Chapter 7

Case–Control Study

7.1 Introduction

After completion of the discomfort survey of HEMM operators, this chapter describes the study design of the case–control analysis. Methods of case–control study have been discussed. Finding of questionnaire survey is listed. Coding for different variables of the two groups is listed. Characteristics of WBV exposure of dumper operators are summarized. Lastly, results of logistic regression are presented and analyzed.

7.2 Study Design

The study protocol included: (1) a request for participation to the management of the four mines; (2) a standardised questionnaire called Worker's Response Device (WRD) questionnaire, which included personal information of operators, machine related information and musculoskeletal painofdumperoperatorsin the past six months. The WRD questionnaire was administered at the workplace for each worker of case and control groups. Management of all the four mines had introduced the research team to the operators. The operators were briefed about the data being taken from them.

7.3 Methods

This investigation was a cross-sectional study conducted on 220 subjects. Out of these, 110 were dumper operators exposed to vibration, and 110 were different types of workers who were not exposed to vibration but working in similar mining environment. Simultaneously, questionnaire survey of all 220 subjects was also conducted in the field. Operators were selected randomly and were explained about the study upon arrival at the mine site. Only male workers were employed in all three coal mines. Most of the operators were belonging to poor socioeconomic background and were less educated. The scheduled working duration of the operators was eight hours per day, and they had to work for six days per week. The study was conducted in October 2017, June 2018 and September 2018. The subjects were randomly selected. It may be noted that the questionnaire included a description of operators' personal information such as age, weight, height, anthropometric body dimensions and driving experience, their associated musculoskeletal symptoms such as pain in the various body regions persisting within last six months. The various body parts for musculoskeletal symptoms mentioned in the questionnaire items are pain in neck, shoulder, forearm, elbow, wrist, hand and finger, upper back, lower back, knees, legs and feet.

7.4 Findings of Questionnaire Study

The characteristic personal factors of operators collected through the questionnaire is presented in Table 7.1.

Table 7.1 Descriptive statistics of personal factors of operators

Personal factor	Case group			Control group		
	Mean	SD	Range	Mean	SD	Range
Age (year)	50.3	8.6	25.0–60.0	48.7	9.0	31.0–60.0
Weight (kg)	71.9	11.9	45.9–105	70.2	10.5	35.5–111
Height (m)	1.7	0.1	1.5–1.8	1.7	0.1	1.4–1.9
Driving experience (year)	26.7	9.3	0.2–38	24.7	10.7	2.0–41.0
Body mass index (kg/m^2)	25.7	4.0	16.3–36.3	25.4	3.2	16.2–34.5

Note: SD = standard deviation.

Table 7.2 illustrates the categorization of the variables in the study. The code given to different categories of variables is also illustrated. The codes “0” and “1” are given to the variables representing the category. The classification of variables is also presented in Table 7.2. The number of persons belonging to each group along with their percentage is also given for both the case and control groups.

Table 7.2 Summary of the case and control groups

Variable	Category	Code		Case group (%)	Control group (%)
Age	< 45 years	0		28 (25.5%)	35 (31.8%)
	≥ 45 years	1		82 (74.5%)	75 (68.2%)
Experience	< 13 years	0		18 (16.4%)	26 (23.6%)
	≥ 13 years	1		92 (83.6%)	84 (76.4%)
Smoking	No	0		69 (62.7%)	80 (72.7%)
	Yes	1		41 (37.3%)	30 (27.3%)
Alcoholic	No	0		68 (61.8%)	77 (70.0%)
	Yes	1		42 (38.2%)	33 (30.0%)
BMI	< 25	0		56 (50.9%)	49 (44.5%)
	≥ 25	1		54 (49.1%)	61 (55.5%)
Neck	No	0		98 (89.1%)	99 (90.0%)
	Yes	1		12 (10.9%)	11 (10.0%)
Hand	No	0		95 (86.4%)	96 (87.3%)
	Yes	1		15 (13.6%)	14 (12.7%)
Upper Back	No	0		78 (70.9%)	87(79.1%)
	Yes	1		32 (29.1%)	23 (20.9%)
Lower Back	No	0		70 (63.6%)	89 (80.9%)
	Yes	1		40 (36.4%)	21 (19.1%)
Leg	No	0		97 (88.2%)	102 (92.7%)
	Yes	1		13 (11.8%)	8 (7.3%)
Mine	Mine 1	1	0	34 (30.9%)	24 (21.8%)
	Mine 2	0	1	43 (39.1%)	38 (34.5%)
	Mine 3	0	0	33 (30.0%)	48 (43.6%)

7.5 Characteristics of WBV Exposure

The WBV exposure of dumper operators have been characterized in terms of frequency-weighted r.m.s. acceleration, crest factor, and VDVs in each translational axis (*x*, *y* and *z*) and summarized in Table 7.3. It can be observed from Table 7.3 that the mean values of $A(8)$ is 0.87 m/s^2, mean $VDV(8)$ is 24.49 m/s$^{1.75}$and mean crest factor is 9.39 for the case group.

Table 7.3 WBV at work posts of case group

Parameters	Frequency-weighted r.m.s. acceleration values, m/s^2				Crest factor values			Vibration dose values, m/s$^{1.75}$			
	a_{wx}	a_{wy}	a_{wz}	A(8)	CF_x	CF_y	CF_z	VDV_x	VDV_y	VDV_z	VDV(8)
Mean	0.43	0.37	0.87	0.87	7.89	7.46	9.39	3.00	2.53	6.06	24.49
Median	0.40	0.35	0.85	0.85	7.54	7.19	8.69	2.95	2.53	6.01	23.70
SD	0.10	0.08	0.20	0.19	1.65	1.58	2.64	0.67	0.56	1.41	5.05
Min	0.22	0.22	0.42	0.45	5.10	4.61	5.94	1.58	1.44	2.93	14.23
Max	0.67	0.72	1.37	1.37	15.91	15.12	21.13	5.69	4.74	9.35	36.75

Note: a_{wx}, a_{wy}, a_{wz} = frequency-weighted r.m.s. acceleration in *x, y, z*-axes respectively; VDV_x, VDV_y, VDV_z = vibration dose value in *x, y, z*-axes respectively, $A(8)$ = daily frequency-weighted r.m.s. acceleration; $VDV(8)$ =daily vibration dose value.

7.6 Results of Logistic Regression

Logistic regression analysis of the case and control groups has been carried out and the results are presented in Table 7.4.

Table 7.4 Results of logistic regression analysis

Variable	β	Wald	Sig.	$Exp(\beta)$	95% CI for $Exp\ (\beta)$	
					Lower	Upper
Age	-0.037	0.008	0.930	0.96	0.43	2.18
Experience	0.389	0.674	0.411	1.48	0.58	3.74
Smoking	0.315	0.893	0.345	1.37	0.71	2.63
Alcohol	0.289	0.82	0.365	1.34	0.71	2.50
Neck group	-0.195	0.15	0.699	0.82	0.31	2.21
Upper back	0.112	0.084	0.772	1.12	0.53	2.38
Lower back	0.923	5.889	0.015*	2.52	1.19	5.31
Leg	0.506	0.868	0.352	1.66	0.57	4.82
Hand group	-0.681	1.683	0.194	0.51	0.18	1.42
BMI	-0.239	0.679	0.41	0.79	0.45	1.39
Mine-1	0.543	2.639	0.104	1.72	0.89	3.32
Mine-2	0.691	3.589	0.058**	2.00	0.98	4.08
Mine-3[#]		4.33	0.115			
Constant	-0.961	4.864	0.027*	0.38		

*significant at $p<0.05$, **significant at $p< 0.10$, β =coefficient, $Exp\ (\beta)$= odds ratio CI= Confidence Interval, [#] reference mine

Out of 11 independent variables, only two variables were found to be significant in the case–control study. Examining the odds ratios of the case group showed that the risk of lower back pain is 2.52 times (95% CI[1.19, 5.31]) more as compared to control

group. Case group of Mine-2 is 2.0 times (95% CI[0.98, 4.08]) more prone to vibration hazards as compared to Mine-3.

7.7 Summary

The case–control study design briefly explains the study protocol of the research conducted on 220 subjects. Findings of questionnaire survey listed the personal factors of the operators. Characteristics of WBV exposure (r.m.s., VDV and CF) of dumper operators were summarized. At the end, the relative risks faced by dumper operators with respect to the control group workers were explained. It was revealed that the prevalence of lower back pain of dumper operators is 2.52 times more than the control group workers. The next chapter deals with the concluding remarks of the research work.