Relationships between MMPI Scales under Defensive Attitude and Safety and Health Indices

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Objective: This study aims to analyze the relationships between personality factors measured by Minnesota Multiphasic Personality Inventory (MMPI) scales and the indices of safety and health in the shipbuilding industry.

Background: Many researches reported that there were significant relationships between some MMPI subscales and traffic and industrial accidents.

Method: This study analyzes 230 male workers in shipyard for their MMPI scores gathered during recruitment process and their safety and health indices from the performance record during their working period. χ^2-test and one-way ANOVA are used for finding the statistical significance for personality factors. The conventional grouping rule for MMPI scales and other grouping criteria considering the attitude of positive answer for the MMPI test during recruitment process are used for analysis.

Results: The Hypomania (Ma) and Psychopathic Deviate (Pd) scales of the MMPI are the main factors related to the safety and health related indices for most grouping rules. Depression (D), Psychasthenia (Pt), Hypochondriasis (Hs), Schizophrenia (Sc), and Masculinity and Femininity (Mf) scales are also related to the safety and health indices.

Conclusion and Application: The results can be used for understanding the psychological factors in human behaviors and safety and can help professional personnel take the necessary steps in improving safety on the job and also in providing the effective teaching of safe work methods.

Keywords: MMPI, Personality factors, Defensive attitude, Safety and health index

1. Introduction

The causes of industrial accidents can be divided into human factors related with a worker's attributes and physical factors related with the process and the environment where work is carried out, with the human factors taking up a higher ratio than the physical factors (Park, 1994). In traffic accidents, the ratio of accidents related with human factors to physical factors was reported to be 60:38, 76:22, and 88:16 in Korea, Japan, and the U.S., respectively (Park, 2000). However, most studies to prevent industrial accidents were on the improvement of safety protective equipment, laws associated with accident compensation, and analyses of accident statistical data. Meanwhile, studies related with human factors were rare (Park, 1994).

Minnesota Multiphasic Personality Inventory (MMPI) was made for the diagnostic classification of psychopathology and had been used to reveal that a test subject in the normal range was normal. It had also been utilized to technically describe personality and pscyhological disorders (Zelin, 1971). Kim (2009) said MMPI was a self-reporting personality test which is most widely used, and inference on general personality characteristics can be made.

Lachar (1974) described that MMPI can predict the serious psychopathology of a person becoming a dropout from an air force school. Strupp and Bloxom (1975) described that a person with a specific MMPI code type seems to have difficulties in personal adaptation such as graduation from school or seeking a job. In a study of Schwenk (1966) on personality and traffic accidents targeting young males, many previous studies carried out by Rommel (1959) and Brown and Berdie (1960) on the correlations between MMPI scores and accidents were surveyed. Mathur and Paliwal (1986) analyzed the relationships between MMPI personality scales and accidents through a fabric factory case in Northern India.

MMPI is widely used for the purpose of overall personality evaluation and the evaluation of ability to cope with stress and fulfill one's responsibility in the student life research institutes of universities in Korea (Lee, 1993). Park and Lee (1997) reported that there was a possibility of the relationship between some MMPI scales and accidents for the drivers with many traffic violations.

Jeong and Jeong (2011) asserted that data useful for accident prevention can be gathered through a personality test in the recruitment process if correlations between personality factors among human factors and safety and health indices are identified. DeBobes (1986) said an identification of the effects of personality factors in a psychological test on human behaviors and safety can be used for safe work education/training. However, Baik (2002) and Choi and Park (2008) reported that a psychological test in the recruitment process shows a defensive attitude and that the mean value of clinical scales shows a declining trend. Therefore they asserted that these should be reflected in analyzing the correlations.

This study aims to analyze correlations between MMPI data showing defensive attitude upon recruitment and safety and health indices after employment and to review field application of the results.
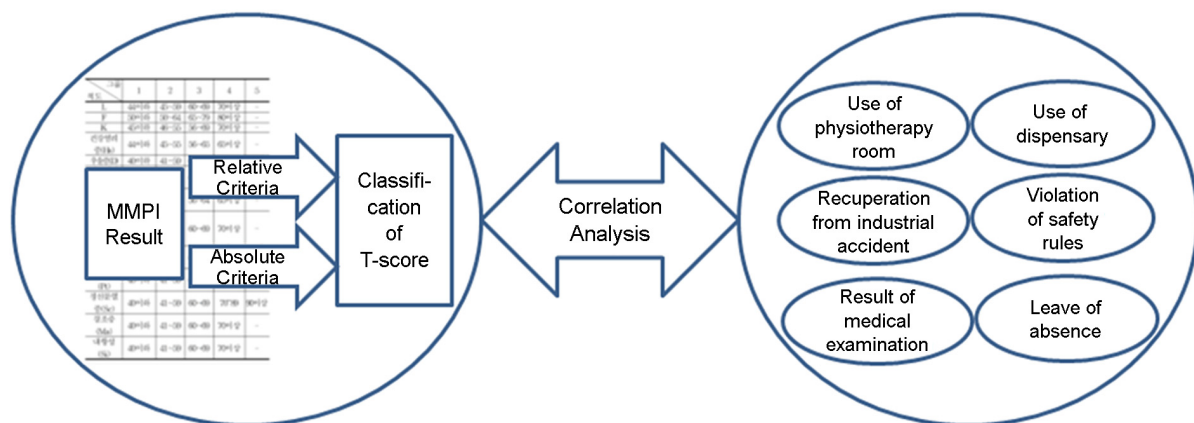
2. Methods

2.1 Research subjects

This study used the MMPI test (566 questions) data of 230 male workers engaged in shipbuilding work, who were recruited in Korea's large scale shipyard 'A' (anonymity) from 2003 to 2006. The mean age of the subjects was 28.91±2.16 years old: 132 people aged 20~29 (57.4%) and 98 people aged 30 or older (43.6%). Their mean continuous service period was 25.24±5.7 months: 3 people with 6~12 months service experience (1.3%), 98 people with 13~24 months service experience (42.6%), and 129 people with 25~36 months service experience (56.1%). By gender, the subjects were all males. As for education level, 139 people were high school graduates (60.4%) and 91 people were junior college graduates (39.6%). Concerning marital status, married people were 39 (17%) and unmarried people took up 83% (Table 1).

2.2 Methods

This study conducted a correlation analysis between the score groups by each subscale of MMPI and safety and health indices. In addition to the grouping of the score groups by the MMPI subscale by Jeong and Jeong (2011), four classification criteria for grouping the score of MMPI subscale considering the employees' defensive attitude is analyzed (Figure 1).

Table 1. Characteristics of the subjects

Classification	Group	Count	Percentage
Age	20~29	132	57.40%
	30 or older	98	42.60%
	Toatl	230	100%
	Mean age	28.91±2.16	
Marital status	Married	39	17%
	Unmarried	191	83%
	Total	230	100%
Education level	High school graduates	139	60%
	Junior college graduates	91	40%
	Total	230	100%

Figure 1. Research scheme

Classification criterion 1 is the one generally used as T-score according to scale presented in the MMPI (clinical interpretation of MMPI) of Kim (2009), which is the T-score classification used by Jeong and Jeong (2011). This classification classifies all scales into four groups, except schizophrenia (Sc) scale (group1: 40 and lower, group: 2: 41~59, group 3: 60~69, group 4: 70~89, and group 5: 90 and higher, based on T-score). For example, in the scale of hypochondriasis (Hs), T-score range of group 1 is 44 and lower, group 2 is 45~55, group 3 is 56~65, and group 4 is 68 and higher. Classification criterion 2 is classified by dividing into two groups of 50 and higher and lower than 50, based on the T-score acquired from the normal group's profile.

While the two classification criteria above used the T-score's absolutely as classification criterion, the following three classification criteria relatively used T-score in dividing groups, considering the defensive attitude of the respondents who remarkably want to show positivity in the case of the MMPI test conducted in the recruitment process. Regarding the 10 clinical scales of the respondents while they are in the process of recruitment, mean T-score was lower than 50. The T-score corresponding to 50th percentile was 43 in Hs scale and 43 in depression (D) scale. Such a result is consistent with the result of the previous studies (Choi and Park, 2008; Baik, 2002) reporting that the respondents show a defensive attitude to remarkably show positivity in the MMPI

test carried out in the recruitment process.

Classification criterion 3 was classified into two groups with 45 and higher and lower than 45, based on 45 which is five points lower than normal people's mean T-score (50) in order to reflect respondents' defensive attitude. Classification 4, shown in Table 2, was classified into four groups by calculating T-scores based on 24th percentile, 25th-49th percentile, 50th-74th percentile, and 75th percentile to reflect respondents' defensive attitude. Classification criterion 5 was classified into two groups, based on the T-score of 75th and higher percentile and the score of lower than 75th percentile.

Table 2. MMPI T-Scores of classification criteria 4

Scale \ Group	Group 1	Group 2	Group 3	Group 4
Hs	39 and lower	39~43	43~47	Above 47
D	34 and lower	34~38	38~41	Above 41
Hy	42 and lower	42~45	45~49	Above 49
Pd	40 and lower	40~44	44~51	Above 51
Mf	38 and lower	38~43	43~50	Above 50
Pa	38 and lower	38~40	40~46	Above 46
Pt	37 and lower	37~40	40~44	Above 44
Sc	35 and lower	35~38	38~41	Above 41
Ma	39 and lower	39~44.5	44.5~50	Above 50
Si	33 and lower	33~37.5	37.5~43	Aabove 43

*Hs: Hypochondriasis, D: Depression, Hy: Hysteria, Pd: Psychopathic Deviate, Mf: Masculinity-Feminity, Pa: Paranoia, Pt: Psychasthenia, Sc: Schizophrenia, Ma: Hypomania, Si: Social introversion

This study used the following safety and health indices to identify correlations between MMPI scores and safety and health related activities after employment. The numerical values of safety and health indices are the data that targeted continuous service period for three to six years of work experience by converting them into actual working days and that were drawn on annual basis.
1) Use of physiotherapy room: Tallying the number of treatment due to pain complaints associated with work after employment
2) Use of dispensary: Tallying the number of dispensary use in relation with work from the dispensary use data
3) Recuperation from industrial accident: Tallying the number of industrial accident recuperation with the approval from the Korea Labor Welfare Corporation due to injuries while working
4) Violation of safety rules: Tallying the number of individually notified warnings from the safety and health manager
5) Result of medical examination: Tallying the status of diseases as a result of special health examination
6) Leave of absence: Tallying the status of leave of absence during the subject's service period

To find out correlations between the MMPI score groups and safety and health indices mentioned above, this study conducted χ^2-test and ANOVA using a statistical analysis program: Minitab version 15.

3. Results

3.1 MMMPI scales showing significant correlations

Table 3 shows correlations between five classification criteria and safety and health indices. The number of dispensary use shows significant differences in the Psychasthenia (Pt), Schizophrenia (Sc), and Hypomania (Ma) scale score groups. The number of physiotherapy room use shows a significant difference in the Pt scale score group. The status of recuperation due to industrial accidents shows significant results with psychopathic deviate (Pd) and Ma scales. The number of warning and guidance receiving experiences due to safety rules violation shows significant differences in the Ma, Hs, D, and Sc scales. The status of abnormality opinion as a result of health examination shows a significant result in the masculinity-femininity (Mf) scale. Lastly, the four groups related with the status of taking leave of absence show significant results in the D and Ma scales.

Table 3. Correlations between five classification criteria and safety and health indices

Indices	Use of dispensary	Use of physiotherapy room	Result of medical examination	Recuperation from industrial accident	Violation of safety rules	Leave of absence
Method	Mean difference ANOVA	Mean difference ANOVA	Differnce of distribution χ^2-test	Differnce of distribution χ^2-test	Mean difference ANOVA	Differnce of distribution χ^2-test
Criteria 1	Pt**				Ma*	
Criteria 2	Sc**		Ma**	Pd*	Hs**, D**, Sc**	Ma**
Criteria 3			Mf*	Pd*, Ma*		D**
Criteria 4	Ma*			Pd*		
Criteria 5		Pt*	Ma**	Pd*		Ma*

*$p < 0.05$, **$p < 0.1$

3.2 Detailed analysis result of classification criteria 4

Table 3 summarizes the result of the analysis for each classification criterion, namely the results acquired by conducting an analysis on differences in the mean and probability distribution of each safety and health indices. To prevent the repetition of similar detailed analysis processes, this study presented only the detailed analysis results on classification 4.

Upon looking at the analysis result in detail according to classification 4, which reflected a defensive attitude of responses and classified entire group into four sets, the number of dispensary use and the status of recuperation due to industrial accidents showed significant results in the Ma and Pd scales, respectively. The details are as follows.

3.2.1 Mean number of dispensary use

Table 4 shows the relationships between Ma scale and the mean number of dispensary use. Upon looking at the distribution of the subjects by score group in Table 4, the number of use was higher in the group of 39~44.5 in T-score taking up 31.7% of the entire subjects in the Ma scale. Therefore they can be inferred as a group with special tendency among normal people. Thus, continuous attention should be paid for the group comprising the subjects with 30~44.5 in T-score in the Ma scale in relation with

the number of dispensary use.

Table 4. Analysis of the mean number of dispensary use and Ma scale

Ma scale	Count (Persons)	Mean (Number)	S.D.
Below 25%tile (39 and lower[*])	42	2.22	(2.45)
25~50%tile (39~44.5)	73	3.90	(5.47)
50~75%tile (44.5~50)	48	2.47	(2.88)
Above 75%tile (above 50)	67	2.88	(2.94)
Test of mean difference	F=2.23 p-value=0.086[**]		

*T-Score, **p<0.1

3.2.2 Status of industrial accident experience

Table 5 shows the distribution difference of the subjects according to Pd and the status of industrial accident experience from the data tallying the number of industrial accident recuperation with the approval from the Korea Labor Welfare Corporation due to injuries while working. According to the χ^2-test, a significant difference in the probability distribution of the subjects was shown, depending on the Pd scale score group and the status of industrial accident experience (p=0.085). However, a further study using accumulated data through an additional analysis is necessary to get meaningful result because there are less than 5 cases of each cell because of a small number of samples.

Table 5. Distribution difference of the industrial accident experience and Pd scale

Pd	Number of Experienced (%)	Number of Unexperienced (%)	Total
Below 25%tile (Less than 40[*])	5 (9.26%)	49 (90.74%)	54 (100.00%)
25~50%tile (40~44)	1 (2.17%)	45 (97.83%)	46 (100.00%)
50~75%tile (44~51)	4 (5.63%)	67 (94.37%)	71 (100.00%)
Above 75% (above 51)	0 (0.00%)	59 (100.00%)	59 (100.00%)
Goodness of fit test	χ^2=6.619, df=3, p-value=0.085[**]		

*T-Score, **p<0.1

4. Conclusion and Discussion

Many studies were attempted with an intention to be useful for effective safety measures if the relationships between personality factors of a psychological test and worker's behaviors and safety were identified. In particular, various studies were carried out using MMPI test, a representative psychological test. In the study result of Mathur and Paliwal (1986) which analyzed accidents in a fabric factory and MMPI scale scores, Hs scale score and D scale score showed a significant relationship, which was consistent with the result of this study. However, Hy scale score also showed a significant relationship, which showed a difference from the result of this study. A survey of Cho (1970) targeting the workers engaged in the manufacturing industry using MMPI reported that

the accident group's Pd was higher than that of the non-accident group. A study of Song et al. (1998) reported that significant differences were shown in the Hs, D, Hy, Pt, and Sc scales in the score distribution by MMPI clinical scale according to the musculoskeletal self-symptom complaints of VDT female workers. In the study results of Rommel (1959), Brown and Berdie (1960), and Shaw (1965), which analyzed traffic accidents, violation cases, and MMPI scales, the Pd scale and Ma scale scores showed a significant relationship. O'German and Kunkle (1947) reported that the accidents of airplane pilots and Pd and Ma scales of MMPI showed relationships. Park and Lee (1997) reported that the Sc, Mf, Pa, and Ma scales had a possibility to be connected with accidents among the drivers with many traffic violations. In a study of Jeong and Jeong (2011), the number of dispensary use increased as the T-score of Pt scale became higher. Also, the mean T-score of Pd for workers who did not experience industrial accidents was higher than that of the workers who experienced industrial accidents.

Although performing MMPI test was not generalized, after production workers were employed, this study made an effort to analyze the correlations between individual personality and accident occurrences or the behaviors of accident occurrence possibility using the data acquired from the MMPI test during recruitment process. Namely this study analyzed relationships among MMPI data upon recruitment and safety and health indices after employment, and attempted an analysis to review the criteria that can be used at sites. As a result of the analysis on the relationships between the MMPI scores of employed people and safety and health indices, significant correlations were confirmed in the Ma and Pd scales in this study. The results on relationships were different based on classification criterion and it is recommended that a criterion with higher T-score should be selected to ascertain relationships, rather than general criteria. In other words, the subjects' defensive attitude revealed in the psychological test associated with recruitment should be considered.

The results of this study imply that ,based on the psychological factor scores in the MMPI psychological test, analyzing score differences by comparing specific groups and a setting up the criteria to select the subjects to be managed are different. From the manager's position, he/she is interested in the selection of classification criteria for management efficiency. However, correlations with the data concerned with industrial accidents can be confirmed only through long-term tracking of the subjects. A difficulty to ensure the validity of the result is implied in view of the subjects' highly defensive attitude. Therefore, caution is required in the utilization of using only correlations between temporary MMPI test results and safety and health indices.

In light of the effects of human factors on accident occurrences, if individual personality is investigated and the result can be utilized for accident prevention, it can contribute in the human resource psychology area. In the case of recruitment, a personality test shows defensive attitude to show the positive aspect; therefore, it is difficult to acquire correlations with safety and health indices with the usual classification criteria. In this regard, this study has meaning in that the study analyzed the relationships with safety and health indices by grouping the MMPI test data with relative classification criteria for the employees showing defensive attitude during recruitment process. There is a limitation, however, to present reliable criteria due to the small numbers of leave of absence, warnings, and industrial accident occurrences, given that the subjects in this study have a short continuous service period. Therefore an additional analysis on the relationships between MMPI scores and safety and health indices is needed from the long-term perspective. The results of this study imply that much time and lots of efforts are required to acquire reliable study results regarding human factors effectively usable in the industrial sites. The development and utilization of psychology and safety counseling and education/training by drawing personality scales associated with accidents are useful to contribute to a safe life at work.

Acknowledgements

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