

Neurobehavioral Performances Among Lead Exposed Workers In Malaysia: An Early Detection Of Lead Toxicity

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Abstract

The objectives of this study is to evaluate subjective symptoms and neurobehavioral performances among workers exposed to lead and its relation with blood lead levels. The methodology of this study was restricted to 141 Malaysian battery manufacturing factories male workers with mean (SD) age of 35.2 (9.6) years, years of employment 9.1 (7.1), current blood lead concentration 40.5 (16.8) µg/dl were given WHO neurobehavioral core test battery. Results showed that highly exposed group blood lead level (high ≥ 40 µg/dl) performed less well in 4 of 13 responses reported higher subjective symptoms of weakness of lower limbs and anorexia. Significant correlation was found between blood lead and Digit Symbol, Digit Forward, Digit Backward, Aiming Pursuit Test and Trail B. Regression analysis showed reduction in cognitive, memory and concentration functions at ≤ 30 µg/dl blood lead levels with maximum lead effect at Digit symbol's score at 40 µg/dl. In conclusion, this study is consistent with the larger body of neurobehavioral tests in lead exposure and has proven the ability of these tests in detecting low level of lead toxicity.

Keywords: Blood lead, low level, neurobehavioral test, workers, Malaysia.

Introduction

The ever increasing interest of neurobehavioral test is probably due to its sensitivity shown by psychological measurement techniques to unveil changes which otherwise would not detected in human. The evidence that this changes are among the earliest indicators of the occurrence of health effects has by now, become unequivocal. As a consequence this test has come to be regarded as a major device of major importance for monitoring of potential health hazards (Iregan & Gamberle 1990).

Clinical manifestation of lead poisoning such as anaemia, wrist drop, and renal failure lie at the upper end of the range of

toxicity, whereas subclinical evidence of lead poisoning has been reported in neurophysiological and neurobehavioral studies (Landrigan 1989; Campara et al. 1984; Arnvig et al. 1980). Most of the neurobehavioral studies undertaken have come from the industrialised countries (Seppalainen et al. 1975; Hanninen et al. 1979; Baker et al. 1984), only few have been reported in developing countries (Jeyaratnam et al. 1985; Maizlish et al. 1995; Mohamed 1986).

The purpose of the present study was to assess the neurobehavioral performances among workers exposed to inorganic lead in battery manufacturing factories in Malaysia.

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Materials and methods

Study Design and Population Studied

The study design was cross-sectional and subjects were drawn from two battery manufacturing factories in the state of Selangor, Malaysia. On average 360 employees were employed, with local citizen to foreign workers from Bangladesh ratio 1:1. Because of high turn-over of the foreign workers and the foreseen difficulties (language problems) in conducting the neurobehavioral test, they were excluded from the study. Eligibility to our study was restricted to 141 male workers from 3 major ethnic groups; Malays, Chinese and Indian who have given consent. Walk-through surveys were conducted together with an industrial hygienist to exclude other neurotoxicants in the factories.

Procedure

The participants were given questionnaire which covers personal data, medical and occupational history, hobbies, smoking, alcohol consumption and subjective symptoms complaints. They were interviewed and examined physically by one of the researchers. Trained examiners blind to participants' exposure history conducted test in quiet rooms during the beginning of the shift to avoid effect of fatigue. The procedure took nearly one hour per person.

Blood Lead Measurement

All participants were requested to provide 10 mls samples of venous blood by venepuncture from a forearm for blood lead analysis by atomic absorption spectrometry in Institute for Medical Research (Fairulnizal 1996). Quality control of the measurement had been taken care by using commercial controls from Bio-Rad, USA and by participating in 'Trace Elements External Quality Assessment Scheme' organised by Robens Institute, University of

Surrey, United Kingdom. This blood lead measurement was assumed to reflect average exposure.

Neurobehavioral Core Test Battery

To correct the lack of standardisation in neurobehavioral assessment, the World Health Organisation (WHO) Neurobehavioral Core Test Battery (NCTB) has been advocated as a validated, standardised psychological test battery that has been reported as transcultural (WHO 1986). This study used 5 tests of NCTB and 1 test from California University (Trail Making Test). This neurobehavioral is a simple pencil and paper test and test conducted by trained examiners. All test has been translated from English to Bahasa Malaysia which is the national language which also has been pre-tested. But the tests were conducted in either Bahasa Malaysia, Chinese or English according to participants choice.

Table 1 summarises neurobehavioral tests used in this study and their domain functions

Digit Symbol

The subject is presented with a key at the top of the page with the numbers 1 to 9 displayed with their respective matching symbols. Below are blanks with digits above. The subject must copy the appropriate matching symbols for each digit based on the key at the top of the page. The number of correct symbols in the 9 seconds test period is the score.

Digit Span

Digit span, from Weschler adult intelligence scale measures short term memory and attention. In the digit forward the tester recites group of 3, 4, 5, 6, progressively up to 8 numbers and the subject is requested to repeat each exactly as he hears them. The digit backwards sequence runs from two to eight digits and the subject is requested to repeat them in exactly reversed order. The

score is the total number of correct sequence individually.

Santa Ana Manual Dexterity Test

The subject must rotate pegs through 180°. The pegs are arranged in 4 rows of 12 pegs on rectangular board. The number of pegs rotated in 30 seconds is the score. The test was repeated for the preferred, non-preferred and both hands.

Table 1. Neurobehavioral tests and the functional domain tested

Test Function	Domain
Digit Symbol	Motor Speed, Visual Scanning, Working Memory
Digit Span	Short term memory and attention
Santa Ana Dexterity	Motor Speed, co-ordination
Benton Visual Retention	Visual Perception, Memory
Pursuit Aiming	Fine motor control and motor steadiness
Trail Making	Attention, Visual Scanning, Processing Speed

Pursuit Aiming Test

With a pencil, the subject is instructed to dot the centre of circles as quickly and accurately as possible. The circle is 2 mm in diameter are arrayed on a paper sheet in 30 columns by 40 rows. Excluding outliers, the number of dotted circles in two 30 s trials is the score.

Benton Visual Retention Test

The subject is shown a drawing for 10 seconds composed of geometric figures. After the drawing is removed, the subject is shown four similar looking drawings, only one of which is a true replica of the original. The subject must identify the correct

drawing. The number correct in 10 trials is the score.

Trail Making Test

This test has two parts, each consisting of 25 circles distributed over a sheet of paper. In Trail A the circles contain numbers 1 to 25. The subject is required to draw a line connecting the circles in numerical sequence as quickly as possible. Trail B differs from Trail A in that the circles contain numbers 1 to 13 and letters A to L. In connecting the circles the subjects is required to alternate between the numbers and letters as he proceeds in ascending sequence. The test is scored as the number of seconds needed to finish each part.

Questionnaire for Subjective Symptoms

This questionnaire was adapted from WHO for assessing subjective symptoms. It consist of 20 items grouped systematically into the following subscales; central nervous system, peripheral nervous system, gastrointestinal system and other symptoms.

Statistical Methods

All data were entered in dBase IV and analysis was done with SAS. To test the relation of blood lead with its influencing factors, t-test or chi-square were used. To control the effect of confounding variables (age, education level, alcohol, tobacco smoking, exposure to other chemical, usage of personal protective equipment and hobbies) general linear model analysis was used. Correlation analysis is used to see the significant of the relations between blood lead, haemoglobin levels and neurobehavioral performances. To test the hypothesis of the sensitivity of neurobehavioral test in comparison with clinical findings and anaemia, t-test, chi-square and multiple regression analysis were used that incorporate age, education level and years of employment.

Results

Table 2 shows the summary of the demographic characteristic of the participants. The response rate from factory A was 78.8% and 81.9% from factory B. Blood lead analysis was not performed for 3 workers (**) because of the unsuitability of the specimens.

Table 2. Demographic characteristic of the participants

Demographic Characteristics	N	Mean (SD)	Range
Age (years)	141	35.2 (9.6)	20-69
Years employed	141	9.01 (7.1)	0.33-32
Education	141	9.0 (*)	2-16
Blood lead ($\mu\text{g}/\text{dl}$)	138**	40.5 (16.8)	4.9-76.5
Duration of smoking (years)	84***	11.2 (6.7)	1-30

*= not available, ***= smokers only

The ethnicity of the participants is shown in Table 3. Participants came from different job categories with the majority of them from production, maintenance and quality control sections (71.6%) whereas the others came from the technical and packaging sections (10.6%), raw material (4.9%), administrative and marketing (6.3 %) and production supervisors (6.4%).

Table 3. Ethnic distribution of the participants

Ethnic group	Numbers	Percentages
Malay	71	50.4
Chinese	35	24.8
Indian	35	24.8
Total	141	100

Neurobehavioral Test Performances

The participants were divided into 2 groups of highly exposed group with blood lead levels (PbB) $\geq 40 \mu\text{g}/\text{dl}$ and low exposed group of PbB $< 40 \mu\text{g}/\text{dl}$ according to WHO's biological exposure index.

Significant difference in score was found between the highly exposed group with the low exposed group (Table 4) in Digit symbol, Digit forward, Santa Ana Preferred hand, Santa Ana both hands, Benton, Pursuit Aiming and Trail B tests.

Table 4 . Mean score of neurobehavioral test with blood lead level

Tests	PbB < 40	PbB ≥ 40	p-value
	µg/ dl Mean Score	µg/ dl Mean Score	
Digit Symbol*	49.6	37.4	0.02
Digit Forward	9.4	8.5	0.19
Digit Backward*	7.3	5.4	0.01
Santa Ana Preferred Hand*	25.1	23.5	0.04
Santa Ana Non-preferred hand	22.6	22.4	0.05
Santa Ana Both Hands*	30	26.5	0.02
Benton*	8.7	7.8	0.02
'Aiming' *	213	182	0.00
Trail A	45.3 seconds	55.5 seconds	0.05
Trail B*	88 seconds	121 seconds	0.00

(t-test, * =p<0.05)

Several factors were found influencing blood lead levels in this study significantly; years of employment (p=0.02), previous exposure to lead (p=0.01), usage of personal protective equipment (p=0.04), and exposure to non-neurotoxic chemicals (p=0.04). However, age, smoking habits, alcohol consumption and hobbies had no significant effects to blood lead levels. After controlling for cofounders, poorer score on the Digit symbol, Digit backwards, Aiming Pursuit and Trail B Tests were consistently associated with lead exposure.

Correlation between the blood lead levels and the neurobehavioral performances indicate higher blood lead level tended to have poorer neurobehavioral performances (Table 4) in Digit Symbol, Digit span, Aiming and Tail B tests. This correlation is also supported with the linear regression

analysis which revealed the similar results (Table 5).

Table 5. Correlation coefficients between blood lead and neurobehavioral performances

Tests	N	Correlation coefficients	p-value
Digit Symbol*	135	-0.4348	0.00
Digit Forward*	135	-0.2107	0.02
Digit Backward*	134	-0.3040	0.00
Santa Ana Preferred Hand	135	-0.0469	0.14
Santa Ana Non-Preferred Hand	134	-0.0529	0.91
Santa Ana Both Hands	132	-0.0141	0.17
Benton	135	-0.1520	0.18
'Aiming' *	135	-0.2476	0.00
Trail A	133	0.1221	0.16
Trail B*	132	0.3040	0.00

(Correlation analysis, * = p < 0.05)

Prevalence of Subjective Symptoms

Workers were complaining high prevalence of subjective symptoms of fatigue and insomnia (13.5%) , tremor of both hands (8.5%) and sleepiness during working and forget-minded (6.4%). Higher exposed group were also complaining significant symptoms of weakness of both lower limbs and loss of appetite.

Testing of Hypothesis

Hypothesis of this study is neurobehavioral test as a diagnostic test to detect lead toxicity at low levels in comparison with overt clinical findings. Few clinical problems were identified such as hypertension, skin diseases, musculoskeletal, respiratory, tremor and eye problems among workers. However, no significant findings were found in relation to blood lead levels (Table 6).

Further regression analysis were used to assessed the contributions of blood lead levels to neurobehavioral tests in particular Digit Symbol because of the strongest correlation's ($r = -0.4348$, $p < 0.05$) in this study (Figure 1). This analysis has proven that the digit score symbol were negatively correlated with the blood lead

levels up to $30 \mu\text{g}/\text{dl}$ ($p < 0.05$)*, thereafter there were no significant correlation between this two parameters ($p = 0.66$). Lead also has shown it maximum effect at digit symbol score of 40**. Therefore this analysis can confirm that the hypothesis of this study is not rejected.

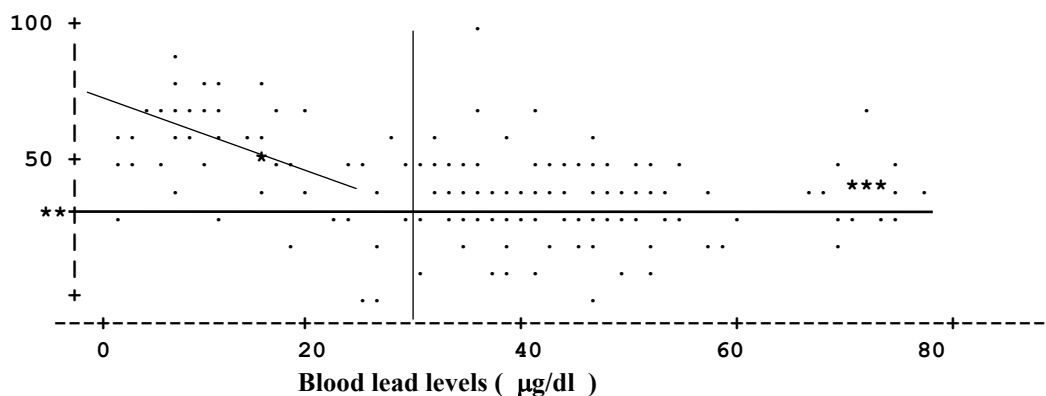
Multiple regression analyses revealed the significant contribution of years of employment (YE) together with the blood lead levels to Digit Symbol score ($R^2 = 0.2385$, $p < 0.05$). This is consistent with the concept of blood lead levels (PbB) reflecting recent exposure and years of employment reflecting chronic (cumulative) exposure (Balbus et al. 1995; Rappaport 1991). This is shown by the formula;

$$\text{Digit Symbol} = 60.28 - 0.307 \text{ PbB} - 0.818 \text{ YE}$$

Table 6. Clinical findings in relation to blood lead levels

Clinical Problems	% Positive cases	Mean (sd) PbB ($\mu\text{g}/\text{dl}$)		p-value
		Positive cases	Normal cases	
1. Hypertension	8.4	40.2 (16.0)	40.6 (17.0)	0.94
2. Skin	10.9	38.9 (11.7)	40.7 (17.4)	0.59
3. Musculoskeletal	13.0	42.5 (14.8)	40.2 (17.1)	0.50
4. Respiratory	6.5	43.4 (15.9)	40.3 (16.9)	0.58
5. Eye	2.9	48.8 (7.3)	40.3 (17.0)	0.09
6. Tremor	8.0	40.2 (16.1)	44.6 (24.4)	0.56
7. Anaemia	141	44.4 (21.4)	40.0 (16.0)	0.39

Digit Symbol Score



$$*y = 67.09 - 1.0634 \text{ PbB}, p < 0.05, R^2 = 0.1891$$

** Limit value in Digit symbol's score of 40

*** $p = 0.6557$

Figure 1. Relationship of Digit Symbol's Score And Blood Lead Levels

Discussion

Results from this study has shown that lead can cause dysfunction's of central nervous system in terms of processing speed, attention, concentration, memory functions and motor steadiness. This is shown in the significant associations between blood lead levels with Digit Symbol, Digit Span, Trail B and Pursuit Aiming Test. Lead also has

given higher subjective complaints of weakness of lower limbs and loss of appetite in the highly exposed group.

This findings of lead toxicity to neurobehavioral performances and the subjective symptom were consistent with many other studies (Campara et al. 1984; Seppalainen 1975; Hamminen 1979; Grandjean et al 1978; Hogstedt et al 1983, Schwartz 1993; Valciukas et al. 1978;

Williamson & Teo 1986). This study also confirmed the ability of the neurobehavioral test in comparison with the overt clinical findings whereby the toxic effect of lead to the cognitive functions can be seen at blood lead levels lower than 30 µg/ dl.

Due to maximum effect of lead at digit symbol score of 40, This score can be taken as a limit value between normal and abnormal score. Score less than 40 can be considered as an abnormal score. This findings highlight the importance of the neurobehavioral tests which can be incorporated in the medical surveillance programme of Lead Regulations Malaysia. Facilities for blood lead measurements are not widely available throughout Malaysia and the resistance of the workers to this invasive procedure which need to be routinely conducted, hinder the success of the surveillance program. On the other hand the applications of the neurobehavioral tests can also detect the early toxic effect of lead, which enhances the prevention strategies before leading to any irreversible damage (Baker 1985).

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The Validity-Reliability Study of the Malay Version of Copenhagen Psychosocial Questionnaire (COPSOQ) in Assessing Psychosocial Status in Relation to Nature of Work among Workers

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Abstract

This study aimed to validate the Malay Version of Copenhagen Psychosocial Questionnaire for Malaysian use and application for assessing psychosocial work environment factors. Validity and Reliability were studied in 50 staff nurses of Hospital Selayang. The validity of the questionnaire was evaluated by calculating the percentage of sensitivity and specificity at the different score level. Both percentage of sensitivity against specificity were plotted to produce a ROC (Receiver Operating Characteristics) curve, and score 52 has the highest both sensitivity and specificity was used as an overall index that expresses the probability that measure the psychosocial problems. For reliability purposes, a descriptive of Test-Retest Mean Scores and Paired Sample T-Test and the coefficient-correlation test were calculated. The Test-Retest Mean Scores and Paired Sample T-Test for all 26 scales were calculated and showed statistically not significant. The reliability of the questionnaire and its 26 scales was assessed by using Pearson (r) (overall questionnaire r within a range of 0.00 to 1.00). The COPSOQ appears to be a reliable and responsive measure of workers for Malaysian use and can be applied for assessing psychosocial work environment factors.

Keywords: Malay version of COPSOQ, sensitivity and specificity validity, test-retest reliability, Pearson r, Malaysia.

Introduction

According to an important International Labour Organizations (ILO) (1975) resolution, work should not only respect workers' lives and health and leave them free time for rest and leisure, but also allow them to serve society and achieve self-fulfillment by developing their personal capabilities (Steven et al, 1998).

The psychosocial demands of the modern workplace are often at variance with the workers' needs and capabilities, leading to stress and ill-health. The most important situational factors that give rise to psychosocial stressors at work are quantitative overload, qualitative underload, role conflicts, lack of control over one's own situation, lack of social support, physical stressors, mass production technology,

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highly automated work process and shiftwork (Lennart, 1998).

Social support increases coping ability and facilitates adaptation. There are five possible elements of social support, which are emotional support (example, care and love), encouragement (example, praise and compliments), advice (example, useful information to solve problems), companionship (example, time spent with supporter) and tangible aid (example, money) (Freda, 1998).

Psychosocial factors which lead to stress at work and associated health and safety problems, include aspects of the job and work environment such as organizational climate or culture, work roles, interpersonal relationships at work, and the design and content of tasks (example; variety, scope, repetitiveness). The concept of psychosocial factors extends also to the extra-organizational environment (example; domestic demands) and aspects of the individual (example; personality, attitudes) which may influence the development of stress at work (Lennart, 1998).

The need for valid and reliable instruments for assessment of exposures applies to the psychosocial field as well as to other fields of work environment research and practice. The Copenhagen Psychosocial Questionnaire (COPSOQ), a questionnaire for assessing psychosocial work environment factors, has been developed by the Psychosocial Department, National Institute of Occupational Health (NIOH) in Copenhagen, Denmark. They have done the reliability and validity of the assessments, among adult Danish employees in Danish version in a year 2000. The questions of the COPSOQ have been translated into English, and some of the questions also into Japanese. Spanish, German, and Flemish versions are under development (Tage et al, 2000).

Tage S.K., et al (2000) have done a project on the reliability and validity of the assessments among 1858 adult Danish employees, 20 to 60 years of age, 49 per cent women and the response rate of 62 per cent. The medium size questionnaire for work environment professionals has been developed in which all dimensions have a national average of 50. Results deviated from the average were in a job group of technicians, shop assistants, secretaries, domestic helpers, accountants, metal workers, shop assistants, cleaners, drivers, office clerks and food industry workers. When the questionnaire is used for assessing the psychosocial work environment of a workplace it is possible to compare each department as well as the whole workplace with the national average on all 26 dimensions.

Since the study population in each country differed culturally and sociodemographically from one to another, therefore a translation version of the questionnaire is required for the assessment of the local population study. Beside the main study, a pilot-study on reliability-validity of the Copenhagen Psychosocial Questionnaire in Malaysian population hopefully may provide a valid new tool for assessing psychosocial factors at work for Malaysian use.

Study Material

The validity of the study depends on the sampling methodology used, instrument reliability and validity, and the design of the study (Steve, 2003). It is important to have a reliable and valid study instrument before conducting a study (Abramson et al, 1999). For this research, since the study instrument, the Copenhagen Psychosocial Questionnaire has been developed in other countries; and since each country differed socio-culturally, therefore there is a need for validation of this

instrument and to look how acceptable the instruments to Malaysian population.

Reliability refers to the stability or consistency of information, which means the extent to which similar information is obtained when a measurement is performed more than once. There are various indices for reliability measurement. For this research, after considering the most practical measurement to be used for an interval or ratio-scale measure questionnaire, the test-retest method will be conducted during the pretesting period.

The Copenhagen Psychosocial Questionnaire (COPSOQ) is a new tool for assessing psychosocial factors at work and has been prepared by the National Institute of Occupational Health (NIOH) of Copenhagen, Denmark in year 2000. It has been developed in three versions: a long version for researchers, a medium size version to be used by work environment professionals, and a short version for the workplaces. The whole concept has been labelled "the three-level concept".

The permission to use the questionnaire has been obtained from the author. In order to make sure the objective to assess the work-related psychosocial status using the medium size version of the questionnaire is met, the author has emphasized that the researcher must use either long version or medium size version of the questionnaire. The short version can only be used by the workplaces employer, not for research purposes. The 95-item medium version of COPSOQ has been used in this study. The questionnaire has been validated internationally and it is a reliable instrument for assessment of exposure applies to the psychosocial field (Steve, 2003).

The questionnaire / instruments have been developed in the form of Likert Scale. The values above or at average are

considered having psychosocial problems (positive psychosocial status), whereas values below average are considered not having psychosocial problems (negative psychosocial status). The scales of the COPSOQ are formed by adding the points of the individual questions of the scales by giving equal weights to each question. The scale value is calculated as the simple average. Respondent who answer less than half of the questions in a scale is regarded as missing. If a person has answered at least half of the question, the scale value is calculated as the average of the questions answered (Steve, 2003).

Study Methods

The initial preparation was in English version. The whole set of the questionnaire has been translated to Bahasa Malaysia by a qualified and an expert person in both language, and the other person translated back to English version without referring to the original questions. It is purposely done to make sure the original content and meanings of the questionnaire will be the same.

The self-administered question-naire was distributed to 50 subjects consists of 25 staffnurses who are shiftworkers and another 25 staffnurses who are not doing shiftworkers and were chosen randomly. Data was collected 2 times (Test-Retest Method) 2 weeks apart. Each respondent was given a set of complete self-administrated questionnaire in an envelope that has been distributed by the matron of Hospital Selayang. The complete questionnaire was returned back to the matron after 2 weeks.

Raw data obtained was coded and entered into Statistical Package for Social Sciences (SPSS) Version 11.5. The data was edited and cleaned for double entry and outliers before analysis could be done.

Results

It is highly probable that language is a factor confounding the validity-reliability of the study and it is important to look into it. The initial preparation of COPSOQ questionnaire was in English version. The whole set of the questionnaire has been translated to Bahasa Malaysia by a qualified and an expert person in both language, and the other person translated back to English version without referring to the original questions. It is purposely done to make sure the original content and meanings of the questionnaire will be the same and to ensure better reliability for the main study.

Sensitivity and specificity of the instrument had been evaluated by comparing the scores in exposed group and un-exposed group for the psychosocial factors. The validity was established by calculating the percentage of sensitivity and specificity at the different score level around the average score. However from the result, score 52 percent is taken as an overall index that expresses the probability that measure the psychosocial problems (Table 1).

Table 1. Validity Test – Percentage Sensitivity and Specificity at Different Score Level

Psychosocial Scores (%)	Sensitivity (%)	Specificity (%)
44	100	36
46	100	44
48	92	56
50	84	64
52	76	76
54	60	84
56	48	92

Both percentage of sensitivity against specificity for those different score levels were plotted to produce a ROC (Receiver Operating Characteristics) curve (Figure 1) and the highest both sensitivity and specificity (score 52 percent) are used as an overall index that expresses the probability that measure the psychosocial problems.

The differences between the paired (paired test-retest means) samples, calculated using paired sample t-test (Table 2), shows that mean scores of test and the retest were not significant for all scales. This means the variations between scores from the two administrations were insignificant and are thus, reliable and consistent (Loh, 2002).

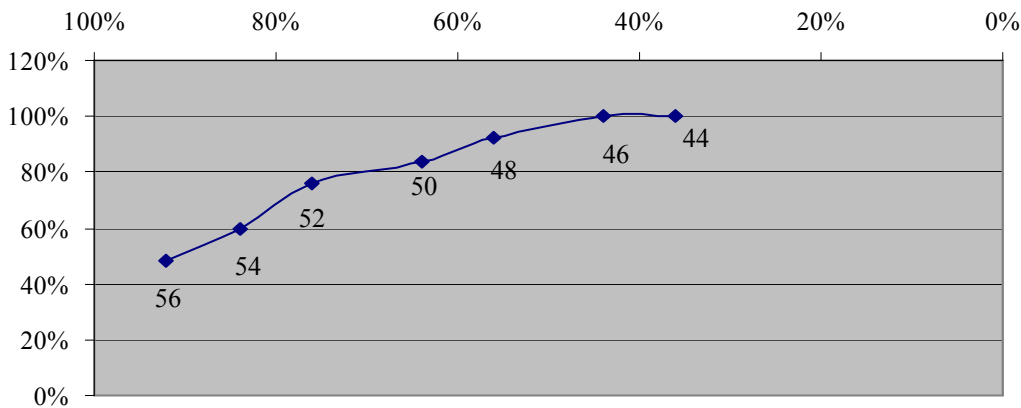


Figure 1. ROC (Receiver Operating Characteristics) curve for psychosocial status score.

Table 2. Descriptive of Test-Retest Mean Scores and Paired Sample T-Test

COPSOQ 26 Scales	Test mean-scores (+SD) n=50	Retest mean-scores (+SD) n=50	Mean Differences			t	Sig. (2-tailed)
			Mean Diff. + SD	95% CI (Lower-upper Diff.)			
				L	U		
Quantitative demands	39.00(12.91)	40.50 (10.51)	-1.50 (13.81)	-5.42	2.42	-0.77	0.446
Cognitive demands	37.13 (4.95)	36.87 (4.59)	0.25 (5.20)	-1.22	1.72	0.34	0.735
Emotional demands	32.67 (11.88)	33.83 (12.42)	-1.17 (14.48)	-5.28	2.95	-0.57	0.571
Demands for hiding emotions	42.75 (13.14)	42.25 (13.81)	0.50 (14.28)	-3.55	4.55	0.25	0.805
Sensorial demands	38.63 (11.62)	42.75 (11.32)	-4.13 (12.35)	-7.64	0.62	-2.36	0.220
Influence at work	53.37 (13.78)	54.50 (13.48)	-1.13 (12.67)	-4.72	2.47	-0.63	0.533
Possibilities for development	65.75 (11.79)	65.75 (14.41)	0.00 (13.77)	-3.91	3.91	0.00	1.000
Degree of freedom at work	24.87 (7.19)	27.25 (7.44)	-2.37 (8.17)	-4.70	0.05	-2.06	0.045
Meaning of work	79.16 (10.27)	77.99 (9.33)	1.17 (10.92)	-1.94	4.27	0.76	0.454
Commitment to workplace	54.87 (24.07)	55.13 (23.17)	-0.25 (22.30)	-6.58	6.08	-0.80	0.937
Predictability	74.00 (11.80)	73.75 (12.44)	0.25 (13.24)	-3.51	4.01	0.13	0.894
Role-clarity	71.75 (11.24)	72.00 (10.12)	-0.25 (12.56)	-3.82	3.32	-0.14	0.889
Role-conflicts	26.13 (11.27)	27.87 (11.65)	-1.75 (11.85)	-5.12	1.62	-1.04	0.301
Quality of leadership	79.50 (14.40)	82.13 (14.45)	-2.63 (13.66)	-6.51	1.26	-1.36	0.181
Social support	72.13 (3.62)	72.37 (3.81)	-0.25 (3.78)	-1.33	0.82	-0.47	0.642
Feedback at work	61.00 (9.99)	61.25 (9.86)	-0.25 (10.26)	-3.16	2.66	-0.17	0.864
Social relations	31.12 (12.27)	29.08 (12.34)	2.04 (14.06)	-1.99	6.08	1.02	0.315
Sense of community	78.57 (15.96)	75.17 (14.78)	3.40 (15.21)	-0.97	7.77	1.57	0.124
Insecurity at work	65.31 (34.16)	64.80 (33.82)	0.51 (36.97)	-10.11	11.13	0.10	0.923
Job satisfaction	76.66 (9.44)	76.66 (9.86)	0.00 (11.05)	-3.17	3.17	0.00	1.000
General Health	48.67 (5.75)	49.18 (4.93)	-0.51 (6.39)	-2.35	1.33	-0.56	0.579
Mental Health	34.56 (10.77)	33.76 (11.72)	0.80 (12.47)	-2.74	4.34	0.45	0.652
Vitality	44.70 (12.22)	43.60 (12.26)	1.10 (13.49)	-2.73	4.93	0.58	0.567
Behavioural stress	14.25 (8.19)	15.75 (8.68)	-1.50(7.63)	-3.67	0.67	-1.39	0.171
Somatic stress	29.87 (14.07)	28.87 (13.99)	1.00 (14.25)	-3.05	5.05	0.50	0.622
Cognitive stress	27.00 (14.75)	28.37 (14.52)	-1.38 (15.74)	-5.85	3.09	-0.62	0.540

* All scales show the mean-difference are not significant at $p < 0.05$

The reliability of the questionnaire and its 26 scales was assessed by calculating the coefficient-correlation test using Pearson (r) which showed that overall questionnaire has value r within a range of 0.00 to 1.00. They

were clearly showed that correlation for each scale showed statistically significant at the 0.05 level. The strength of the correlation of test-retest is presented in Table 3.

Table 3. Reliability of COPSOQ Scales on Malaysian Sample

COPSOQ 26 Scales	No. of Questions	Pearson, r n=50	Significant (2-tailed)
Quantitative demands	4	0.319*	0.024
Cognitive demands	4	0.409*	0.003
Emotional demands	3	0.290*	0.041
Demands for hiding emotions	2	0.440*	0.001
Sensorial demands	4	0.421*	0.002
Influence at work	4	0.568*	0.000
Possibilities for development	4	0.462*	0.001
Degree of freedom at work	4	0.377*	0.007
Meaning of work	3	0.383*	0.006
Commitment to workplace	4	0.555*	0.000
Predictability	2	0.404*	0.004
Role-clarity	4	0.312*	0.027
Role-conflicts	4	0.466*	0.001
Quality of leadership	4	0.551*	0.000
Social support	4	0.483*	0.000
Feedback at work	2	0.466*	0.001
Social relations	2	0.348*	0.014
Sense of community	3	0.513*	0.000
Insecurity at work	4	0.408*	0.004
Job satisfaction	4	0.346*	0.015
General Health	5	0.291*	0.042
Mental Health	5	0.388*	0.005
Vitality	4	0.395*	0.005
Behavioural stress	4	0.592*	0.000
Somatic stress	4	0.485*	0.000
Cognitive stress	4	0.422*	0.002

*Correlation is significant at the 0.05 level (2-tailed). All correlation is significant for 26 scales.

Discussion

The validity-reliability of the Malay Version of COPSOQ for 50 staffnurses was tested. Score 52 percent has the highest both sensitivity and specificity is used as an overall index that expresses the probability that measure the psychosocial problems. There were no variations between scores from the two administrations of the questionnaire and are thus, reliable and consistent. Based on the reliability methods in the Survey Methods in Community Medicine (Abramson et al, 1999) stated that for value r below 0.5 suggested poor to moderate reliability, 0.5 to 0.75 suggested moderate to good reliability and above 0.75 suggested good reliability. From the findings above showed that the questionnaire has poor to moderate reliability. This could be attributed to some changes in the scores during the test and retest. Since each domains comprised from 2 to 5 questions, therefore, there is likelihood changes in the total scores although majority of individual items or questions may not changed much during test retest.

The validity showed high sensitivity and specificity in the Malay version COPSOQ. Therefore, it is sensitive and specific at assessing the psychosocial impact of the workers. The cut off point were 76 for both sensitivity and specificity. These cut off points were chosen based on the need that the questionnaire to be highly sensitive and specific. The purpose of having high specificity is to overcome Type I error (False positive).

Overall, the COPSOQ questionnaire as a whole is a reliable tool to measure psychosocial work environment factors in a Malaysian population.

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Hepatitis B Sero-Conversion Following Immunisation among a Cohort of Rural Australian Health Care Workers

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Abstract

Although vaccination against Hepatitis B Virus (HBV) is highly effective in preventing occupational transmission among health care workers, not all people develop protective immunity. Furthermore, little is known about sero-conversion in rural areas. We investigated the serology of Anti HBV Surface Antigens (Anti-HBs) among staff at a regional health facility in Queensland, Australia between 1998 and 2000. Anti-HBs concentrations were divided into four categories (<10, 10 to 499, 500 to 999, \geq 1000 mIU/mL), with <10 mIU/mL considered unprotected. Statistical analysis was conducted by intention to treat. At baseline, 91.8% of staff were found to be unprotected against HBV. After the first vaccination, this level had dropped to 44.3% and further to 9.8% by the second schedule. However, after 3 vaccinations, 1.6% of the original group still had Anti-HBs levels below 10 mIU/mL and thus, remained unprotected. Overall, this study has shown that Anti-HBs levels among rural cohorts can be increased by multiple booster vaccinations. Nevertheless, HBV vaccine was not 100% effective, even after 3 doses. Vaccination against HBV is an important occupational consideration in many areas of health care. Nevertheless, as a certain percentage of individuals in rural areas do not successfully sero-convert, alternative vaccination strategies may need to be considered.

Keywords: Hepatitis B Virus, Regional, Vaccination, Occupational, Australia

Introduction

Vaccination against Hepatitis B Virus (HBV) has been shown to be highly effective in preventing horizontal transmission (Brotherton et al, 2003). HBV vaccine is now almost universally offered to hospital staff (Queensland Department of Health, 2004). HBV immunization has been a condition of employment with Queensland Health since 1997 (Murray et al, 2002). Despite a high coverage rate, up to 12% of health care workers may not develop protective Anti HBV Surface Antigens

(Anti-HBs) following vaccination (Playford et al, 2002). As this group is clearly at risk, occupational screening for Anti-HBs is highly recommended (Public Health Association of Australia, 2004). Despite this fact, little is known about occupational sero-conversion following HBV immunization and the epidemiology of Anti-HBs levels in regional health facilities.

Subjects and Methods

We investigated the nature of Anti-HBs sero-conversion among staff at a rural,

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mental health facility in Charters Towers, Queensland, Australia between 1998 and 2000. Anti-HBs levels were established using ELISA at Queensland Pathology Health Services. Concentrations were divided into the following categories: <10, 10 to 499, 500 to 999 and ≥ 1000 mIU/mL. Staff with Anti-HBs levels below 10 mIU/mL were considered to be unprotected against HBV. Those with a low level (<10) were automatically offered a booster vaccination, while those with Anti-HBs levels between 10 and 499 were also offered a booster vaccine to increase their potential level of immunity. Staff were re-tested three months after the booster vaccination. Three vaccination schedules were offered and statistical calculations were performed by intention to treat (as a percentage of all staff).

Results

A total of 61 individuals were studied. Most (78.7%) were health care workers,

employed as registered nurses, enrolled nurses or nursing assistants. Their mean age was 51.5 years (SD: 10.5 years). At baseline, 91.8% were considered to be unprotected against HBV. After the first vaccination, this level had dropped to 44.3% and further to 9.8% by the second schedule. However, after 3 vaccinations, 1.6% of the original group still had Anti-HBs levels below 10 mIU/mL. The serology of Anti-HBs in the other concentration ranges was not linear, although all showed an improvement. The percentage of staff in the range 10 to 499 mIU/mL rose continuously throughout the vaccination schedule. A similar effect was also seen for the concentration range $\geq 1,000$ mIU/mL. Interestingly, for 500 to 999 mIU/mL, the number levelled off after 2 vaccinations, with no improvement seen after 3 courses (Refer to Table 1). Over the duration of our study, 8 staff dropped out or were lost to follow-up due to resignation, relocation or retirement.

Table 1. Anti HBV Surface Antigen Concentrations among Rural Health Care Workers

Concentration	Number and Percentage of Staff at Each Vaccination ^a							
	Baseline		First		Second		Third	
<10 mIU/mL	56	(91.8)	27	(44.3)	6	(9.8)	1	(1.6)
10 – 499 mIU/mL	0	(0.0)	22	(36.0)	27	(44.3)	28	(45.9)
500 – 999 mIU/mL	0	(0.0)	2	(3.3)	3	(4.9)	3	(4.9)
≥ 1000 mIU/mL	0	(0.0)	10	(16.4)	19	(31.1)	21	(34.4)
Unknown ^b	5	(8.2)	0	(0.0)	6	(9.9)	8	(13.2)
TOTAL	61	(100)	61	(100)	61	(100)	61	(100)

^a Calculated as a percentage of all staff, with intention to treat (n = 61)

^b Staff member was either not tested at baseline or lost to follow-up

Discussion

This investigation showed that the majority of rural health staff who were vulnerable to HBV at baseline had reached adequate immunity by the third vaccination schedule. Nevertheless, after three doses some of our original group still had Anti-

HBs levels below the recommended figure. As such, this study has demonstrated that Anti-HBs levels among rural health care workers can certainly be improved by HBV vaccination. However, there are a few reasons why rural staff may be difficult to vaccinate and follow-up. Firstly, there may be problems accessing appropriate health

care facilities. Secondly, HBV vaccination may not attract a high priority in regional areas, where community levels of the disease are probably lower than for urban centres. Thirdly, it may also be difficult to follow-up staff after vaccinations, simply due to the dispersed geographical nature of many rural communities. Nevertheless, HBV vaccination is highly recommended for all health care workers and those at risk of occupational exposure to HBV. Health care workers whose occupation poses a potential risk of exposure to blood or body fluids must be immunised against HBV according to Queensland Health Infection Control Guidelines (Queensland Department of Health, 2004). HBV immunisation is a condition of employment for Queensland Health workers who have direct patient contact, as well as those staff who may be occupationally exposed to blood or body fluids. By the end of our study, a small but significant proportion of the original group remained unprotected against HBV. It has been previously suggested that as many as 12% of vaccinated health care workers may not develop protective antibodies in this regard (Playford et al, 2002). Where adequate Anti-HBs levels are not reached following three vaccinations, the possibility of HBsAg carriage should be investigated (Public Health Association of Australia, 2004). Those who are HBsAg negative and do not respond should be offered further doses of vaccine. Persistent non-responders should be informed about the need for Hepatitis B Immunoglobulin (HBIG) within 48 hours of parenteral exposure to HBV (Public Health Association of Australia, 2004). Intradermal administration of HBV vaccine has also been trialled for those failing to sero-convert, and may hold some promise in various health care situations (Playford et al, 2002). Controlled trials of intradermal HBV vaccine should now be undertaken among rural cohorts where immunisation-related sero-conversion does not reach 100%.

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Off -Site Emergency Planning

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Abstract

Emergency in a major hazard installation may cause extensive damage to property and serious disruption both inside and outside the installation. The overall objectives of an emergency plan are: to localise the emergency and, if possible, eliminate it; and to minimise the effects of the accident on people and property. The off-site emergency plan is an integral part of any major hazard control system. In many countries the duty to prepare the off-site plan lies with the local authorities, including Malaysia. Thus, the preparations of written off-site emergency response planning is required to minimize the impact of major accident to the people , property and environment.

Keyword: emergency, plan, off-site, Malaysia

Introduction

A major emergency in a major hazard installation is one, which has the potential to cause serious injury, loss of life, and damage to environment. It may cause extensive damage to property and serious disruption both inside and outside the major hazard installation. It would normally require the extensive assistance of outside emergency services to handle it effectively. Although the emergency may be caused by a number or different factors, e.g plant failure, human errors, earthquake, vehicle crash or sabotage, it will normally manifest itself in three basic forms: fire, explosion or toxic release.

Other major hazard controls are concerned with preventing accidents through good design, operation, maintenance and inspection. Achieving all this will reduce the risk of an accident, but it will not eliminate it altogether - absolute safety is not achievable,

and an essential part of major hazard control is concerned with mitigating the effects of a major accident.

An important element of mitigation is emergency planning, i.e recognising that accidents are possible, assessing the consequences of such accidents and deciding on the emergency procedures, both on site and off-side, that would need to be implemented in the event of an emergency.

Emergency plans are likely to be separate for on-site and off-site matters, but they must be consistent with other, i.e. they must be related to the same assessed emergency conditions. While an on-site plan will always be the responsibility of the manufacturer, different legislations may place the responsibility for the off- site plan elsewhere: for example, the Control of Industrial Major Accidents Regulations (CIMAH), 1996 requires the authority to prepare the off-site plan but not mandatory.

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Objective of Emergency Planning

The overall objectives of an emergency plan are: to localise the emergency and, if possible, eliminate it; and to minimise the effects of the accident on people and property.

Elimination will require prompt action by operators and installation emergency staff using, for example fire-fighting equipments emergency shut-off valves and water sprays.

Minimising the effects may include rescue, first aid, evacuation, rehabilitation and living information promptly to people living nearby.

Off-Site Emergency Planning

The off-site emergency plan is an integral part of any major hazard control system. It should be based on those accidents identified by the manufacturer, which could affect people, property and the environment outside the installation. Thus, the off-site plan follows logically from the analysis that took place to provide the basis for the on-site plan and the two plans should therefore complement each other. The off-site plan in detail should be based on - those events, which are most likely to occur, but other less likely events, which would have severe consequences should also be considered. Incidents which would have very severe consequences yet have a small probability of occurrence will be in this category, although there will be certain events which are so improbable that it would not be sensible to consider them in detail in the plan. These events might include aircraft crashes on to the installation. However, the key feature of a good off-site emergency plan is flexibility in its application to emergencies other than those specifically included in the formation of the plan.

The roles of the various parties who may be involved in the implementation of an off-site plan are described below. For CIMAH regulation, the responsibility for the off-site plan will be likely to rest with the

manufacturer and local authority. Either way, the plan must identify an emergency coordinating officer who would take overall command of the off-site activities. As with the on-site plan, an emergency control centre will be required within which the emergency coordinating officer can operate.

An early decision will be required in many cases on the advice to be given to people living "within range" of the accident - in particular whether they should be evacuated or told to go indoors. In the later case, the decision can regularly be reviewed in the event of an escalation of the incident. Consideration of evacuation may include the following factors:

- (a) in the case of a major fire but without explosion risk (e.g. an oil storage tank), only houses close to the fire are likely to need evacuation, although severe smoke hazard may require this to be reviewed periodically;
- (b) if a fire is escalating and in turn threatening a store of hazardous material, it might be necessary to evacuate people nearby, but only if there is time; if insufficient time exists, people should be advised to stay indoors and shield themselves from the fire. This latter case particularly applies if the installation at risk could produce a fireball with very severe thermal radiation effects (e.g. Liquidified Petroleum Gas storage);
- (c) for releases or potential releases of toxic materials, limited evacuation may be appropriate down wind if there is time. The decision would depend partly on the type of housing 'at risk'. Conventional housing of solid construction with windows closed offers substantial protection from the effects of a toxic cloud - while shanty houses

which can exist close to factories, particularly in developing countries, offer little or no protection.

The major difference between releases of toxic and flammable materials is that toxic clouds are generally hazardous down to much lower concentrations, and therefore hazardous over greater distances. Also, a toxic cloud drifting at, say, 300 meters per minute cover a large area of land very quickly. Any consideration of evacuation must take this into account.

Although a plan should have sufficient flexibility built into cover the consequences of the range of accidents identified for the on-site plan, it is suggested that it should cover in some detail the handling of the emergency to particular distance from each major hazard installation. This distance may be judge form the result of worst case consequence analysis.

Identification and Assessment of Hazards

Most major hazard accidents come within the following categories:

- (1) Events involving flammable materials
 - (a) major fires with no danger of explosion: hazards from prolonged high levels of thermal radiation and smoke.
 - (b) fire threatening items of plant containing hazardous substances; hazards from spread of fire, explosion or release of toxic substances.
 - (c) explosion with little or no warning; hazards from blast wave, flying debris and high levels of thermal radiation.
- (2) Events involving toxic materials
 - (a) slow or intermittent release of toxic substances, e.g. from a leaking valve.
 - (b) items of plant threatened by fire (Chemical Industrials Association,

1976); hazards from potential lost of containment.

- (c) rapid release of limited duration, due to plant failure. e.g fracture of pipe: hazards from toxic cloud, limited in size, which may quickly disperse.
- (d) massive release of toxic substance, due to failure of large storage or process vessel or uncontrollable chemical reaction and failure of safety systems; the exposure hazard would affect a wide area.

The assessment of possible incidents should produce a report indicating -

- (a) the worse events considered.
- (b) the route to those worst events.
- (c) the time-scale to lesser events along the way.
- (d) the size of lesser events if their development is halted.
- (e) the relative likelihood of events.
- (f) the consequences of each event.

Incidents should be assessed in terms of the quantity of hazardous materials which could be released, the rate of release and the effects of that release – i.e. as thermal radiation from a fire or fireball or as a toxic gas cloud - as a function of distance from the plant.

Guidance on the dangers of uncommon hazardous substances should be obtained from the suppliers of those substances.

The overall assessment of the major hazard provides the framework for both emergency plans to be drawn up.

Aspects to be Included in an Off-Site Emergency Plan

The CIMAH Regulation has not given the aspects to be included in off-site emergency plans but ideal plan develop at least having the following:

Organisation

Details of command structure, warning systems, implementation procedures, emergency control centers names and appointments of incident controller, site main controller, their deputies and other key personnel.

Communications

Identification of personnel involved, communication centre, call sign, network, lists of telephone numbers.

Specialised Emergency Equipment

Details of availability and location of heavy lifting gear, bulldozers, specified fire-fighting equipment fire boats.

Specialised Knowledge

Details of specialist bodies, firms and people upon whom it may be necessary to call, e.g. those with specialised chemical knowledge, laboratories.

Voluntary Organisations

Detail of organisers, telephone numbers, resources, etc.

Chemicals Information

Detail of the hazardous substances stores or processed on each site and a summary of the risks associated with them.

Meteorological Information

Arrangements for obtaining details of weather conditionals prevailing at the time and weather forecasts.

Humanitarian Arrangements

Transport, evacuation centres, emergency feeding, treatment of injured, first aid, ambulances, temporary mortuaries.

Public Information

Arrangements for:

- (a) dealing with the media-press office.
- (b) informing relatives.

Assessment

Arrangement for:

- (a) collecting information on the causes of the emergency.
- (b) reviewing the efficiency and effectiveness of all aspects of the emergency plan.

Role of the Emergency Coordinating Officer

The various emergency services will be coordinated by an emergency coordinating officer (ECO) who is likely to be a senior police officer but, depending on the circumstances, could be a senior fire officer. The ECO will liaise closely with the site main controller.

Role of Major Hazard Installation Managements

The role of major hazard installation managements in off-site emergency planning will be to establish liaison with those preparing the plants and to provide information appropriate to such plans. This will include a description of possible on-site accidents with potential for off-site harm, together with their consequences and an indication of the relative likelihood of the accidents.

Advice should be provided by major hazard installation managements to all the outside organisations which may become involved in handling the emergency off site and which will need previously to have familiarised themselves with some of the technical aspects of the major hazards installation activities, e.g. emergency services, medical departments and also water authorities (if water contamination could be a consequence of an accident).

Role of the Local Authority

In many countries the duty to prepare the off-site plan lies with the local authorities, including Malaysia. They may

have appointed an emergency planning officer (EPO) to carry out this duty as part of the EPO's role in preparing for a whole range of different emergencies within the local authority area. The EPO will need to liaise with the major hazard installation to obtain the information to provide the basic for the plan. This liaison will need to be maintained to ensure that the plan is continually kept up to date.

It will be the responsibility of the EPO to ensure that all those organisations which will be involved off site in handling the emergency know of their role and are able to accept it by having, for example, sufficient staff and appropriate equipment to cover their particular responsibilities.

Role of the Police

The overall control of an emergency is normally assumed by the police, with a senior officer designated as emergency coordinating officer. Formal duties of the police during the emergency include protecting life and property and controlling traffic movements. Their function including controlling bystanders, evacuating the public, identifying the dead and dealing with casualties, and informing relatives of death injury.

Role of the Fire Authorities

The control of a fire is normally the responsibility of the senior fire brigade officer who would take over the handling of the fire from the site incident controller on arrival at the site. The senior fire brigade officer may also have a similar responsibility for the other events, such as explosions and toxic releases. Fire authorities should be familiar with the location on site of all stores of flammable materials, water and foam supply points, and fire-fighting equipment. They may well have been involved in on-site emergency rehearsals both as participants and, on occasion, as observers of exercises involving only site personnel.

Rehearsals and Exercises in Off-Site Emergency Planning

Extensive experience in the chemical industry with on-site emergency planning has proved the need and value of rehearsals of emergency procedures.

The organization responsible for producing the off-site plan should test its arrangements in conjunction with on-site exercises. Table-top rehearsals have proved extremely useful in such cases, although needing close control to maintain a sufficient element of realism in the exercises.

An essential component of any trial is that of testing fully the various communication links necessary to gather the information needed for overall coordination, e.g. between major hazard installation and emergency control centre and the incident.

Management of major hazard installation are well placed to advise on the setting up of rehearsals, and particularly to advise on the scope for an escalation in the degree of emergency.

Information to the Public

Experience of major accidents, particularly those involving toxic gas releases, has shown the importance of the public nearby having prior warning of: (a) how to recognize that an emergency is occurring; (b) what action they should take; (c) what remedial medical treatment would be appropriate for anyone being affected by the gas. CIMAH regulation requires those living near to the major hazard installation to be given information, particularly covering their action in the event of an emergency. For inhabitants of conventional housing of solid construction, the advice in the event of an emergency is to go indoors and close all doors and windows, switch off all ventilation air conditioning, and switch on the local radio for further instructions.

Where the large numbers of shanty-dwellers like close to a major hazard

installation, this advice would be inappropriate because, for example, of the low protection from gas cloud that such housing offers, and large-scale evacuation might, be necessary. In these cases, film shows are considered a useful medium for passing advice to local people, particularly where a proportion of them may be unable to read.

Conclusion

Although identification, prevention and mitigation of major accident in place at major hazard installation but risk of occurrence such accident cannot be eliminate. Thus, the preparations of written off-site emergency response planning is required to minimize the impact of major accident to the people, property and environment. The most important is to keep up to date of the establish plan and conduct drill to ensure the plan is working.

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Safety in the Construction Industry: Are we Barking at the Wrong Tree?

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Abstract

The construction industry is an important industry in the Malaysian's economy. Much has been said about the quality of the product as well as the image of the industry due to the small percentage of local workers on site. The industry's welfare and safety record is not at all encouraging. To stop the rot, the government has taken important and significant steps by the establishment of the Malaysian Construction Industry Development Board (CIDB) and the National Institute of Occupational Safety and Health (NIOSH). These efforts have shown some significant positive improvement in the perception and action of those involved in the industry but we are still far from the standard shown in other developed countries in terms of site safety. This paper is to discuss the roles and responsibilities of the key players in the industry be it the clients, consultants or contractors. The focus is on the 'upstream' activities i.e. the pre-construction stage, rather than the 'downstream' i.e. the construction phase of a project:

Keyword: safety, responsibilities, upstream activities, Malaysia.

Introduction

The building and construction industry is a dynamic and hazardous industry, making it both unique and challenging to study. This is due to diverse and complex nature of work tasks, trades and environments, as well as the temporary and transitory nature of construction workplaces in the construction workforce. Have you come across an incident involving an express bus causing catastrophic death? In usual case scenario, the driver is always found guilty of reckless driving and will be given a few years prison sentence. On the other hand, what about the company? No charge was taken and of course they are covered by insurance and in no time they can buy a new bus and hire another driver. In other words they got off scott's free! Now let us think, who is in charge of the company, who hires the driver,

who is in charge of maintenance, who design the drivers schedule-the answer is the management. Therefore, in many ways they are also responsible for the accident. This example is taken as to compare what is happening on construction sites. In the event of an accident, all fingers will be pointing to the contractor. There are many contributory factors to any accident that happens. This will be discussed further later, but the point here is that in any accident on construction site, the root cause of an accident must be looked into and the contractor or builder is not the only one to be blamed for any injury or fatality on construction site.

The theory of accident causation

There are many theories about accident causation but one of the most simple and easy to accept theory is the Domino Theory. This theory has been developed in the

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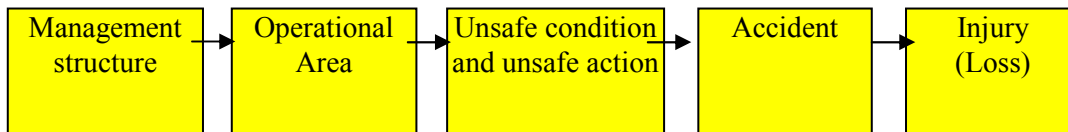


Figure 1: Adam's Dominoes Sequence (Adapted from: Karim & Lee,1993)

1930's by a man called Heinrich and has been modified by several others including Bird (1974) and Adam (1976).

The above Figure 1 shows the dominoes in Adam's theory which represents the elements that contribute to the injury resulting from an accident. Basically, the source of an accident is at the management level, example lack of clear safety policy for the project, and this might triggers choosing in competent contractor who do not care about safety resulting in dangerous operation. The unsafe action or operation

will result in accidents to happen and workers will suffer.

Another famous theory is The Failure Initiation Theory by Whittington et al (1992). This theory addresses deficient policy in the top of organizational level, suggesting that it stimulates failures in the lower levels of organization, including in the site and operational levels. The model of this theory is as shown in Figure 2 below.

Figure 2 suggests that there four levels at which failures can occur. In this theory, the failures at higher level will increase the probability of failures at lower



Figure 2: Adam's Dominoes Sequence (Adapted from: Karim & Lee,1993)

level. Failure at top level can be the failure of the company's policy which will increase the probability of failures at the project level. Examples of failures at this level are, in adequate in training policy or poor methods of procurement. At the project level the failures are, lack of planning, poor work schedule, or choice of inappropriate construction methods. At the site management level, failures can be poor communication, lack of supervision or failure to adequately segregate work. At individual level failures can be wrong equipment or failure to comply with an agreed method of work.

Therefore causes of accident in construction site can be linked to many factors that can be traced along the production process i.e. even before the

construction starts. This is where the roles of other players in the production process namely the client and consultants or designers in the upstream activities can be related to what is happening on site.

Who is responsible?

It is common in the construction industry that design and construction be undertaken separately by different professional organisations. Design of the constructed facility is normally the responsibility of an architect and engineer, whereas design of the construction process, including safety, is conventionally considered to be the contractors' responsibility. It is now generally understood in Europe, enshrined in European legislation and, more specifically, since the introduction in 1994 of the

Construction [Design and Management] (CDM) Regulations into UK legislation, that design of the constructed facility should take into account foreseeable risks during the construction process (Duff & Suraji, 2000).

Since introduction of the domino theory of accident causation (Heinrich, 1969), accidents have not been only viewed as a consequence of operative unsafe actions and unsafe site conditions but further as a consequence of lack of management control. Research in the last decade show that management and organisational failures are often precursors of accidents (Reason, 1993; Groeneweg, 1994). It has been found that around 70% of accidents could be prevented by improved management (HSE, 1988). Duff (1998) specifically asserts that construction safety problems are, and always have been, one of management control. In fact, the term 'management control' here is generally understood to be part of contractors' management, related to the construction process. Construction site safety is widely perceived as a matter of construction management rather than clients' management or other participants' management. Therefore, when a construction accident takes place, perceived factors of construction accidents causation are always associated with contractor's management failures or site operative failures to control unsafe site conditions or unsafe actions (Abdelhamid and Everett, 2000). In the ARCTM (analysis of root causes tracking model) developed by Abdelhamid and Everett (2000), possible errors stimulated by the designers or clients are not recognised as possible causal factors. This may result from lack of understanding as to how these participants can share their attempts in promoting construction safety.

Accident causes focusing on the upstream activities

Churcher & Alwani (1996) divide the causes of construction accidents into three classes: those due to design decisions, those

due to lack of planning and those due to failure during construction process.

The percentages in each category are shown below:

Design – 36 % Planning – 36 %
Construction – 27 %

These figures were obtained from European Communities. This means 63 % of fatalities and injuries on site are traceable back to design decisions or lack of planning. It is argued that many of these situations are avoidable if due thought is given at the early stage of the projects i.e. how the nature of the design will influence the construction process and the health and safety of workers on site.

All players in the industry have vital roles to ensure better health and safety, which in turn will result in better quality and productivity. Their contributions has been highlighted by several authors as follows:

The Client

Clients have great influence on the overall success of a project. Clients have the moral if not legal duty to take reasonable care to ensure safety to all workers on construction site. They have to make sure the contractors recognise their contractual responsibility to work in a healthy and safe manner. Due to the optimal interaction with designers or consultants, clients have great influence to encourage designers to recognise the importance of health and safety aspects of any particular project (Jeffery and Douglas 1994). The client should realise that successful projects are those projects not only completed in time within cost and according to specification but also being done with due consideration for health and safety of the workers. The client is responsible to provide a detailed comprehensive brief for the design team. This is the most crucial phase to ensure minimum variations of design during

construction phase where variations from the brief can be the catalyst that triggers a series of events from designer through to workers that culminate in a site accident (Smallwood 1996).

Client's pressure to complete a project due to commercial demands can be counter productive and negatively effects health and safety because this will results in undue stress to workers in order to complete the job under pressure (O'Reilly et al 1994).

In a survey done in South Africa by Smallwood (1998), he concludes that most clients give priority equally to cost and quality and only a minority give priority to health and safety.

According to Smallwood (1993), majority of the South African general contractors when surveyed responded that the client's has great influence on their health and safety performance. This can be summarised as 72.7 % less accidents, 29.5% less rework, 25% increased productivity, 25% reduced accident costs and 22.7% gain compensation insurance rebates.

Designers

The International Labour Office (ILO) (1997) recommends that those involved in the design and planning of projects:

- (a) Should not include anything in design and planning which would necessitate the use of dangerous structural or other procedures and, or hazardous materials which could be avoided by design modifications or by substitute materials, and
- (b) Should consider the health and safety of workers during maintenance subsequent to project completion by; inter alia, designing so that such maintenance can be performed with the minimum risk.

Several authors have written about the importance of design in relation to health and safety. Here are some of them:

Jeffrey and Douglas (1994), " It has to be accepted that in terms of causation there is a link between design decisions and safe construction and maintenance. Especially maintenance access, late design, inadequate design and design changes during construction." This is based on research carried out by The European Foundation for Improvement of Living and Working conditions, which concluded, that site fatalities (Smallwood, 1998):

- (a) 35% were caused by falls, which could have been reduced through design decisions;
- (b) 28% are due to the simultaneous performance of incompatible activities, and;
- (c) 37% are due to the management of production

Based on a research done in the USA concerning the impact of design on health and safety, Hinze and Gambatese (1994) give the following findings;

- (a) In terms of the contribution of the various disciplines of design to health and safety, structural was identified the most frequently followed by architectural and then civil;
- (b) In terms of site hazard, falls were identified most frequently followed by obstructions and cave-ins, and
- (c) In terms of project components, structural-above grade was identified most frequently followed by architectural, and mechanical / electrical.

Hinze and Gambatese (1994) cite the following suggestions resulting from the research;

- (a) Pre-fabricate building components in the prefabrication works or on the ground, and erect them as complete assemblies to reduce worker exposure to falls from elevation and being struck by falling object;
- (b) Design columns to have a hole in the web at 42 inches (1070mm) above floor level to support a guard-rail cable and provide a connection point for safety ropes. Since the safety system is built in place such fabrication details will facilitate worker safety with reduced construction cost and reduced worker exposure.

Conclusion

In Malaysia, the steps taken by CIDB, NIOSH and other bodies concerning about safety in the construction sites are still focusing on the 'downstream' activities i.e. the construction site. The introduction of the Green Card to site workers and the OHSAS 18001 Certification for contractors are no doubt an important steps to improve the site condition and also to make the contractor more responsible to site safety. But the other key players who have so much influence in a construction project have been left out of the picture. It is about time for us to make them realized their responsibility and role concerning site safety.

So are we barking at the wrong tree? The answer is yes, it is the right tree but there are more trees to be barked at.

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Worksite Health Promotion

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Abstract

Health promotion, a discipline fast growing, deals with the prevention of illness and injury at the workplace. This article review defines health promotion and suggests the means for planning an effective, organized and well-structured program. A properly executed program will benefit both employer and employee in managing workplace absenteeism, reducing staff turnover, improving morale and productivity and keeping health care costs at an acceptable level

Keywords: vitality, health promotion.

Introduction

Vitality, as related to an institution, is defined in the Oxford dictionary as the ability to endure (stamina) and perform a function. Health promotion can be defined as the process of enabling people to increase control over, and to improve their health (World Health Organization). It can also be defined as the science and art of helping people change their lifestyle to move toward a state of optimal health (American Journal of Health Promotion).

Background

Under the auspices of the World Health Organization, the 1st International Conference on Health Promotion was held in Ottawa, Canada (1986). A direct result of this conference saw the birth of the Ottawa Charter, designed to lead health promotion along its intended path.

The Ottawa Charter included five key thrusts namely

- (a) To build a healthy public policy
- (b) To create supportive environments for health
- (c) To strengthen community action for health
- (d) To develop personal skills
- (e) To reorient health services

In continuity the 2nd conference was held in Adelaide, Australia (1988) – Adelaide Recommendations on Healthy Public Policy. This was followed by the 3rd held in Sundsvall, Sweden (1991) – Sundsvall Statement on Supportive Environments. The 4th conference held in Jakarta, Indonesia (1997) was a milestone of sorts as this was the first to be held in a developing country and the first to recognize private sector contribution and participation in the propagation of health promotion.

The Jakarta Declaration, which evolved from this conference, identified five key areas of importance namely:

- (a) To promote social responsibility for health

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- (b) To increase investment for health development
- (c) To consolidate and expand partnerships for health
- (d) To increase community capacity and empower the individual
- (e) To secure an infrastructure for health promotion

The 5th conference (From Ideas to Action) was held in Mexico City, Mexico (2000), while the 6th will be held in Bangkok, Thailand (August 2005).

Today there is undisputable evidence to show that life style factors are significant in their contribution to illness and injury at the workplace leading to an increase in medical costs, absenteeism and low productivity and performance at the worksite. It stands to reason then, that modifications to life style habits can bring about measurable benefits by favorably altering risk factors, disease prevalence, absenteeism, work performance and medical care costs.

Epidemiological studies have identified the main contributors to good health as (a) genetic factors (12%); (b) medical factors (14%); (c) public health amenities (23%) and (d) life style factors (51%). Thus education on life style habits, proper use of the health care systems in place, coupled with medical prevention (primary, secondary) and screening in the primary care setting will benefit both employer and employee. Dependents should not be disregarded as they can contribute to ill health costs and can either be an encouragement or an impediment to life style changes.

Although there has been a rapid proliferation of workplace health promotion activities, there is still an apparent lack of understanding in the importance of an organized, comprehensive and well-managed program. The introduction of terms such as disease prevention, health promotion and wellness within this context has further

compounded the issue. Primary prevention is generally defined as reduction of risks or treatment of sub-clinical disease. Health promotion in turn goes beyond this and encourages total positive health, which includes the physical, emotional, intellectual, spiritual and social components, while wellness refers to a state of optimal health, a positive state that exceeds the absence of disease.

Precursors namely tobacco, alcohol, high blood pressure, obesity and gaps in primary prevention account for 75% of total preventable health issues. This reiterates further the need for worksite health promotion and underlines the association between life style and environmental risks and ill health. In addition there is a definite association between changes in the prevalence of health risks to morbidity and mortality. As there will be both acute and chronic effects of detrimental lifestyle and environmental factors, one would expect worksite health promotion activities to deliver both immediate and long term benefits as these factors are addressed.

Planning for health promotion must take into account the needs of both employees and management. For the activity to succeed, target and objectives drawn up should be consistent with the organizations goals. It is important to be able to differentiate between “employee favorites” and expertly determined requisites as results are directly related to employee participation.

Table 1. Examples of common worksite health promotion programs

Activity	Reduction
Smoking cessation program	Upper Respiratory Tract Infection (URTI), Asthma, Back pain, Heart disease, Cancer
Alcohol abstinence	Trauma, Domestic violence, Liver disease

program	
Diabetes/hypertension control	Complications
Vehicle safety	Motor vehicle trauma
Safe sex education	HIV, Hepatitis B
Employee Assistance Program	Staff turnover
Physical fitness	Absenteeism

Devising a health promotion program involves a series of structured steps in which data gathering is the first. Data gathering includes information on life style related diseases, current and if possible projected future medical costs, dependent medical costs (if applicable), levels of absenteeism and employee work productivity. Typically, projecting the desired state of health to identify the specific gaps between the current and expected situation should follow this, as this projection makes it easier for management to observe the disparity and develop appropriate strategies to bridge the gap.

Program design and organization must include active employee participation, relationships with departments that have common goals (e.g. human resource) and address identified risks in an integrated synergistic approach. Programs could be developed within or outsourced depending on available budget, employee size and on the expected level of control and continuity. Information should be communicated via multiple modes, as there would be preferred means for different levels of staff. The information must be tailored to bring on the change, steps to achieve this change and to provide repetition and re-enforcement.

Incentives such as “point of practice” and risk rating benefits should be considered

as rewards for targets reached. Proper facilities are important for the delivery of services and programs, and the importance of the workplace as a base for this, should not be overlooked. The workplace would provide the necessary peer support, contribute to a supportive work environment and be an ideal avenue for communication.

Budgeting requests should take into account full use of current resources and projected needs based on the total participation level. It is important to recognize the size of the budget requested in relation to total expenditure and of the variance between in house and outsourced programs. Monitoring and evaluation of programs should not be overlooked, as these are necessary to track the overall benefit and ascertain the contribution from each component of the program. Identifying behavioral changes and analyzing program costs for a single employee or for the work force as a whole, would be beneficial in planning for continuous improvement of the program as well as for establishing the most effective approach. The final objective is to have a program which is people friendly and fully utilizes all available administrative, marketing and communicative tools to increase employee participation, facilitate behavioral change and bring on the desired results.

In conclusion, as medical costs continue to escalate, it will become increasingly important to incorporate health promotion as an integral part of workplace activities so as to prevent illness and injury wherever possible. For health promotion to succeed it must ideally utilize the existing workplace culture, and its information and incentive systems to promote a safe and healthy lifestyle. The future for health promotion would involve an integrated approach where risks factors of disease and injury can be altered at a reasonable cost. This is a discipline still in infancy, and much effort is

needed to make organizations aware of the benefits of a well-balanced, organized, structured program. The occupational health physician must take the lead in advocating such programs and demonstrate that employee vitality can and will lead to organization growth.

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