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Field Study

Use of Material Safety Data Sheets at Workplaces Handling Harmful Substances in Okayama, Japan

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Abstract: Use of Material Safety Data Sheets at Workplaces Handling Harmful Substances in Okayama, Japan: Akihiko SEKI, *et al.* Department of Public Health, Okayama University Medical School—In April 2000, the revised Industrial Safety and Health Law, which prescribes the creation and issue of material safety data sheets (MSDSs), was enforced in Japan. Before the enforcement, we conducted a survey relating to the use of MSDSs in hazardous workplaces in Okayama Prefecture, Japan. We sent questionnaires to all workplaces possibly using hazardous chemicals, and answers from 422 workplaces, where hazardous chemicals were used but not produced, were analyzed. One-third of the workplaces did not request MSDSs at the time of chemical transfer. In more than half of the workplaces, MSDSs were not posted or kept. The main reason for such lack of use or misuse of the MSDS system was a lack of knowledge and understanding of the system. In addition, half of the respondents considered that MSDS documents were unsatisfactory because of the difficult words used in them. These two problems, i.e., a lack of knowledge and understanding of the MSDS system, and the use of difficult words in the documents, should be remedied in order for the MSDS system to be implemented effectively and thereby protect workers from the harmful effects of chemicals.
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Key words: Material safety data sheet (MSDS), Hazardous chemicals, Questionnaire

A large number of hazardous chemicals are present in workplaces. The Occupational Safety and Health Administration (OSHA) estimates that there are 575,000 hazardous chemical products in American workplaces[1)]. The adverse effects of these chemicals are acute toxicity, irritation, corrosion, sensitization, carcinogenicity, reproductive toxicity, and so on. Several measures have been taken to protect workers against such adverse effects. To ensure workplace safety, the first step is to ascertain which chemicals are used in the workplace. The next step is to identify the adverse effects of these chemicals. Risk assessments and risk measures can then follow. In the past, however, many substances used in workplaces were identified only by their trade names and it was difficult to obtain details of their potential hazards. In the 1970s, labor, community, environmental and public health groups began to claim a right to know the chemical names of such substances as a necessary first step in preventive efforts[2)]. OSHA proposed the Hazard Identification Rule in January 1981[3)], and released revised regulations in November 1983[4)]. In June 1990, the International Labour Organization (ILO) adopted the Convention concerning Safety in the use of Chemicals at Work[5)]. These regulations established the right to know and the duty to disclose hazard information on chemical products. For example, the convention of ILO stated that; "Suppliers of chemicals shall ensure that chemical products are marked so as to indicate their identity, and that chemical safety data sheets, known as material safety data sheets (MSDSs) containing detailed essential information on the chemicals, are prepared for hazardous chemicals. Employers shall ensure that all chemicals used at work are labeled or marked, and that the chemical safety data sheets have been provided and are made available to workers. Workers have a need for, and right to, information about the chemicals they use at work"[5)]. In the convention, the MSDS was defined as one of the fundamentals for protection of workers from the harmful effects of chemicals.

In North America and Europe, the MSDS system has

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been obligated already. The format of MSDS is not fixed and differ according to the country and the chemical supplier, but it certainly contains information on chemical substance names, components and contents, physical and chemical properties, cautions on storing and handling, hazards and types, emergency treatment in case of exposure, and so on.

In Japan, the Ministry of Labor provided the Guidelines Concerning Indication of Hazards of Chemical Substances in July 1992[6]. The guidelines provided instructions saying that chemical suppliers were required to prepare MSDSs and to issue them to those who receive hazardous chemicals, and that employers were required to make MSDSs available to employees and to take measures to prevent industrial accidents by heeding warnings contained with MSDSs. Nine years after the guidelines were announced, the Industrial Safety and Health Law was revised in May 1999[7], and enforcement of the revision began in April 2000. The revised law prescribed the creation and issuing of MSDSs by the suppliers. In the past 9 yr, this MSDS system has been gradually put into practice in Japan[8], but there are still some problems with its application in workplaces.

In the present study we investigated the current state of MSDS usage in workplaces handling hazardous chemicals before the enforcement of the revised law, and we also examined the problems associated with applying the MSDS system in workplaces exposed to these hazards.

Materials and Methods

We carried out a survey on the use of MSDSs at workplaces handling harmful substances in Okayama prefecture, Japan in October 1999, 5 months before enforcement of the revised Industrial Safety and Health Law. The potential subjects were all workplaces in Okayama Prefecture, in which health examination for workers exposed to specific occupational hazard had been carried out. We sent a self-administered questionnaire to the workplaces and asked the person(s) responsible for handling chemical substances to complete the questionnaire. In the questionnaire, we asked about the scale and type of business in the workplace, the variety of hazardous chemicals used, the means of collecting chemical information, and the actual use of MSDSs in the workplace. We also asked about their evaluation of the MSDS system and the degree of comprehension of the words used in MSDSs.

The types of business that were included in the questionnaire are shown in Table 1, and classified into two categories, manufacturing and non-manufacturing industries. Workplaces were classified into small-, medium-, and large-scale workplaces, in which under 50, between 50 and 499, and 500 or more persons were working.

Hazardous chemicals handling in the workplace was classified into 5 categories according to the Japanese ordinances. There are 4 ordinances on prevention of hazards due to harmful chemicals in Japan. The ordinance on the prevention of organic solvent poisoning regulates the use of 54 organic solvents. The ordinance on prevention of lead poisoning and the ordinance on prevention of 4-alkyl lead poisoning regulate the use of lead and 4-alkyl lead, respectively. The ordinance on prevention of hazards due to specified chemical substances regulates the use of the 63 specified chemical substances, which have definite carcinogenic, chronic toxic or acute toxic characteristic. We therefore classified hazardous chemicals into organic solvents, specified chemical substances, lead, 4-alkyl lead and non-regulated hazardous chemicals.

In order to ascertain the degree of comprehension of the technical words used in MSDSs, 8 such words were listed in the questionnaire and respondents were asked whether the words were understandable or not. The words were CAS number, occupational exposure limit, administrative level, acute toxicity, mutagenicity, carcinogenicity, sensitization and gas mask for organic compounds. The number of words understood by each of the respondents were counted and scored 0 to 8 points.

After collection of the questionnaires, it was revealed that some of the workplaces did not use hazardous chemicals. We excluded such workplaces from the present study. We also excluded chemical industries, i.e., chemical suppliers, because they should prepare MSDSs in order to send them with chemical products to purchasers, and might then acquire a different attitude from that of people in other industries. In this study, therefore, we analyzed workplaces where hazardous chemicals were only consumed, but not produced.

Data analysis was conducted by SPSS for Windows 8.0J[9], and a p value under 0.05 was considered statistically significant.

Results

We sent out 1,241 questionnaires and received 569 answers, a response rate of 45.9%. Of the respondents, 147 workplaces were excluded either because they did not use hazardous chemicals (86 workplaces) or because they were chemical producers (61 workplaces). The remaining 422 workplaces were analyzed in this study.

Characteristics of the workplaces are summarized in Tables 1 and 2. Two thirds of the workplaces were manufacturing industries. Almost half of the workplaces were small-scale, and large-scale workplaces represented only 6.9% of the total. More than 90% were using some kind of organic solvent. In the manufacturing industries, workplaces that were using the specified chemical substances, lead and hazardous chemicals not regulated tended to be found more frequently in larger scale workplaces.

Table 1. Types of business of the workplaces studied

Type of business	N	(%)
Manufacturing industries	291	(69.0)
Food industry	10	(2.4)
Wooden industry	12	(2.8)
Steel and/or metal industry	20	(4.7)
Textile industry	6	(1.4)
Printing office and/or bookbinding industry	18	(4.3)
Ceramic industry	9	(2.1)
Machine industry	90	(21.3)
Other manufacturing industries	126	(29.9)
Non-manufacturing industries	131	(31.0)
Construction industry	49	(11.6)
Transport industry	17	(4.0)
Other non-manufacturing industries	65	(15.4)
Total	422	(100.0)

Table 2. Scale, type of business and type of chemicals handled at the study workplaces

Type of business	Manufacturing			Non-manufacturing			Total
Scale of workplaces [a]	Small	Medium	Large	Small	Medium	Large	
Number of companies	110	162	19	87	34	10	422
Types of chemicals handled [b]							
Organic solvents	93.6	93.8	100.0	89.7	70.6	90.0	91.2
Specified chemical substances	17.3	25.3	78.9	19.5	55.9	70.0	28.0
Lead	3.6	11.7	26.3	6.9	8.8	0	8.8
4-alkyl lead	0.9	0	0	1.1	0	0	0.5
Non-regulated hazardous chemicals	10.0	11.7	63.2	11.5	41.2	40.0	16.6

[a] Workplaces were classified into small-, medium-, and large-scale workplaces, in which under 50, between 50 and 499, and 500 or more persons were working. [b] Data are the percentages of workplaces where each chemical was used. Types of handled chemicals were classified according to the ordinances on the prevention of organic solvent, lead and 4-alkyl lead intoxication and specific chemical substance disorders. Multiple choices allowed.

Table 3 shows the extent to which workplaces collect hazard information and use MSDSs. Hazard information relating to chemical products was collected in most of the workplaces; but at 70 workplaces (16.7%) it was not collected. MSDSs were not requested at the time of obtaining chemical products in 37.4% of the workplaces. At 59.4% of workplaces MSDSs were not posted or kept. Information collection and the use of MSDSs were worse at small-scale workplaces than large-scale workplaces. They were also worse in non-manufacturing industries than in manufacturing industries (data not shown). The reasons why MSDSs were not requested, posted or kept in workplaces are listed in Table 4. The most frequent reasons cited were that they did not know that MSDSs should be issued by the suppliers, or that MSDSs should be posted and/or kept in workplaces.

As for the evaluation of the MSDS, almost half of the subjects replied that it was unsatisfactory because the words and/or content used in the documents were difficult to understand. In small-scale and medium-scale workplaces, 52.8% and 50.8% of subjects, respectively, considered MSDS unsatisfactory because of this difficulty. In contrast, 32.1% of large-scale workplaces replied that it was unsatisfactory because its content was not enough to understand the nature or hazards of the chemical substances, and only 25.0% of them considered it unsatisfactory because of difficulty with words and/or content (Table 5).

Table 6 shows the percentage of respondents who understood each technical word listed in the questionnaire. Almost 90% of the respondents understood the meaning of gas mask for organic compounds,

Table 3. Collection of hazard information and use of MSDSs [a]

	Small-scale workplaces [b]	Medium-scale workplaces [b]	Large-scale workplaces [b]	Total
Did not collect information [c]	43 / 196 (21.9)	23 / 194 (11.9)	4 / 29 (13.8)	70 / 419 (16.7)
Did not request MSDS [d]	96 / 188 (51.1)	51 / 192 (26.6)	5 / 26 (19.2)	152 / 406 (37.4)
Did not post or keep MSDS [e]	135 / 191 (70.7)	101 / 191 (52.9)	8 / 29 (27.6)	244 / 411 (59.4)

[a] Data are numbers of negative responses / number of valid responses and the percentage (in parentheses). Some workplaces were excluded because of missing values. [b] For classification, see Table 2. [c] Workplaces where hazard information on chemicals used was not collected. [d] Workplaces where MSDSs were not requested at the time of chemical transfer. [e] Workplaces where MSDSs were not posted nor kept.

Table 4. The reasons for not requesting MSDSs at the time of chemical transfer and for not posting or keeping MSDSs in workplaces [a]

Did not request for MSDSs at the time of chemical transfer (N=150) [b]	
Due to no knowledge of MSDS transfer	96 (64.0)
Due to difficulty with interpretation of MSDS	19 (10.7)
Due to other reasons	35 (23.3)
Did not post or keep MSDSs in the workplace (N=244)	
Due to no knowledge of the requirement to post and keep MSDSs [c]	175 (71.7)
Due to no necessity to do so [c]	32 (13.1)
Due to MSDSs making employees uneasy [c]	7 (2.9)
Due to other reasons [c]	32 (13.1)

[a] Values are numbers of worksites and percentages (%). [b] Because of the missing value, 2 workplaces were excluded. [c] Multiple choices allowed. Total number of answers was 246, because 2 workplaces gave 2 reasons.

Table 5. Evaluation of the MSDS [a]

	Small-scale workplaces [b] N (%)	Medium-scale workplaces [b] N (%)	Large-scale workplaces [b] N (%)	Total N (%)
Satisfactory	49 (27.2)	59 (31.9)	8 (28.6)	116 (29.5)
Unsatisfactory	131 (72.8)	126 (68.1)	20 (71.4)	277 (70.5)
Due to difficult words and/or content	95 (52.8)	94 (50.8)	7 (25.0)	196 (49.9)
Due to insufficient content	25 (13.9)	17 (9.2)	9 (32.1)	51 (13.0)
Due to other reasons	11 (6.1)	15 (8.1)	4 (14.3)	30 (7.6)
Total	180 (100.0)	185 (100.0)	28 (100.0)	393 (100.0)

[a] Because of the missing value, 29 workplaces were excluded. [b] For classification, see Table 2.

carcinogenicity and occupational exposure limit. On the other hand, the words CAS number, sensitization and mutagenicity were understood by fewer than half of respondents. The average number of words that could be understood out of the 8 technical words was 5.41. The average numbers for the respondents at large-, medium- and small-scale workplaces were 5.93, 5.42 and 5.32, respectively. The respondents in large-scale workplaces tended to understand more words than those in medium- and small-scale workplaces, though the differences were not statistically significant (data not shown).

Discussion

In this study, we investigated the use of MSDSs in Japan during 1999, before the enforcement of the revised

Table 6. Percentage of respondents who could understand each technical word (N=422)

Gas mask for organic compounds	92.9%
Carcinogenicity	89.3%
Occupational exposure limit	88.2%
Administrative level	80.6%
Acute toxicity	67.1%
Mutagenicity	44.8%
Sensitization	41.2%
CAS number	37.0%

Industrial Safety and Health Law, which prescribed the creation and issue of MSDS by the suppliers. The current study made it evident that there were two problems in applying the MSDS system in hazardous workplaces.

One of the problems is the lack of recognition in workplaces of the importance of chemical information collection, the system of MSDS transfer, or the necessity for posting and keeping MSDSs in workplaces. To acquire information on hazardous chemicals at work is a fundamental step in managing safety in workplaces, and a MSDS is one of the best sources of hazard information. Nine years after the introduction of the guidelines for the MSDS system for hazardous chemicals, many workplaces collected the hazard information of the chemicals and requested MSDSs at the time of chemical purchase, but some of the workplaces, especially the small-scale workplaces or non-manufacturing industries, did not even collect chemical information. A considerable percentage of workplaces did not request MSDSs at the time of chemical transfer. The main reason for not requesting MSDSs at the time of purchasing hazardous chemicals was a lack of knowledge of the MSDS transfer process. Workplaces in which MSDSs were posted and/or kept did not reach 50 percent, and the main reason was that it was not known that this was required.

Another problem is difficulty with MSDS comprehension due to the use of difficult words and content. Almost half of the subjects considered that MSDSs were unsatisfactory because the words and/or content were difficult to understand and interpret. In fact, the average number of understandable words in the questionnaire list of 8 common technical words present in MSDSs was only 5.41.

To tackle the first problem, increased communication and training will be indispensable. Administrative organs and the Japan Industrial Safety and Health Association had advertised the MSDS system and had taken training courses. Prefectural and regional occupational health promotion centers, which promote and provide support for industrial health issues in local areas, also have introduced the MSDS system to workplaces. It is desirable to continue such advertisement and training courses. Moreover, active and pinpointed training courses will be needed. For example, explanation of MSDSs for major organic solvents and presentation of the way to utilize them in workplaces will be more effective, especially for small-scale workplaces. Most small-scale workplaces do not employ an industrial physician and lack both information and manpower to handle risk and health control generally. Therefore, training courses on how to use and understand the MSDSs of the chemical substances they actually use, seem more effective than general explanation of the MSDS system. Local institutions for industrial health, such as prefectural and regional occupational health promotion centers, should take such concrete training courses for small-scale workplaces from now on.

In this study we did not investigate the awareness of MSDS systems by employees. It is not expected that the degree of awareness by employees is better than that by employers. It is therefore also desirable that employees are trained in the MSDS system, in order to protect themselves from potential hazards.

If such enlightenment is carried out, there still remains a second problem. The subject of the comprehensibility of MSDSs was also reported by Kolp *et al.*[10] For adequate measures to be taken to protect against the harmful effects of chemical products, adequate understanding of the words and content of MSDSs, i.e., sufficient comprehension of hazard information, is necessary. But there are many technical terms related to medical, chemical and pharmacological sciences used in MSDSs, and this seems to be one of the main reasons for difficulty in MSDS comprehension. To make MSDSs understandable for employers and employees, there are at least two solutions. One of the solutions is a training course for understanding the important technical terms. It is desirable that institutions, such as occupational health promotion centers, hold such courses for employers and employees. Another solution is to make the words and content of MSDSs easier to understand. To this end, the international chemical safety cards (ICSCs) project undertaken by the International Programme on Chemical Safety (IPCS) is helpful. ICSCs summarize essential health and safety information on chemicals for their use at the "shop floor" level by workers and employers[11]. To achieve comprehensibility, ICSCs consist of a series of standardized words, terms, phrases and formulas[12]. In MSDSs documents the same matter can be described in various words and expressions, and the reader should know each word and expression in them to understand the documents. If the words and expressions were standardized, the reader would only need to know them to understand the document. It might be better to consider the standardization of important terms and phrases in MSDSs.

In April 2000, the enforcement of the revised law began

in Japan. The awareness of MSDS and MSDS transfer at the time of chemical supply needs to be improved. In addition, it is of importance at hazardous workplaces to understand the information contained in MSDSs sufficiently in order to take adequate measures against hazards. Considerable measures, as mentioned above, must be taken to make the best use of the MSDS system in order to secure the safety of workplaces.

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