CHAPTER 3

Results

3.1 Studies completed

This chapter consists of preliminarily analysis of published articles. The first article aimed to investigate the treatment outcome of MDR-TB and factors associated with treatment outcome in Nepal from 2005 to 2008. Statistical analysis used Kaplan-Meier Curves and Cox proportional hazards to assess statistically significant factors for two outcomes of interest (1) culture conversion status and (2) treatment success. The following individual co-variates are included in the analysis: Age, gender, caste, religion, year, region and MDR-TB registration group. This manuscript has been schedule for publication in *Asian Pacific Journal of Public Health,* Volume 24 No. 4 July 2012.

The second article aimed to forecast TB mortality in Thailand by the joint effects of gender-age, year and location using multivariate linear regression. This manuscript has been schedule to publish in *Journal of Health Research.* Volume 26 No. 1 March 2011.

The third study aimed to model the joint effects of gender-year and location associated with the incidence of TB in Nepal during 2003-2010 using log transformed linear model. This manuscript has been submitted to *The Southeast Asian Journal of Tropical Medicine and Public Health.*

3.2 Preliminary Analysis

Study I: Treatment Outcome of MDR-TB in Nepal

The bar chart shows the characteristics of the MDR-TB cases from 2005 to 2008. Majority of the cases were males and from Central Region (60.1 %). The highest cases were observed in the year 2006 followed by 2007. The treatment outcome of MDR-TB cases were still on treatment (45%), complete treatment (31%), defaulted (13%), died (7.3%) and failed (3%).

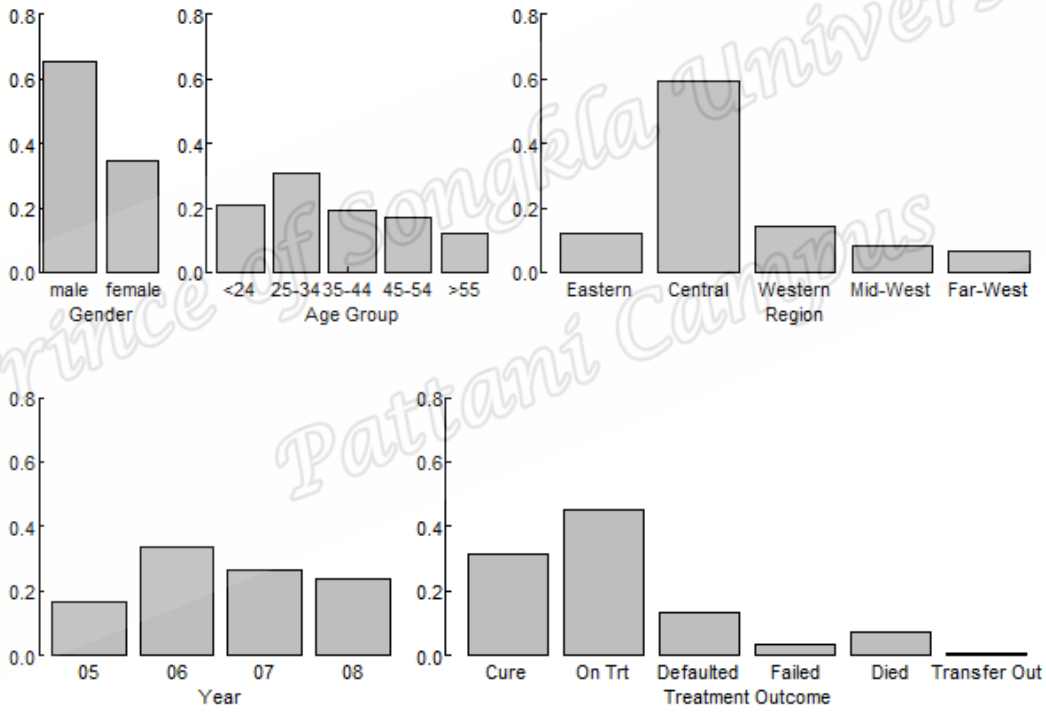

Figure 3.1: Bar chart showing the characteristics of MDR-TB cases in Nepal

The further analysis involved the application of Kaplan-Meier Curves to determine overall times to sputum smear conversion, cure, and failed/died, respectively, with other outcomes classified in each case as censored data. Both univariate and multivariate Cox proportional hazards models were used to generate estimates of the

associations between demographic factors and treatment and the time to cure, with other outcomes censored.

Study II: Forecasting TB Mortality in Thailand using Multivariate Linear Regression

A total of 57,259 deaths occurred due to TB for 10 year period (2000-2009) in Thailand. Table 3.1 shows the TB mortality rate for gender, age-group, year and region. There existed gender difference in mortality rates in TB; the rate of death from TB was more than two times higher in males than in females. The highest mortality was found among people aged 55 or above yrs. TB mortality was increased after 2001 and remains steady in consequent year and decreased in recent years. Mortality was also higher in Central and North Region.

Table 3.1: Mortality of TB in Thailand by gender, age, year and region

Characteristics	Number of deaths (N= 57259)	Population	Mortality/1000
Gender			
Male	40,565	318,590,939	0.127
Female	16,694	327,334,617	0.051
Age group			
Below 15 yrs	442	146,513,043	0.003
15-24 yrs	1,564	106,148,142	0.014
25-34 yrs	12,012	109,993,073	0.109
35-44 yrs	11,786	107,303,043	0.109
45-54 yrs	8,191	81,434,589	0.100
55-64 yrs	7,669	49,582,230	0.154
Above 65 yrs	15,595	44,951,436	0.346
Year			
2000	6,246	62,132,877	0.10
2001	6,284	62,752,738	0.10
2002	6,751	63,400,761	0.106
2003	6,906	63,979,453	0.107
2004	6,076	64,478,958	0.094
2005	5,534	65,040,718	0.085
2006	5,214	65,514,243	0.079
2007	4,859	65,805,714	0.073
2008	4,821	66,243,318	0.072
2009	4,568	66,576,776	0.068
Region			
Central	22,004	217,942,056	0.100
North-East	18,431	221,963,205	0.083
North	10,389	118,721,810	0.087
South	6,435	87,298,485	0.073

Tables 3.2 to 3.5 shows correlation coefficients of seven age groups in four regions, with correlations greater than 0.6 in bold. Highest correlation was observed between 35-44 years and 45-54 years in females of the central region (0.88), followed by 35-44

years and above 65 years in male of south region (0.87) and 45-54 years and above 65 years in female of north east region (0.82).

Table 3.2: Pearson correlation coefficients of age groups in central region

	Below 15 yrs	15-24 yrs	25-34 yrs	35-44 yrs	45-54 yrs	55-64 yrs	Above 65 yrs
Male							
Below 15 yrs	1						
15-24 yrs	**0.66**	1					
25-34 yrs	0.4	-0.14	1				
35-44 yrs	**0.66**	-0.07	0.7	1			
45-54 yrs	0.29	-0.39	0.55	**0.66**	1		
55-64 yrs	0.51	0.33	0.26	0.41	0.16	1	
Above 65 yrs	**0.81**	0.28	0.39	**0.67**	0.53	0.13	1
Females							
Below 15 yrs	1						
15-24 yrs	-0.01	1					
25-34 yrs	0.26	0.46	1				
35-44 yrs	0.3	0.32	0.52	1			
45-54 yrs	0.35	0.16	0.23	**0.88**	1		
55-64 yrs	0.33	0.49	0.49	0.51	0.49	1	
Above 65 yrs	-0.2	0.03	0.14	0.6	0.39	0.28	1

Table 3.3: Pearson correlation coefficients of age groups in north region

	Below 15 yrs	15-24 yrs	25-34 yrs	35-44 yrs	45-54 yrs	55-64 yrs	Above 65 yrs
Male							
Below 15 yrs	1						
15-24 yrs	-0.37	1					
25-34 yrs	-0.12	-0.14	1				
35-44 yrs	0.02	-0.01	-0.29	1			
45-54 yrs	-0.17	0.01	-0.03	0.3	1		
55-64 yrs	-0.03	-0.34	0.1	0.3	0.56	1	
Above 65 yrs	-0.08	-0.14	0.21	0.33	0.43	**0.75**	1
Female							
Below 15 yrs	1						
15-24 yrs	0.05	1					
25-34 yrs	0.6	-0.53	1				
35-44 yrs	0.03	-0.09	0.32	1			
45-54 yrs	-0.21	0.18	0.26	0.11	1		
55-64 yrs	0.28	-0.65	**0.64**	-0.16	0.1	1	
Above 65 yrs	0.31	-0.63	0.57	-0.02	-0.21	**0.73**	1

Table 3.4: Pearson correlation coefficients of age groups in north east region

	Below 15 yrs	15-24 yrs	25-34 yrs	35-44 yrs	45-54 yrs	55-64 yrs	Above 65 yrs
Male							
Below 15 yrs	1						
15-24 yrs	**0.74**	1					
25-34 yrs	-0.15	0.16	1				
35-44 yrs	0.1	0.13	0.5	1			
45-54 yrs	0.09	0.4	**0.63**	0.56	1		
55-64 yrs	-0.37	-0.06	**0.61**	0.47	0.41	1	
Above 65 yrs	-0.16	0.41	0.32	0.28	0.59	0.21	1
Female							
Below 15 yrs	1						
15-24 yrs	-0.2	1					
25-34 yrs	-0.19	0.11	1				
35-44 yrs	-0.08	-0.75	0.17	1			
45-54 yrs	0.37	-0.49	0.35	0.46	1		
55-64 yrs	0.07	0.43	0.5	-0.35	0.49	1	
Above 65 yrs	0.34	-0.01	0.41	0.12	**0.82**	**0.69**	1

Table 3.5: Pearson correlation coefficients of age groups in south region

	Below 15 yrs	15-24 yrs	25-34 yrs	35-44 yrs	45-54 yrs	55-64 yrs	Above 65 yrs
Male							
Below 15 yrs	1						
15-24 yrs	-0.33	1					
25-34 yrs	0.39	-0.11	1				
35-44 yrs	0.23	-0.44	0.43	1			
45-54 yrs	**0.66**	-0.13	0.54	**0.61**	1		
55-64 yrs	0.05	0.08	-0.48	-0.57	-0.37	1	
Above 65 yrs	0	-0.3	0.07	**0.87**	0.47	-0.32	1
Female							
Below 15 yrs	1						
15-24 yrs	0.11	1					
25-34 yrs	-0.51	-0.14	1				
35-44 yrs	-0.03	-0.2	0.55	1			
45-54 yrs	-0.23	0.01	-0.04	-0.08	1		
55-64 yrs	0.52	-0.6	-0.28	0.4	0.01	1	
Above 65 yrs	0.11	-0.56	-0.02	0.24	-0.01	0.43	1

After fitting multivariate linear regression, we found that the correlation varied substantially between age groups. Factor analysis was used for removing correlation between age groups that mask their effects on the TB mortality. Factor analysis was based on the variance-covariance matrix obtained from the multivariate analysis. Table 3.6 shows the loadings with values less than 0.20 in magnitude suppressed. Factor 1 encompasses age groups 25-34 years, 35-44 years and 45-54 years, factor 2 represents the age groups 55-64 years and above 65 years and factor 3 represents age groups below 15 years and 15-24 years in males. Similarly in females, factor 1 represents the age groups 55-64 years and above 65 years, factor 2 represents age

groups 25-34 years, 35-44 years and 45-54 years and factor 3 represents age groups below 15 years and 15-24 years.

Table 3.6: Factors Analysis

Variable	Factor	Factor	Factor
Male			
Below 15 yrs	0.25	-	**0.58**
15-24 yrs	-	-	**0.79**
25-34 yrs	**0.81**	0.13	-0.30
35-44 yrs	**0.75**	0.35	-
45-54 yrs	**0.89**	-	-
55-64 yrs	-	**0.78**	-
Above 65 yrs	-	**0.68**	0.341
Female			
Below 15 yrs	0.38	-	**0.82**
15-24 yrs	-0.39	-	**0.61**
25-34 yrs	-	**1.01**	-
35-44 yrs	0.37	**0.54**	-
45-54 yrs	0.20	**0.68**	-0.36
55-64 yrs	**1.01**	-	-
Above 65 yrs	**0.97**	-	-

After fitting the factor analysis, we plot the factors (aggregations of mortality rates for data within the age groups defined by the factors), and use these combined rates for forecasting. The time trends indicate that the TB mortality decreases sharply for below 25 years, decrease moderately for 25-54 years and decrease steady for above 55 years for both sexes.

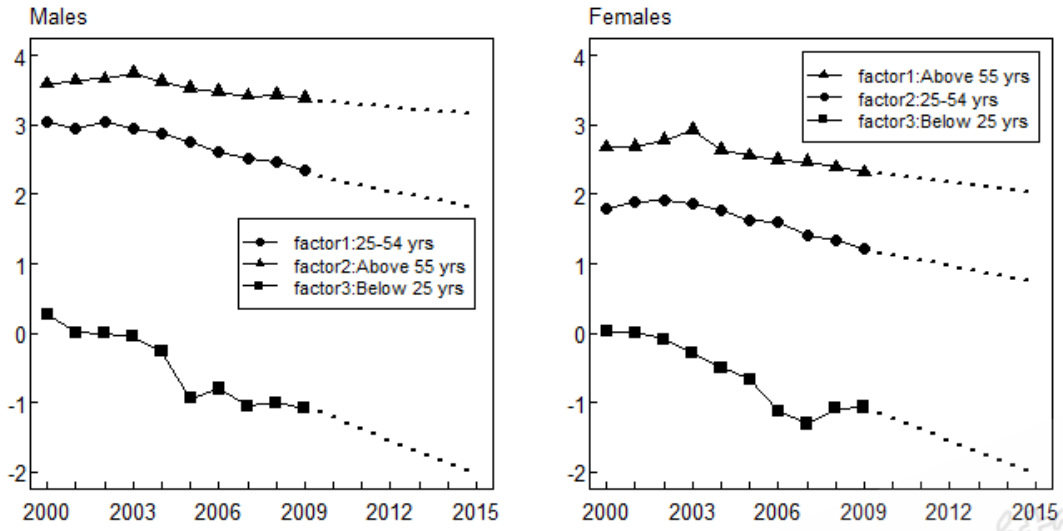

Figure 3.2: Plot of TB trend with forecasts for three factors of age group of Thailand

In further analysis, we used the multivariate linear regression for modeling and forecasting age-specific TB mortality rates in Thailand.

Study III: Spatial and Temporal Variations of TB Incidence in Nepal

In this study, we use TB data from NTC for the 8-year period (2003-2010). During the study period, 271,873 confirmed cases were notified. Among them, 175,365 cases (64%) were male and 96,508 cases (36%) were females. The mean incidence rate of TB was 1.31 per 1,000 populations. The incidence rates by year are shown in Table 3.7.

Table 3.7: TB incidence rates in Nepal by year

Years	Number of TB cases (N=271,873)	Population	Incidence/1000
2003	31,637	23,999,357	1.31
2004	32,903	24,516,403	1.34
2005	34,077	25,083,994	1.36
2006	33,206	25,266,209	1.31
2007	33,492	26,284,014	1.27
2008	33,419	26,805,469	1.25
2009	35,407	27,383,773	1.29
2010	37,732	27,497,584	1.37

The further analysis involved application of log-transformed linear regression for examining spatial and temporal variations of TB in Nepal.