Associated Covariates of Functional Limitation Among Older Adults in India: an Exploration

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Abstract Using the Longitudinal Ageing Study in India 2010 pilot survey data, the present study examines the covariates and risk factors associated with functional limitations among older adults (45+ ages) in India. Functional limitation is defined as the difficultly in performing some basic activities of daily livings (ADLs) viz. bathing, eating, walking, dressing, toileting and getting in/out of bed. Result suggests that one in every seven older adults in India has at least one of the functional limitations. Among all the activities of daily livings, the most reported problem is difficulty in getting in and out of bed (7 %) followed by walking (6.6 %) and toileting (5.5 %). Age and physical functionality is inversely correlated; older adults aged 60 years report more functional limitations and this becomes more noticeable for older adults aged 75 years and above. We found inverse association between functional limitations and education level and positive association with wealth possession. The multivariate results also corroborate the findings of bivariate results that older adults at higher age, females and older adults with low education are more likely to have functional limitations than their counterpart groups. The likelihood of functional limitations increases significantly in the presence of chronic diseases and smoking tobacco. These finding calls for devising policy to ensure the social security and health care requirements of aged, uneducated, females, poor and those suffering from chronic diseases.

Keywords Functional limitations · Older adults · Associated covariates · India

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Introduction

The global demographic change is taking place at an unprecedented rate with increase in size and share of elderly population. The increase in elderly population is faster than the overall population. With falling fertility and increasing longevity, *older adults*[1] at the age of 60 are expected to live 20 years more. While *population ageing*[2] in developed countries took place at a relatively higher level of income and strong social security system, population ageing in developing countries is taking place at low level of income and in the absence of social security system. As the tempo of population ageing in developing countries is much faster than in developed countries, developing countries will have less time than the developed countries to adjust with the consequences of population ageing (Bloom et al. 2010; WHO 2011; Frye 2011). The process of healthy aging in developing countries required comprehensive planning; improved health care, economic support and utilising the wisdom of older adults.

The demographic transition in India is faster than expected. Elderly population (60 years and above) comprises 8.6 % of total population and accounted at 104 million in 2011 census (Office of the Registrar General and Census Commissioner of India 2011). About 27 million elderly were added between 2001 and 2011 and likely to be more in coming decades. The growth rate of elderly population was 3.04 % compared to 1.63 % of overall population during the same period. By 2050, the population aged 60 and above will be more than 300 million comprising one-fifth of the total population (United Nations 2010). Though, the manifestation of ageing is recognized in the recent decades, measures to address the ageing related issues have not been sufficient in the country (Jamuna 2003).

Evidence suggests that the onset of chronic diseases in developing countries, including India, is earlier than in developed countries and the case fatality rate is also higher in developing countries compared to developed countries (Reddy and Yusuf 1998; WHO 2004; Xavier et al. 2008; Patel et al. 2011). The presence of chronic diseases worsened the health status. This generally corroborates the result of many other studies which found that, presence of chronic diseases increase the functional limitation of older people (Korda et al. 2014; Arokiasamy et al. 2015). Almost half of the elderly in India suffered from at least one of the chronic diseases (Rajan 2014) and estimate reveals that nearly half (45 %) of India's disease burden is projected to be borne by older adults in 2030 (Chatterji et al. 2008). The early onset of chronic diseases and disability can be avoided by improving the health care services and enhancing the preventive risk factors for older adults (Lynn and Adamson 2003; Centers for Disease Control and Prevention 2009; Halpin et al. 2010).

Generally, it is often assumed to be the responsibility of family members to take care of all the basic requirements of the older person (Ara 1997; Liebig 2003) but due to the modernization and urbanization the traditional joint family system has also been weakened over the time leaving elderly more vulnerable. There are reports which suggest that older people are deliberately neglected, abandoned and even abused often by people whom they believe or dependent for their survival (O'Loughlin and Duggan

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[1] Older adult is defined as person aged 45 and above.
[2] United Nations defines a country to have experienced population ageing when the share of its 60+ aged population reaches 7 %.

1998; Wallace and Bonnie 2003). Number of factors may be associated for this; among all, the most apparent factors are over-dependency on their care takers in terms of financial and physical need (Wolf and Li 1999; Schiamberg and Gans 1999; Hickey and Douglass 1981). The National Policy on Older Persons (2012) in India assures to provide economic security, healthcare and nutrition, shelter and protection of life and property to older persons within the ambit of state's capacity. But, indeed, most of the older adults being illiterate are unaware about the policies and programmes of government (Planning Commission 2011; UNFPA 2012).

In this context, any insightful assessment of the covariates associating with functional limitations of older population becomes pertinent. This information is also important from policy and program perspectives to bring changes in the future course of actions on elderly issues. Accordingly, the specific objectives for this study are; 1) to examine the covariates of functional limitations among older adults in India and 2) to identify the risk factors associated with functional health of older adults in India.

Methods and Materials

Data Source

The unit data from Longitudinal Aging Study in India (LASI) pilot survey (2010) has been used for the study. The LASI-Pilot was conducted by the International Institute for Population Sciences (Mumbai) in collaboration with the Harvard school of Public Health and RAND Corporation with financial support from the National Institute of Aging. The LASI is a global effort to bridge the data gap on adult health and has drawn heavily from the Health and Retirement Survey in USA, English Longitudinal Study of Ageing in UK (ELSA), China health and Retirement Study (CHARLES) etc. LASI provides comprehensive details of socio-economic and health status of the persons aged 45 and above and their spouses (irrespective of their age). The LASI pilot survey was carried out in four states of India viz. Kerala, Karnataka, Punjab and Rajasthan which reflects demographic, economic, health and cultural diversity of India. A total of 1683 individual from 950 households were interviewed. The analyses have been carried out at individual level and we have restricted our study to respondents with 45 and above age. The effective number of samples were 1486 individuals, aged 45 years and above and their spouses. The detailed sampling design and preliminary findings are available elsewhere (IIPS 2012; Arokiasamy et al. 2012).

Variable Description

Outcome Variable In LASI-Pilot survey, information on whether the person has difficulty in performing some specific activities of daily livings (ADLs) was collected at the time of survey. The examples of pertaining questions were, "Because of a health or memory problem, does the respondent have any difficulty with getting in or out of bed?" Considering existing literatures and as per the availability of data we have compiled all the activities of daily living viz. difficulty in walking, dressing, bathing, eating, toileting and getting in/out of bed to assess the *functional limitation*. This study used a binary variable to define the functional limitation of older adults. Older adults

answered 'Yes' (coded as 1) to any one of the selected functional limitation mentioned as "Having any functional limitation" and those who did not respond positively to all the functional limitations categorized as "No functional limitation"- coded as 'No' (0). Later, for the more notable analysis, a three-categorical variable defining functional limitations of older adults was used. In this, older adults without positive response to any of the selected functional limitations categorized as "None functional limitation", older adults with one functional limitation only mentioned as "Single functional limitation" and those who responded positively to at least two of the selected functional limitations stated as "Multiple functional limitation".

Covariates Beside above, in LASI-Pilot survey, information on a number of demographic and socioeconomic covariates was collected which could affect the functional limitations of older adults. Age, sex, education level, wealth tertile, place of residence and state were used as the predictors in this study. In addition, the risk factors such as number of chronic diseases, consumption of alcohol and smoking tobacco included to examine their association with the functional limitation among older adults.

Statistical Analysis

Bivariate analysis was used to understand the differentials in ADLs by socio-economic and demographic variables in addition with some risk factors. Multivariate analysis (binary logistic regression) has been used to assess adjusted impact of covariates on functional limitation. We used binary logistic regression to model the association between functional limitation at the individual level with demographic and socioeconomic predictors along with risk factors. The binary response (y, having any functional limitation or not) for each individual were related to a set of categorical predictors, X, (age, sex, education level, wealth tertile, place of residence, state, chronic diseases, alcohol consumption and smoking tobacco). The logit-link function is formulated as:

$$\text{log}it\left(\pi_{ij}\right) = \log[\pi_i/(1-\pi_i)] = \beta_0 + \beta(X) + \varepsilon$$

The probability of an individual having any functional limitation is π_i. The parameter β_0 estimates the log odds of any functional limitation for the reference group, and the parameter β estimates with maximum likelihood, the differential log odds of any functional limitation associated with the predictor X, as compared to the reference group. Odds ratios (OR) and predicted probabilities (PP) with 95 % CI were calculated.

We used four different models to better understand the impact of each covariate on functional limitations. In the Model 1, we adjusted for only demographic variables (age and sex) followed by socioeconomic variables in Model 2 (education and wealth). Further we controlled for spatial predictors (place of residence and state) in the third Model. Finally, risk factors (chronic diseases, alcohol consumption and smoking

tobacco) were adjusted along with all other predictors in Model 4 to assess the adjusted effect of all the covariates on functional limitation.

Results

Functional Limitations Among Older Adults in India

One in every seven older adults in India (14 %) has at least one of the functional limitations (Table 1). Among all the older adults, 86 % did not report any functional limitation 6.6 % of the older adults had only one functional limitation and 7.4 % reported multiple functional limitations. By age 60, health limits the physical functioning and it deteriorates sharply after reaching 75 years of age. Nearly 30 % of the respondents of 75 & above age group had two & more functional limitations. A considerably higher proportion of females reported functional limitations than males. Each gradient after the primary education was associated with lower reporting of multiple functional limitations. The functional limitations increase with higher wealth tertile. Hence respondents in rich wealth tertile reported more functional limitations compared to all other two groups. We found levelling off in reporting of functional limitations among rural and urban residents. Among the states, Kerala had the highest reporting of both single and multiple functional limitations (10 % and 12 % respectively) while Rajasthan and Punjab had least reporting of single and multiple functional limitations respectively. The functional limitation is linked to chronic diseases; higher the chronic diseases more were the reporting of functional limitations. Only 8.9 % of the older adults without any chronic diseases reported any functional limitations compared to 35 % among those who had two+chronic diseases. Functional limitation is higher among those who smoked and consumed alcohol compared to their counterparts.

Difficulty in Performing Specific Activities of Daily Livings (ADLs)

Figure 1 shows the percentage of older adults having difficulty in performing some specific activities of daily livings (ADLs). Among all the ADLs, the most reported problem is difficulty in getting in/out of bed (7 %) followed by walking (6.6 %) and toileting (5.5 %). Difficulty in all of the activities of daily living increases with age (Table 2). More than one-fifth of the elderly aged 75 & above reported problem in all of the ADLs. Females had higher reporting of difficulty in performing all of the ADLs. Functional limitation increases with each gradient of chronic diseases. The result depicts that the difficulty in ADLs declines with higher education level except for the getting in/out of bed which has shown inconsistency.

Among the states, respondents from Punjab had lower difficulty in carry out ADLs. A higher proportion of respondents in Karnataka reported that they had difficulty in walking and dressing compared to all other states. Likewise, a higher proportion of respondents in Kerala stated that they had difficulty in bathing, eating, getting in/out of bed and toileting than all other states. More than one-fifth of the older adults who had

Table 1 Percentage distribution of number of functional limitations among older adults in India by selected background characteristics, 2010

Background characteristics	Any functional limitations		No. of functional limitations		N (Unweighted)
	No	Yes	Single	Multiple	
Age group					
45–59	91.7	8.3	4.7	3.6	872
60–74	83.0	17.0	8.8	8.3	472
75 & Above	59.7	40.3	10.8	29.5	142
Sex					
Male	88.5	11.5	6.0	5.5	732
Female	83.6	16.4	7.1	9.3	754
Education level					
Non-Literate	86.8	13.2	5.0	8.2	682
Primary	81.8	18.3	7.7	10.6	232
Secondary	85.6	14.4	8.5	5.9	446
High school+	90.9	9.1	7.2	1.9	124
Wealth tertile					
Poor	90.1	9.9	3.9	6.0	486
Middle	83.4	16.6	8.4	8.3	499
Rich	83.4	16.7	8.2	8.4	500
Residence					
Urban	85.7	14.4	7.2	7.1	419
Rural	86.2	13.8	6.3	7.5	1,067
State					
Rajasthan	91.7	8.4	2.5	5.8	363
Punjab	90.2	9.8	5.7	4.1	368
Kerala	78.3	21.8	9.9	11.8	418
Karnataka	84.5	15.5	8.3	7.1	337
Chronic disease					
None	91.1	8.9	4.4	4.5	955
One	80.8	19.2	11.6	7.6	286
Two & above	64.6	35.4	12.2	23.2	167
Consume alcohol					
No	86.4	13.6	6.4	7.2	1,262
Yes	83.8	16.3	7.5	8.7	217
Smoke tobacco					
No	87.2	12.8	5.3	7.6	1,183
Yes	82.0	18.0	11.1	6.9	298
All	86.0	14.0	6.6	7.4	1,486

two+chronic diseases were also reported functional limitation compared to only 4.3 % who did not have any chronic disease.
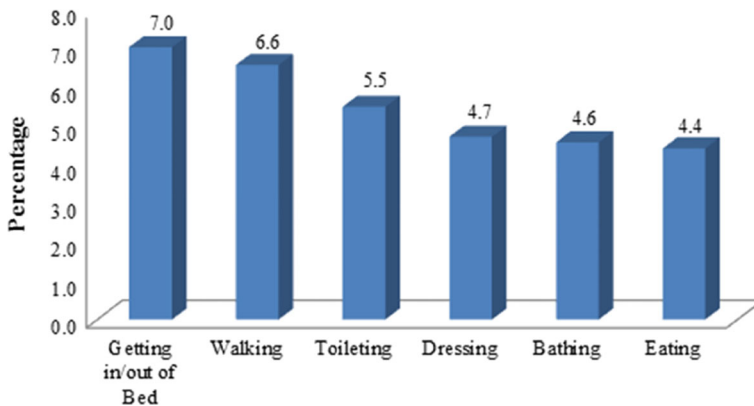
Fig. 1 Percentage of older adults having difficulty in performing some specific ADLs, 2010

Figure 2 presents the predicted probability of difficulty in performing ADLs by age-groups. Among the various difficulties, the predicted probability is higher for walking and getting in and out of bed compared to others. The predicted probability increases faster for all types of functional limitation after age 60 indicating the vulnerability of older people and their health.

Results of Logistic Regression for Functional Limitation

The first column of the Table 3, labelled Model 1, shows the association between functional limitation and demographic factors (age and sex). The older age is associated with higher odds of reporting functional limitation. Respondents with age 75 & above years are more likely to have any functional limitation. The likelihood of reporting functional limitation is significantly higher among females than males.

We also present the predicted probability of any functional limitation and each of the functional limitation controlling for age and educational level (Fig. 3). Age was categorised in three cohort; 45-59, 60-74 and 75+. We found that controlling for education, the predicted probability of any functional limitation increases for higher cohort. This suggests that age has positive association with functional limitation controlling for educational level. The probability of functional limitation declines with each gradients of higher education level.

In the Model 2, we further control education and wealth, which are thought to be most important socio-economic predictors. We found that the probability of difficulty in carrying out ADLs declines with educational level indicating that those who are better educated enjoy a better health. The higher education level indicates lower odds of reporting functional limitation while each gradients of wealth is significantly associated with higher odds of reporting functional limitation. Additional adjustments were done in Model 3 by controlling some spatial predictors (place of residence and state). Karnataka and Punjab have shown higher odds of reporting functional limitation compared to Rajasthan. Finally, risk factors (chronic diseases, alcohol consumption and tobacco) along with all other covariates were

Table 2 Difficulty in performing different activities of daily livings (ADLs) among older adults in India by selected background characteristics, 2010 (%)

Background characteristics	Difficulty in performing different activities of daily living					
	Dressing	Walking	Bathing	Eating	Getting in/out of bed	Toileting
Age group						
45–59	1.9	3.2	1.8	1.8	3.8	2.8
60–74	4.9	7.8	5.2	4.9	8.8	5.7
75 & Above	22.3	24.7	20.3	20.2	22.2	22.2
Sex						
Male	4.6	4.9	3.4	2.3	4.9	3.9
Female	4.8	8.2	5.8	6.5	9.1	7.0
Education level						
Non-Literate	5.9	7.7	5.1	5.5	6.2	4.9
Primary	5.1	7.4	6.2	5.1	12.2	8.4
Secondary	3.3	4.9	3.8	3.5	6.5	5.6
High school+	1.6	4.2	1.2	0.0	3.6	2.6
Wealth tertile						
Poor	4.8	6.1	4.4	3.6	4.5	3.7
Middle	5.0	6.6	5.3	5.6	9.7	6.4
Rich	4.4	7.3	4.1	4.4	7.7	7.0
Residence						
Urban	4.5	6.9	4.3	4.1	8.5	4.5
Rural	4.8	6.5	4.7	4.6	6.5	5.8
State						
Rajasthan	4.4	5.8	4.7	4.7	4.2	3.8
Punjab	3.3	4.0	1.3	3.5	2.4	1.6
Kerala	5.1	7.5	6.9	5.8	12.1	13.0
Karnataka	5.3	7.7	4.2	3.6	8.1	3.2
Chronic disease						
None	3.3	4.4	2.8	2.9	4.3	2.3
One	5.6	6.8	4.6	5.9	7.8	6.7
Two & above	7.9	16.1	12.5	7.3	22.3	21.3
Consume alcohol						
No	4.5	6.5	4.5	4.8	7.0	5.4
Yes	5.9	7.6	5.4	2.5	7.2	6.0
Smoke tobacco						
No	4.9	6.9	4.6	5.1	6.9	5.0
Yes	4.1	5.5	4.5	2.2	7.7	7.1
All	4.7	6.6	4.6	4.4	7.0	5.5

controlled in the Model 4. The chances of functional limitation is significantly higher among older who had chronic diseases (also shown in Fig. 4) and who
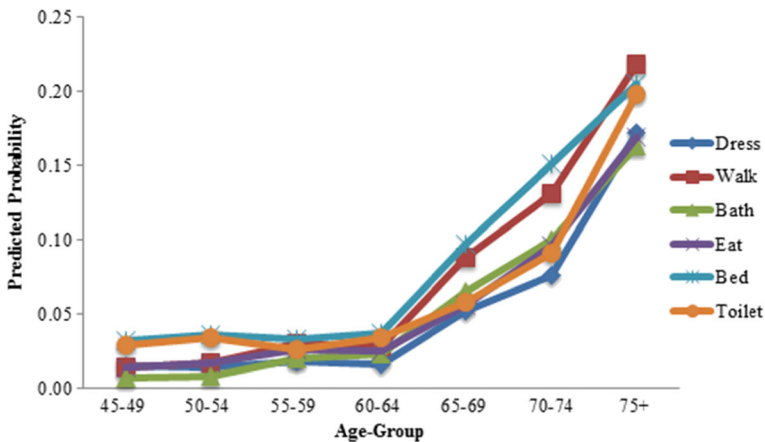
Fig. 2 Predicted probability of having difficulty in performing different ADLs by age-groups, 2010

smoked tobacco than those who did not have any chronic disease and never smoked.

Discussion

There is no dearth of studies on social, economic and health implication of population ageing worldwide but there are limited studies in India (Coast 2002; Mohanty and Sinha 2010; WHO 2011; Chakrabarti and Sarkar 2011; Beard, et al. 2012). Further, as an effort to assist in better planning and policymaking, many have also predicted the volume of older population for the coming two-three decades or so (Wiener and Tilly 2002; Streatfield and Karar 2008; Stevens and Schieb 2011). This is because of lack of empirical data on various dimensions of older adult. We take opportunity in using the LASI-Pilot data and examined the functional limitations of older adults. This is the first ever study that assess the associated covariates of functional limitations of aged population. We have used the demographic, individual and geographical/spatial as the potential covariates to estimate their individual effect on functional limitations of elderly. By doing so, the study broadened its analysis to understand the associated factors of functional limitation of older people in a more comprehensive manner than ever.

Results suggests that, significant proportion of older people have at least one and as high as 7.4 % have multiple functional limitations. Getting in and out of the bed has been found as the most common functional limitation among the studied population. Successive decline in socio-economic status (SES) significantly increases the probability of reporting poorer functional disorder. Many studies have shown the diminishing effect of SES on health and mortality at very old ages. The oldest age groups have the weakest association between the SES and health (Zimmer and Amornsirisomboon 2001; Mukamel et al. 2002; Huisman et al. 2003). Our study also found age as the important predictor and positively correlated with the functional limitation. This corroborates the result of many other studies which evidently concluded that older people at higher age report more functional limitation than the younger group (Al-Sabahi et al. 2009; Holmes et al. 2009; Arokiasamy et al. 2012; Besen et al. 2015;

Table 3 Results of logistic regression (odds ratio) for having any functional limitations among older adults in India, 2010

Background characteristics	Model 1 (N = 1473)	Model 2 (N = 1470)	Model 3 (N = 1470)	Model 4 (N = 1393)
Age group				
45–59[®]	1.00	1.00	1.00	1.00
60–74	2.39***	2.42***	2.31***	1.83***
75 & Above	7.76***	7.67***	7.68***	6.11***
Sex				
Male[®]	1.00	1.00	1.00	1.00
Female	1.68***	1.65***	1.48**	1.56**
Education level				
Non-literate[®]		1.00	1.00	1.00
Primary		1.41	0.86	0.76
Secondary		1.13	0.64*	0.54**
High school+		0.85	0.48*	0.40**
Wealth tertile				
Poor[®]		1.00	1.00	1.00
Middle		1.73**	1.65**	1.42
Rich		1.68**	1.87**	1.44
Residence				
Urban[®]			1.00	1.00
Rural			1.06	1.02
State				
Rajasthan[®]			1.00	1.00
Punjab			0.97	1.04
Kerala			2.81***	1.79*
Karnataka			2.65***	2.40***
Chronic disease				
None[®]				1.00
One				2.18***
Two & above				5.20***
Consume alcohol				
No[®]				1.00
Yes				0.76
Smoke tobacco				
No[®]				1.00
Yes				1.75**

[®] Represents reference category, *P*-value: - ***< 0.01, **< 0.05 & *< 0.1

Morciano et al. 2015). Beside age, other disadvantaged socioeconomic covariates such as economic condition and being in rural adversely associated with the functional limitations of older people (Caregiving 2000). Education more strongly associated with
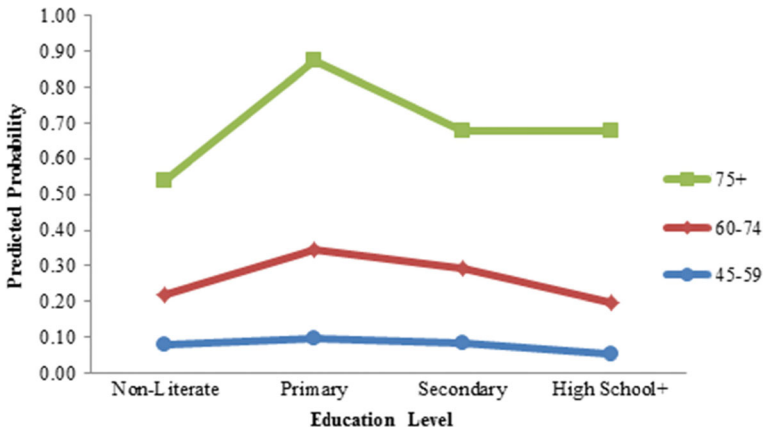
Fig. 3 Predicted probability of any functional limitation by education levels and age-groups, 2010

functional health problem while income more relates to the severity of the problem. Our results are also in line with other studies which have shown the inverse relationship of education level and functional limitation among aged population indicating education contributes to good health (Freedman and Martin 1999; Zimmer and House 2003; Honjo et al. 2009).

Apart from that, result from this analysis also consistent with other analysis that female elderly suffer more functional limitation than male counterpart (Nandakumar et al. 1998; Barbosa et al. 2005; Roy and Chaudhuri 2008). As an effort to identify the responsible factors for high functional limitation among females, studies suggest that, higher fat mass which is relatively higher among women associated with slower walking speed and greater likelihood of functional limitation (Sternfeld et al. 2002; Tager et al. 2004; Barbosa et al. 2005; Hardy et al. 2013). Finally, alike other studies, chronic diseases is identified as one of the crucial the risk factors that enhance the chance of functional limitation among older adults (Dunlop et al. 2005; Korda et al. 2014; Arokiasamy et al. 2015).
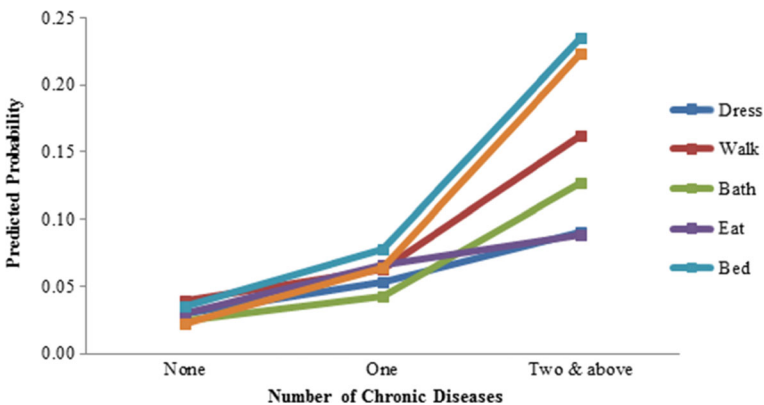

Fig. 4 Predicted probability of having difficulty in performing different ADLs by number of chronic diseases, 2010

Conclusion

Worldwide, there has been significant improvement in the life expectancy of the population but in lieu of morbidity expansion and undoubtedly India is no exception. People are now living with more disability. With fast increasing of the older people, the health system in India will experience the challenge to meet the health needs of aged population. As it is evident from this study and many others, aging has many negative consequences like increase in the healthcare needs and constant nursing. Functional limitation of the older adults is a reality which is witnessed to increase with age. In this context, India's existing healthcare system looks abysmal to meet the future challenges of older adults. There is an imperative requirement to strengthen the present healthcare system to address the health needs of the elderly. Inclusion of separate clause in the recent launched "National Health Mission" for the benefits of older people will probably give extra mileage to meet the health needs of the elderly. Besides, the role of state becomes more important than ever before to protect the rights and well-being of older people. The changing family structure and increasing competition in the income generation has weakened the traditional care system of older people. The support of state has become more essential for those older adults who are less educated, have no saving, income and live with functional limitation.

Limitations

First, the data excluded the institutionalized older adults, which leaves out a large group with a high burden of morbidity. It might leads to underestimation of the prevalence of functional limitation because it is expected that institutionalized older adults have on average more health problems than the non-institutionalized. Second, it is assumed that present health status is correlated with past health status but our data lacks this information. This is the first large scale longitudinal study of older adults in India and the main waves of the data are yet to come in near future which may helpful in understanding the deep insights and causal-effect relationship of functional limitation with its associated covariates.

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