Marginal Risk Progression of Non Communicable Diseases with Increasing Age in India: An Application of Competing Risk Model

Introduction:

According to Special Survey of Deaths (SSD), undertaken in 2001-2003 (Registrar General of India, 2008), non-communicable diseases are the leading causes of death in India, constituting 42% of all deaths. Since the risks of these diseases are generally arise in the age of late 30's or after, so a larger section of working population is bound to suffer with these diseases which definitely affect their productivity. So there is huge economic burden on household as well as on the country because of the chronic diseases.

Competing Risks of Chronic Diseases: A person is likely to get affected with a particular chronic disease from the time of his/her birth with some chance which depends upon the various risk factors associated with that person. But in general population, irrespective of the risk factors, it would be quite informative to estimate the chance of having a particular chronic disease by a specific age. If the interest lies in getting the true or marginal risk at various ages, cumulative incidence function would be the better option.

Here the concept of competing risk is coming because for the disease by which a person is affected at age x for the first time, rest of the chronic diseases are like competing risks. Therefore competing risks are events that prevent an event of interest from occurring. Unlike cumulative hazard function, the absolute or marginal risk of onset of a disease in the presence of competing risk is measured in terms of 'cumulative incidence function'. Cumulative incidence, F_j(t) for a particular cause of failure j is the probability of experiencing this cause of failure until time t, in the presence of all the other possible causes (Bakoyannis et al). So

$$F_j(t) = \Pr(T \leq t, C = j) = \int_0^t h_j(u) \exp\left\{-\int_0^u \sum_{c=1}^{k} h_c(w)\, dw\right\} du,\ j=1,2,3,.....,k$$

Objective of the Study: The main objective of this study is to assess the marginal risk progression of selected non-communicable chronic diseases as age increases in competing risk setting across different socio-demographic subgroups in India. Here competing risks are the chronic diseases of study interest other that the disease of investigation.

Data and Method: The present study will be based on the 60th round of data on 'Morbidity and Health Care' by National sample survey in 2004. The NSSO 60th round is a multi-stage cluster sample survey covering 73868 nationally representative households.

Method: The present study will focus on six major non communicable chronic diseases namely cardiovascular diseases which include heart diseases and hypertension, diabetes mellitus, bronchial asthma, disorder of joints and bones, mental illness (includes neurological disorder and psychiatric disorder) and cancer. A popular model for the cumulative incidence is the proportional hazards model for the sub-distribution of a competing risk (Fine & Gray, 1999). This method makes use of the hazard of sub-distribution which is a function of the cumulative incidence for the corresponding cause of failure and can be defined as:

$$h_j^{sub}(t;\mathrm{x}) = \lim_{\Delta t \to 0} \frac{\Pr[(t \le T < t+\Delta t, C=j | T \ge t \cup (T \le t \cap C \ne j), x]}{\Delta t}$$

$$= \frac{\{dF_j(t;x)/dt\}}{\{1-F_j(t;x)\}} = -\frac{d\log\{1-F_j(t;x)\}}{dt}$$

Result and Discussion: The risk of onset of CVD up to age 40 years is negligible after that it started increasing. Female have double risk of being affected with CVD in India in compare with that of male. Marginal risk of CVD in urban people is 1.3 times higher than that of rural people. As we go from lower ladder to higher ladder of economic well being, the adjusted marginal risk starts increasing significantly. Hazard in the people who are graduate or higher have significantly 50% less risk of mental illness in compare with illiterate people. Those who are in highest MPCE quintile have 75% more risk than those who are in lowest quintile. Female have 42% higher risk

of diabetes than male in the presence of competing risk disease. Risk of diabetes is lowest for the people who are in lowest MPCE quintile and as we move from lower to higher MPC quintile risk increases. By the age 70 the risk of diabetes in lowest quintile is 1% whereas it 8% for highest quintil. The marginal risk of cancer is very low in compare with other selected chronic disease. Currently married or divorced people have 80% less risk of cancer than unmarried people with 0.1% level of significance.

In conclusion, this study reveals that the prevalence of cardiovascular diseases is highest among rest chronic diseases. The risk of major chronic diseases starts in the age around 40's. There is early onset of mental illness in Indian population and diabetes onset is comparatively late. For some chronic diseases like CVD and disorder of joints and bones females are more vulnerable. CVD and diabetes onset is earlier in richer and highly educated people in India. Rural-urban differential for diabetes, CVD and arthritis is very significant. The final analysis would give better insight about the marginal risk of these NCDs.

Table 1: Proportional Hazard Ratio of Selected Chronic Diseases with Competing risks among Various Socio- Demographic Subgroups in India

	CVD		Asthma		Disorder of joints and bones		Mental illness		Diabetes		Cancer	
Background characteristics	HR	SE	HR	SE	HR	SE	HR	SE	HR	SE	HR	SE
Sex												
male®												
female	1.93***	0.12	0.73***	0.07	2.02***	0.16	1.52***	0.15	1.42***	0.12	1.43*	0.28
Sector												
rural®												
urban	1.35***	0.09	0.85	0.08	0.86*	0.06	0.9	0.11	1.43***	0.15	0.97	0.22
Education Level												
no schooling or illiterate®												
primary or below	1.89***	0.14	1.06	0.11	1.37***	0.14	1	0.13	2.22***	0.26	1.59*	0.4
middle and higher schooling	2.46***	0.21	0.96	0.12	1.35***	0.13	0.97	0.15	2.51***	0.31	1.47	0.45
diploma/graduate & above	2.37***	0.29	0.56	0.13	0.94	0.17	0.47***	0.14	3.16***	0.54	0.94	0.42
MPCE Quintile												
first®												
second	1.60***	0.27	1.44**	0.22	1.55***	0.19	0.85	0.15	1.80**	0.5	0.8	0.29
third	2.13***	0.34	1.40**	0.2	1.74***	0.22	1.06	0.18	1.86**	0.45	1.08	0.36
fourth	2.96***	0.45	1.62***	0.22	1.69***	0.19	1.25	0.21	3.21***	0.74	1.02	0.34
fifth	4.32***	0.68	1.34*	0.2	1.84***	0.22	1.75***	0.31	5.78***	1.34	1.11	0.41

Cumulative Incidence of Selected Non-Communicable Chronic Disease in India