidemiologic evidence, sounder evidence for the relationship between ALS and occupational exposure, and more compensated cases are necessary to include this disease in the OD list. In contrast, in the case of PTSD, there is strong evidence of occupational causality and many compensated cases; hence, PTSD was included in the new list. In the meantime, the occupational relationships of various mental disorders such as depression, adjustment disorders, anxiety disorders, panic disorders, and sleep disorders, which have led to increasing public concern, need more research for the inclusion of these disorders in the list.

There have been several specific issues related to exposure concentration and duration. At least 2 yr of exposure is a required condition for chronic encephalopathy due to CS_2. According to EC, the minimum exposure duration of CS_2 for chronic encephalopathy is 10 yr, and its maximum latent period is unclear (7). Irrespective of the fact that there is little evidence for the effects of a 2-yr CS_2 exposure, the 2-yr exposure condition was retained in the new list. The exposure concentration condition for CS_2 seems high and debatable. The American Conference of Governmental Industrial Hygienists (ACGIH) changed the 8-hr time weighted average threshold limit for CS_2 from 10 ppm to 1 ppm in 2005 (10). Hence, the concentration level and duration for CS_2 exposure need to be researched. The clause "within 3 months after the cessation of exposure" for trigeminal nerve palsy due to trichloroethylene (TCE) is controversial. According to the EC guide, trigeminal nerve palsy due to TCE needs the minimal exposure duration for several years and the maximal latency period for immediacy (7). Because there is little evidence for the "within 3 months after cessation of TCE exposure," it could not act as an exclusion criterion; hence, the "3-month" condition was retained in the new list.

Although the amendment has many improvements, the work-relatedness evaluation (WRE) for ONDs and OMDs is not easy. Because ONDs have no specific pathognomonic feature for exposure to hazardous agents, WRE is not easy. The following might help clinicians to evaluate work-relatedness (5): a sufficiently intense or prolonged exposure to chemicals; an appropriate neurologic syndrome based on knowledge about the putative chemical; evolution of symptoms and signs over a compatible temporal course; and exclusion of other neurologic disorders that may account for a similar syndrome. When clinicians diagnose several specific conditions such as a diffuse lesion of the gray matter of the brain, brain atropy, lesion in globus pallidus, demyelinating encephalopathy, and bilateral peripheral neuropathy, ONDs could be suspected. Further, epidemics of neurological or mental disorders are signs of OD. There were three cases of mercury poisoning in a waste treatment company in 2000 (11). The workers involved used to extract silver with inorganic mercury. All workers had peripheral neuritis and abnormal findings on magnetic resonance imaging (MRI). One showed symptoms of hallucination and delirium and was diagnosed with brief reactive psychosis. Eight cases of peripheral neuropathy were found at an LCD manufacturer in 2005 (12). All female workers cleaned LCD frames and were exposed to n-hexane. Clinicians should not exclude ONDs when they do not find abnormal findings with the usual diagnostic tools and even when there are no abnormal findings in radiological tests, neurological exams, and nerve conduction tests. Although chronic organic solvent intoxication causes abnormal emotions and behaviors, there might not be abnormal findings in traditional tests. In this case, neurobehavioral tests and psychological evaluations might be helpful. Biological monitoring for specific agents or metabolite tests of blood or urine are helpful when clinicians suspect ONDs due to specific agents. In such a case, the half-life of these agents should be considered. Because the half-life of organic solvents is usually less than one day, biological samples from the workplace might be helpful. While cadmium in blood has a very long half-life, mercury or manganese has a short half-life. The blood concentration for lead or mercury after several days from the cessation of exposure is not helpful for WRE. The interpretation of exposure monitoring such as the ambient air concentration of specific agents needs caution. Environmental monitoring results of usual and regular tasks are correlated with real exposure. However, the environmental monitoring for unusual and irregular tasks might not reveal real exposure. There were outbreaks of methyl bromide intoxication among fumigation workers who infused pesticide into containers containing agricultural goods (13). The airborne concentration of methyl bromide in 10 cases ranged from an undetected level to 28.8 ppm. The number of non-working days was very small.

Based on scientific evidence and causality, the ILO list, EC schedule, and compensated cases in Korea were reviewed to revise the previous standards for the recognition of ODs in Korea. The disease-based approach using ICD-10 was added in the previous standards, which was an agent-specific approach. Amended compensable OMDs and ONDs in Korea are acute CNS disorders, chronic CNS disorders, chronic toxic neuropathy, peripheral neuropathy, manganese-related disorders, and PTSD. Several agents including TCE, benzene, vinyl chloride, organotin, methyl bromide, and CO were newly included in the list of acute CNS disorders. TCE, lead, and mercury were newly included in the list of chronic CNS disorders. Mercury, TCE, methyl n-butyl ketone, acrylamide, and arsenic were newly included in the list of peripheral neuropathies. PTSD was newly

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included as an OMD. This amendment makes the standard more comprehensive and practical. However, this amendment could not perfectly reflect recent scientific progress and social concerns. Ongoing effort, research, and expert consensus are needed to further improve the standard.

DISCLOSURE

The authors have no conflicts of interest to disclose.

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