

# BMJ Open Multivariate decomposition analysis of sex differences in functional difficulty among older adults based on Longitudinal Ageing Study in India, 2017–2018

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## ABSTRACT

**Objectives** This study investigates the gender disparities in difficulty in activities of daily living (ADL) and instrumental activities of daily living (IADL) and explores its contributing factors among older adults in India.

**Design** A cross-sectional study was conducted using country representative survey data.

**Setting and participants** The present study uses the data from the Longitudinal Ageing Study in India, 2017–2018. Participants included 15 098 male and 16 366 female older adults aged 60 years and above in India.

**Primary and secondary outcome measures** Difficulty in ADL and IADL were the outcome variables. Descriptive statistics and bivariate analysis were carried out to present the preliminary results. Multivariate decomposition analysis was used to identify the contributions of covariates that explain the group differences to average predictions.

**Results** There was a significant gender differential in difficulty in ADL (difference: 4.6%; p value<0.001) and IADL (difference: 17.3%; p value<0.001). The multivariate analysis also shows significant gender inequality in difficulty in ADL (coefficient: 0.046; p value<0.001) and IADL (coefficient: 0.051; p value<0.001). The majority of the gender gap in difficulty in ADL was accounted by the male–female difference in levels of work status (18%), formal education (15% contribution), marital status (13%), physical activity (9%), health status (8%) and chronic morbidity prevalence (5%), respectively. Equivalently, the major contributors to the gender gap in difficulty in IADL were the level of formal education (28% contribution), marital status (10%), alcohol consumption (9%), health status (4% contribution) and chronic morbidity prevalence (2% contribution).

**Conclusion** Due to the rapidly increasing ageing population, early detection and prevention of disability or preservation of daily functioning for older adults and women in particular should be the highest priority for physicians and health decision-makers.

## BACKGROUND

The 2030 agenda of sustainable development goals emphasises the importance of achieving health for everyone without causing financial

## Strengths and limitations of this study

- The study uses a country representative sample of the older individuals.
- The study provides insights into the disability burden and the sex differentials and its contributing factors using an exhaustive survey information.
- Self-reported measure of functional health information has been used in the study.
- The study design is cross-sectional and, therefore, we cannot establish any causality in the relationships between variables.

hardship. The goal of health for all cannot be achieved without addressing the needs of the dramatically increasing world's old age population. The proportion of older adults is increasing by 3% annually, and it is projected to double from 12% in 2015 to 21% in 2050.<sup>1 2</sup> Predominantly, population ageing was a phenomenon in high-income countries. However, today, the middle-income and low-income countries experience the most significant shift in population structure towards the older population. According to WHO, by 2050, about 80% of the world's older population is projected to be living in low-income and middle-income countries.<sup>3</sup> The ageing population face physiological changes, and the primary health concern will be the risk of chronic diseases and physical disabilities.<sup>4 5</sup>

The significant burden of disability in older adults are caused by a loss in hearing, vision or mobility and various non-communicable diseases.<sup>6</sup> There is also evidence of a positive relationship between disability and economic poverty, and it extends across all kinds of impairment.<sup>7</sup> The age-related functional difficulty is often worsened by the discrimination based on gender existing in society. Even when disability increases with age irrespective

of gender, older women, compared with similar-aged men, face a relatively higher risk from it.<sup>8–11</sup> The rate of incidence and the duration of disability is often higher among women than in men.<sup>12</sup> On assessing the activities of daily living (ADL) and instrumental activities of daily living (IADL), the proportion of women who have at least one difficulty in IADL and ADL was higher than men.<sup>13</sup>

The sex difference in disability is likely to be contributed by a range of socioeconomic and demographic risk factors. Chronic disease prevalence is higher among older women than men.<sup>8</sup> Education and marital status can explain the gender differences in ADL and IADL of older adults.<sup>14</sup> In a pooled analysis of 57 countries, approximately 45% of the disadvantage faced by older women is contributed by their differences in working status, education level, marital status, income levels, age and country of residence. Of all the reasons mentioned in the 57 countries, differences in working status between the genders were the most significant contributor to inequality, that is, a higher proportion of men were involved in paid jobs than women.<sup>15</sup> The higher rate of incidence and retention of disability that older women encounter is sometimes pinned on their higher life expectancy.<sup>11 16</sup> According to another study, disability in older adults is because of their lifestyle in earlier stages of life.<sup>17</sup> For example, smoking, drinking and being obese at an early age have contributed to disability at older ages. However, there exists a gender difference in the prevalence of smoking and drinking, as men are more prone to it than women. As documented, had women started smoking and drinking at the levels men do, it would have had a further detrimental impact on them.<sup>14</sup>

Above 46% of the older adults live with a disability, and at the current rate of population ageing, by 2050, the older adults will become the world's biggest community with disability<sup>18</sup> and greater disability burden is observed among population in higher age groups in India.<sup>19 20</sup> On the other hand, women have higher life expectancy than men; however, they are worse off at functional ability than men—which is known as the male–female health-survival paradox.<sup>13 21</sup> Therefore, understanding the factors associated with differential disability burden among older men and women is crucial for framing policies and interventions. Thus, the purpose of the present study is to investigate the prevalence of sex disparities in reported difficulty in ADL and IADL and explore the factors contributing to such sex disparities in functional health among older adults in India using extensive country representative survey data.

## METHODS

### Data

This study used the baseline survey of the Longitudinal Ageing Study in India (LASI) conducted during 2017–2018.<sup>22</sup> The LASI, which is the Indian version of the Health and Retirement Studies, is a nationally representative survey conducted by the International Institute for

Population Sciences in collaboration with the Harvard T.H. Chan School of Public Health and the University of Southern California.<sup>22</sup> LASI provides vital information on demography, biomarkers, chronic health conditions, symptom-based health conditions, functional health, mental health (cognition and depression), household economic status, healthcare utilisation and health insurance, family and social networks, work and employment, retirement and life expectations of 72 250 adults aged 45 and above across all the states and union territories of India.<sup>22</sup> LASI adopted a multistage-stratified cluster sampling design to follow the sample biennially for 25 years. Further details regarding the sample design, survey instruments, fieldwork, data collection and processing, and response rates are publicly available in the LASI report.<sup>22</sup> The overall sample size for the LASI was over 72 250 people aged 45 years and over. However, the present study analysed the data of people aged 60 years and above. Hence, the analytical sample size for the present study was 31 464 (15 098 male and 16 366 female) older adults.

## Variable description

### Outcome variables

The outcome variables were dichotomised—difficulty in ADL was coded as no and yes, and difficulty in IADL was coded as no and yes.<sup>22</sup> The respondents who had no difficulty in performing ADL were categorised as 'no' (code 0) and otherwise were categorised as 'yes' (code 1). Similarly, older adults who did not face difficulty in performing IADL were grouped into the 'no' category and otherwise were grouped as 'yes'.<sup>23 24</sup>

1. ADL is a term used to refer to normal daily self-care activities (such as movement in bed, changing position from sitting to standing, feeding, bathing, dressing, grooming and personal hygiene). The ability or inability to perform ADLs is used to measure a person's functional status, especially in the case of people with disabilities and older adults.<sup>25 26</sup>
2. IADLs are activities not necessarily related to the basic functioning of a person, but they let an individual live independently in a community. Respondents were asked if they were having any difficulties performing these activities expected to last more than 3 months. The activities were—preparing a hot meal; shopping for groceries; making a telephone call; taking medications; doing work around the house or garden; managing money (such as paying bills and keeping track of expenses); and getting around or finding an address in unfamiliar places.<sup>25 26</sup>

### Explanatory variables

1. Age was categorised as young-old (60–69 years), old-old (70–79 years) and oldest-old (80+ years).
2. Sex was categorised as male and female.
3. Educational status was categorised as no education/primary not completed, primary, secondary and higher.

4. Working status was categorised as currently working, retired/never worked and currently not working.
5. Marital status was coded currently married, widowed and others. Others included never married/divorced/separated.
6. Living arrangement was coded as living alone, living with a spouse, living with children and spouse and living with others.
7. Tobacco and alcohol consumption was recoded as no and yes.
8. Overweight/obesity was coded as no and yes. The respondents with a body mass index of 25 and above were categorised as obese/overweight.<sup>27</sup>
9. Physical activity status was recoded as frequent (every day), rare (more than once a week, once a week, one to three times in a month) and never.<sup>28</sup> The question through which physical activity was assessed was 'how often do you take part in sports or vigorous activities, such as running or jogging, swimming, going to a health centre or gym, cycling, or digging with a spade or shovel, heavy lifting, chopping, farm work, fast bicycling, cycling with loads?'.<sup>29</sup>
10. Self-rated health was coded as good, which includes 'excellent', 'very good' and 'good' categories of the original variable, whereas poor includes 'fair' and 'poor' categories.<sup>29</sup>
11. Morbidity status was categorised as 'no morbidity', '1' (one morbid condition) and '2+' (comorbidity).
12. The monthly per capita consumption expenditure (MPCE) quintile was assessed using household consumption data.<sup>22</sup> Sets of 11 and 29 questions on the expenditures on food and non-food items, respectively, were used to canvas the sample households. Food expenditure was collected based on a reference period of 7 days, and non-food expenditure was collected on reference periods of 30 days and 365 days. Food and non-food expenditures have been standardised to the 30-day reference period. The MPCE is computed and used as the summary measure of consumption. The variable was divided into five quintiles, that is, from poorest to richest.<sup>22</sup>
13. Religion was coded as Hindu, Muslim, Christian and Others.
14. Caste was recoded as Scheduled Tribe (ST), Scheduled Caste (SC), Other Backward Class (OBC) and others. The STs and SCs comprise of the historically socially segregated population as per the now constitutionally abolished Indian caste system, and are India's most disadvantaged social groups. The OBCs are identified as 'educationally, economically and socially backwards', and considered low in the traditional caste hierarchy but are better than the SC and ST populations. The 'other' caste category comprises of people with higher social status who are not included in any of the three groups.
15. The place of residence was categorised as rural and urban.

16. The region was coded as North, Central, East, Northeast, West and South.

### Statistical analysis

Descriptive analysis and bivariate analysis were carried out to present the preliminary results. The proportion test evaluated the gender differentials and observed the difference's statistical significance.<sup>30</sup> Multivariate decomposition analysis was used to identify covariates' contributions, explaining the group differences in average predictions.<sup>31</sup> The decomposition analysis examined the contribution of the independent variables to the gender difference in difficulty in ADL and IADL among older adults in India.

The multivariate decomposition analysis has two contribution effects: compositional differences (endowments) 'E' and the effects of characteristics (which are the difference in the coefficients or behavioural change) 'C' for the selected predictor variables.<sup>32</sup> The observed differences in difficulty in ADL and IADL thus can be additively decomposed into characteristics (or endowments) components and a coefficient (or effects of characteristics) component.<sup>33</sup> The command `mvdcmp` was used to perform multivariate decomposition analysis in STATA V.14.<sup>34</sup>

### Patient and public involvement

No patients were involved.

## RESULTS

### Background characteristics

**Table 1** shows the biodemographic and socioeconomic characteristics of 15 098 male and 16 366 female older adults in India. We observed that six in every ten older adults of either gender were in the young-old age group. Additionally, 53%, 44% and 16% of male older adults had no formal education, were currently not working and were widowed, respectively. Further, among female older adults, 82% had no formal education, 19% were currently working and 54% were widowed. While 16% of males were overweight or obese, the same was higher (23%) in female older adults. Six in ten women and three-fourths of older men never experienced physical activity. Nearly half of older adults of either gender had poor self-rated health, and a quarter had two and more morbidities. Moreover, the majority (more than 80%) of older adults followed Hinduism, and more than 26% belonged to the SC/ST caste. While four in every ten older adults belonged to the lowest 40% wealth quintile, seven in ten older adults lived in a rural community, respectively.

### Bivariate analysis

**Table 2** gives the bivariate distribution of male and female older adults with physical limitations concerning the biodemographic and socioeconomic characteristics. There was a significant gender differential in difficulty in ADL (% diff: 4.6%,  $p$  value<0.001) and difficulty in

**Table 1** Sociodemographic profile of older adults in India, 2015–2016

Background characteristics	Male		Female	
	Sample	Percentage	Sample	Percentage
<b>Age</b>				
Young-old	8730	57.8	9678	59.1
Old-old	4702	31.1	4803	29.4
Oldest-old	1666	11.0	1886	11.5
<b>Education</b>				
Not educated/primary not completed	8019	53.1	13314	81.4
Primary	2235	14.8	1297	7.9
Secondary	3096	20.5	1297	7.9
Higher	1748	11.6	458	2.8
<b>Working status</b>				
Currently working	6613	43.8	3108	19.0
Retired/never worked	7907	52.4	5593	34.2
Currently not working	578	3.8	7665	46.8
<b>Marital status</b>				
Currently married	12242	81.1	7211	44.1
Widowed	2489	16.5	8837	54.0
Others	366	2.4	318	2.0
<b>Living arrangement</b>				
Living alone	380	2.5	1397	8.5
Living with spouse	3929	26.0	2485	15.2
Living with children and spouse	10205	67.6	11268	68.9
Living with others	583	3.9	1216	7.4
<b>Tobacco consumption</b>				
No	6197	41.1	12706	77.6
Yes	8901	59.0	3660	22.4
<b>Alcohol consumption</b>				
No	10939	72.5	15943	97.4
Yes	4159	27.6	423	2.6
<b>Obesity/overweight</b>				
No	12755	84.5	12568	76.8
Yes	2343	15.5	3798	23.2
<b>Physical activity</b>				
Frequent	3706	24.6	1966	12.0
Rarely	2360	15.6	1672	10.2
Never	9031	59.8	12729	77.8
<b>Self-rated health</b>				
Good	8253	54.7	8335	50.9
Poor	6845	45.3	8031	49.1
<b>Morbidity</b>				
No morbidity	7507	49.7	7274	44.5
1	4240	28.1	4928	30.1
2+	3351	22.2	4164	25.4
<b>Wealth index</b>				
Poorest	3145	20.8	3681	22.5

Continued

Table 1 Continued

Background characteristics	Male		Female	
	Sample	Percentage	Sample	Percentage
Poorer	3219	21.3	3611	22.1
Middle	3262	21.6	3331	20.4
Richer	2902	19.2	3136	19.2
Richest	2570	17.0	2607	15.9
Religion				
Hindu	12 386	82.0	13 484	82.4
Muslim	1769	11.7	1781	10.9
Christian	388	2.6	511	3.1
Others	555	3.7	590	3.6
Caste				
Scheduled Caste	2836	18.8	3113	19.0
Scheduled Tribe	1166	7.7	1389	8.5
Other Backward Class	6925	45.9	7308	44.7
Others	4172	27.6	4556	27.8
Place of residence				
Rural	10 879	72.1	11 322	69.2
Urban	4219	28.0	5044	30.8
Region				
North	1863	12.3	2096	12.8
Central	3395	22.5	3202	19.6
East	3713	24.6	3729	22.8
Northeast	437	2.9	497	3.0
West	2457	16.3	2941	18.0
South	3233	21.4	3900	23.8
Total	15 098	100.0	16 366	100.0

IADL (% diff: 17.3%,  $p$  value<0.001). Among individuals with difficulty in ADL, a higher proportion of females had no formal schooling (28%), were widowed (30%), never had physical activity (29%), had poor health (34%) and had two or more morbidities (35%) in comparison to their male counterparts (25%, 24%, 27%, 28% and 30%, respectively). In the oldest-old age group, a higher proportion of women (47%) suffered from difficulty in ADL than men (41%). On the other hand, a higher proportion of older women with difficulty in IADL had no formal schooling (60% in women vs 48% in the men), was widowed (63% vs 48%), never had physical activity (59% vs 45%), had poor health (66% vs 40%) and had two or more morbidities (66% vs 47%).

#### Decomposition of gender difference in difficulty in ADL

Table 3 shows the contribution of biodemographic and socioeconomic characteristics to gender inequality in difficulty in ADL. The results showed significant gender inequality in difficulty in ADL (coef: 0.046;  $p$  value<0.001), and 78% of the gender difference can be explained by the differences in distributions of characteristics between

the male and female older adults. The majority of the gender gap in difficulty in ADL was accounted for by the difference in the level of formal education (15% reduction), work status (18% reduction) and marital status (13% reduction), respectively. Moreover, differences in the level of physical activity, health status and morbidity prevalence between the male and female older adults contributed to a 9%, 8% and 5% increase in the gender gap, respectively. Additionally, 2% of the ADL-related gender gap was accounted for by the gap among the six regions of India.

#### Decomposition of gender difference in IADL

Table 4 shows the contribution of biodemographic and socioeconomic characteristics to the IADL-related gender gap. We observed a significant gender gap in difficulty in IADL (coef: 0.051;  $p$  value<0.001), and 30% of the gender inequality can be explained by the differences in characteristics between the male and female older adults. We found that differences in the level of formal education (28% contribution), marital status (10% contribution), health status (4% contribution) and morbidity

**Table 2** Percentage of older males and females reported difficulty in ADL and IADL in India, 2017–2018

Background characteristics	Difficulty in ADL				Difficulty in IADL			
	Male	Female	Differences	P value	Male	Female	Differences	P value
<b>Age</b>								
Young-old	16.1	19.8	3.7	<0.001	31.3	49.7	18.4	<0.001
Old-old	25.8	32.1	6.3	<0.001	46.8	64.3	17.5	<0.001
Oldest-old	41.3	47.1	5.8	<0.001	63.1	75.3	12.1	<0.001
<b>Education</b>								
Not educated/primary not completed	24.8	28.2	3.4	<0.001	47.8	60.1	12.3	<0.001
Primary	18.7	22.4	3.7	0.023	35.9	41.6	5.7	<0.001
Secondary	19.6	16.4	-3.2	<0.001	31.0	49.8	18.8	<0.001
Higher	16.8	19.4	2.5	<0.001	22.5	28.6	6.1	<0.001
<b>Working status</b>								
Currently working	12.6	16.8	4.2	<0.001	28.4	50.0	21.6	<0.001
Retired/never worked	29.3	32.9	3.6	<0.001	48.8	63.0	14.2	<0.001
Currently not working	27.7	25.9	-1.8	0.121	42.8	55.3	12.5	<0.001
<b>Marital status</b>								
Currently married	21.4	21.9	0.6	<0.001	37.6	49.5	11.9	<0.001
Widowed	24.5	30.3	5.8	<0.001	48.1	63.1	15.0	<0.001
Others	23.0	26.2	3.3	0.144	50.8	55.4	4.7	0.084
<b>Living arrangement</b>								
Living alone	23.8	28.5	4.7	0.147	48.1	62.8	14.7	<0.001
Living with spouse	25.7	21.5	-4.2	0.494	42.6	49.5	6.9	<0.001
Living with children and spouse	20.3	26.8	6.5	<0.001	37.7	56.9	19.2	<0.001
Living with others	24.4	32.8	8.4	<0.001	49.0	66.2	17.2	<0.001
<b>Tobacco consumption</b>								
No	21.9	25.6	3.6	<0.001	37.1	56.0	18.9	<0.001
Yes	21.9	29.9	8.0	<0.001	41.4	60.2	18.8	<0.001
<b>Alcohol consumption</b>								
No	23.0	26.7	3.7	<0.001	39.8	57.0	17.2	<0.001
Yes	19.1	21.4	2.3	0.008	39.2	55.1	15.8	<0.001
<b>Obesity/overweight</b>								
No	22.1	27.8	5.6	<0.001	40.9	58.1	17.2	<0.001
Yes	20.8	22.5	1.8	<0.001	33.0	53.1	20.2	<0.001
<b>Physical activity</b>								
Frequent	14.2	19.2	4.9	<0.001	30.6	51.0	20.3	<0.001
Rarely	15.1	19.0	3.9	<0.001	32.0	51.5	19.5	<0.001
Never	26.9	28.7	1.8	<0.001	45.3	58.6	13.2	<0.001
<b>Self-rated health</b>								
Good	16.5	18.9	2.4	<0.001	31.1	47.9	16.7	<0.001
Poor	28.4	34.5	6.0	<0.001	49.9	66.4	16.5	<0.001
<b>Morbidity</b>								
No morbidity	17.7	21.4	3.7	<0.001	35.5	51.5	16.0	<0.001
1	23.2	26.8	3.5	<0.001	41.3	57.1	15.9	<0.001
2+	29.7	35.3	5.6	<0.001	46.9	66.3	19.4	<0.001
<b>Wealth index</b>								

Continued

Table 2 Continued

Background characteristics	Difficulty in ADL				Difficulty in IADL			
	Male	Female	Differences	P value	Male	Female	Differences	P value
Poorest	22.8	28.4	5.6	<0.001	42.6	57.1	14.4	<0.001
Poorer	20.8	27.0	6.2	<0.001	41.3	57.4	16.1	<0.001
Middle	24.6	26.4	1.8	<0.001	38.7	55.1	16.4	<0.001
Richer	20.0	24.8	4.7	<0.001	37.9	58.6	20.8	<0.001
Richest	21.0	25.7	4.7	<0.001	37.2	56.5	19.3	<0.001
Religion								
Hindu	21.0	26.3	5.2	<0.001	38.8	57.3	18.5	<0.001
Muslim	28.0	30.0	2.0	<0.001	43.3	58.2	14.9	<0.001
Christian	26.1	23.4	-2.8	<0.001	37.0	47.9	10.9	<0.001
Others	20.2	25.7	5.5	<0.001	49.1	53.7	4.6	<0.001
Caste								
Scheduled Caste	22.1	29.0	6.9	<0.001	42.6	58.2	15.7	<0.001
Scheduled Tribe	19.7	20.8	1.1	<0.001	37.8	51.4	13.6	<0.001
Other Backward Class	22.9	25.0	2.1	<0.001	41.6	60.0	18.4	<0.001
Others	20.8	29.0	8.2	<0.001	34.9	52.9	18.0	<0.001
Place of residence								
Rural	21.9	27.1	5.2	<0.001	42.7	60.1	17.4	<0.001
Urban	21.9	25.2	3.3	<0.001	31.8	49.8	18.0	<0.001
Region								
North	12.9	15.2	2.3	<0.001	32.5	49.6	17.1	<0.001
Central	18.1	23.3	5.2	<0.001	35.4	53.1	17.7	<0.001
East	25.6	32.3	6.7	<0.001	42.8	59.6	16.7	<0.001
Northeast	13.5	20.1	6.6	<0.001	32.1	48.3	16.3	<0.001
West	28.5	36.6	8.1	<0.001	35.6	54.3	18.7	<0.001
South	23.0	23.1	0.0	<0.001	48.7	64.6	15.9	<0.001
Total	21.9	26.5	4.6	<0.001	39.7	56.9	17.3	<0.001

Difference: Female–Male; p value based on proportion test; p values were not adjusted for multiple testing and may be interpreted as exploratory only.

ADL, activities of daily living; IADL, instrumental activities of daily living.

prevalence (2% contribution) among females and males contributed significantly to the gender gap in difficulty in IADL. Moreover, the male–female gap in alcohol consumption accounted for a 9% decrease of gender gap in difficulty in IADL.

## DISCUSSION

The present study of sex differences in functional difficulties demonstrated that the proportion of older people with difficulty in ADL and IADL increased with age for both sexes. In the total study population, 5% more women than men had difficulty in ADL, whereas, 17% more women than men had difficulty in IADL. The sex difference in difficulty in ADL and IADL observed in the present study was in line with the previous studies.<sup>35–37</sup> A recent study by Crimmins *et al* found that the likelihood of having difficulties in ADL and IADL was about twofold

higher for women than for men around the world.<sup>36</sup> The current findings also agree with the female disability disadvantage reported in earlier studies showing that women have lower grip strength, slower gait speed, take longer time to rise from a sitting position and have worse physical functioning than men.<sup>37–39</sup>

The decomposition of contributing factors to sex differences showed that lack of education among older women substantially contributed to differences in difficulty in ADL and IADL. Several studies showed an independent association between education and disability in older women, suggesting that low education may be regarded as a risk factor for accelerating decline.<sup>40–41</sup> Also, female gender and lower levels of education were found to be the risk factors of functional difficulties in multiple studies.<sup>42–43</sup> As documented, ADL and IADL require a range of physically demanding capabilities, and in addition, IADL requires

**Table 3** Multivariate logistic regression decomposition estimates for gender differentials in difficulty in ADL among older adults in India, 2017–2018

Background characteristics	Due to differences in characteristics				Due to differences in coefficients				
	Coef.	SE	P value	Per cent contribution	Coef.	SE	P value	Per cent contribution	
<b>Age</b>									
Young-old				-1.4				16.3	
Old-old	-0.002	<0.001	<0.001	-2.5	0.006	0.003	0.034	9.9	
Oldest-old	0.001	<0.001	<0.001	1.1	0.004	0.001	0.008	6.4	
<b>Education</b>									
Not educated/primary not completed	0.012	0.005	0.014	20.2	-0.014	0.009	0.126	-23.2	-35.1
Primary	-0.001	0.001	0.536	-1.2	-0.005	0.003	0.074	-9.0	
Secondary	-0.002	0.003	0.384	-3.9	-0.002	0.004	0.681	-2.8	
Higher									
<b>Working status</b>									
Currently working				17.7				-25.0	
Retired/never worked	-0.014	0.002	<0.001	-24.2	-0.013	0.005	0.016	-21.1	
Currently not working	0.025	0.004	<0.001	41.9	-0.002	0.001	0.003	-3.9	
<b>Marital status</b>									
Currently married				12.6				4.1	
Widowed	0.008	0.003	0.004	12.7	0.002	0.002	0.299	2.6	
Others	0.000	<0.001	0.021	-0.1	0.001	0.001	0.183	1.5	
<b>Living arrangement</b>									
Living alone				0.9				22.1	
Living with spouse	0.000	0.001	0.800	-0.6	-0.001	0.005	0.852	-1.7	
Living with children and spouse	0.000	<0.001	0.217	0.1	0.014	0.014	0.298	24.0	
Living with others	0.001	0.001	0.129	1.4	0.000	0.001	0.858	-0.3	
<b>Tobacco consumption</b>									
No				4.4				-2.5	
Yes	0.003	0.002	0.251	4.4	-0.001	0.005	0.748	-2.5	
<b>Alcohol consumption</b>									
No				6.1				-4.2	
Yes	0.004	0.004	0.372	6.1	-0.003	0.004	0.559	-4.2	
<b>Obesity/overweight</b>									
No				-1.6				0.8	
Yes	-0.001	0.001	0.066	-1.6	0.000	0.002	0.774	0.8	
<b>Physical activity</b>									
Frequent				8.7				-10.1	
Rarely	-0.001	0.001	0.122	-1.7	-0.001	0.002	0.668	-1.6	
Never	0.006	0.002	<0.001	10.4	-0.005	0.007	0.476	-8.5	
<b>Self-rated health</b>									
Good				8.0				-3.6	
Poor	0.005	<0.001	<0.001	8.0	-0.002	0.003	0.482	-3.6	
<b>Morbidity</b>									

Continued



Table 3 Continued

Background characteristics	Due to differences in characteristics				Due to differences in coefficients				
	Coef.	SE	P value	Per cent contribution	Coef.	SE	P value	Per cent contribution	
No morbidity				5.4				-2.1	
1	0.001	<0.001	<0.001	1.2	-0.001	0.002	0.760	-1.3	
2+	0.003	<0.001	<0.001	4.2	-0.001	0.002	0.816	-0.8	
<b>Wealth index</b>									
Poorest	0.000	<0.001	0.769	0.0	-0.001	0.002	0.896	-1.3	-7.9
Poorer	0.000	<0.001	0.223	-0.1	-0.001	0.002	0.187	-1.8	
Middle	0.000	<0.001	0.406	0.0	-0.004	0.002	0.463	-6.4	
Richer	0.000	<0.001	0.725	0.0	0.001	0.002	0.749	1.5	
Richest									
<b>Religion</b>									
Hindu				-0.2				0.0	
Muslim	0.000	<0.001	0.252	0.0	0.002	0.001	0.209	2.9	
Christian	0.000	<0.001	0.119	-0.2	-0.002	0.002	0.144	-3.7	
Others	0.000	<0.001	0.198	0.0	0.000	0.001	0.604	0.8	
<b>Caste</b>									
Scheduled Caste				0.1				-12.5	
Scheduled Tribe	0.000	<0.001	0.233	-0.1	-0.001	0.002	0.674	-1.6	
Other Backward Class	0.000	<0.001	0.053	0.3	-0.006	0.004	0.180	-9.4	
Others	0.000	<0.001	0.986	0.0	-0.001	0.003	0.792	-1.5	
<b>Place of residence</b>									
Rural				-0.1				5.7	
Urban	0.000	<0.001	0.441	-0.1	0.003	0.003	0.226	5.7	
<b>Region</b>									
North				1.8				18.9	
Central	-0.001	<0.001	<0.001	-1.3	0.001	0.002	0.460	2.5	
East	-0.001	<0.001	<0.001	-1.9	-0.001	0.002	0.666	-1.7	
Northeast	0.000	<0.001	0.478	0.0	0.004	0.002	0.086	6.0	
West	0.002	<0.001	<0.001	4.0	0.003	0.002	0.108	4.9	
South	0.001	<0.001	<0.001	0.9	0.004	0.003	0.156	7.2	
Constant					0.031	0.032	0.339	51.2	
Total	0.046	0.006	<0.001	77.5	0.013	0.007	0.066	22.5	

P values were not adjusted for multiple testing and may be interpreted as exploratory only.

ADL, activities of daily living.

cognitive capacity, which is known to be related to educational level, and older women are primarily disadvantaged.<sup>44 45</sup> Longitudinal studies are needed to determine how education influences the progression of disability in specific subgroups of older people and older women in particular in their daily activities.

An individual-level analysis of SRH by gender based on the World Health Survey showed that some differences between older men and women could be attributed to education and employment levels.<sup>46</sup> Consistently, the working status extensively explained our study's sex

differences in difficulty in ADL and IADL. However, differences in lifestyle habits such as tobacco and alcohol consumption did not explain the gender gap in functional limitations in the current study.

Further, women had higher chances of suffering from disability due to physiological differences such as lower muscle strength or bone density or lifestyle factors such as sedentary life and obesity,<sup>42 47</sup> suggesting a female disadvantage in overall physical and associated functional health. Although a few studies have shown no gender differences in physical and functional health, the current

**Table 4** Multivariate logistic regression decomposition estimates for gender differentials in difficulty in IADL among older adults in India, 2017–2018

Background characteristics	Due to differences in characteristics				Due to differences in coefficients			
	Coef.	SE	P value	Per cent contribution	Coef.	SE	P value	Per cent contribution
<b>Age</b>								
Young-old				-0.7				0.6
Old-old	-0.002	<0.001	<0.001	-1.2	0.002	0.004	0.549	1.2
Oldest-old	0.001	<0.001	<0.001	0.5	-0.001	0.002	0.546	-0.7
<b>Education</b>								
Not educated/primary not completed	0.065	0.006	<0.001	37.6	0.004	0.013	0.774	2.2
Primary	-0.006	0.002	<0.001	-3.6	-0.001	0.004	0.875	-0.4
Secondary	-0.010	0.004	0.007	-5.6	0.001	0.006	0.911	0.4
Higher								2.2
<b>Working status</b>								
Currently working				-3.5				-17.2
Retired/never worked	-0.012	0.002	0.000	-6.8	-0.029	0.008	<0.001	-16.5
Currently not working	0.006	0.005	0.283	3.2	-0.001	0.001	0.248	-0.7
<b>Marital status</b>								
Currently married				10.4				-0.3
Widowed	0.018	0.003	<0.001	10.4	0.000	0.002	0.839	0.3
Others	0.000	<0.001	0.062	0.0	-0.001	0.001	0.295	-0.6
<b>Living arrangement</b>								
Living alone				0.3				-11.5
Living with spouse	-0.002	0.002	0.283	-1.1	-0.007	0.008	0.385	-4.0
Living with children and spouse	0.000	<0.001	0.029	0.1	-0.013	0.020	0.531	-7.4
Living with others	0.002	0.001	0.003	1.3	0.000	0.001	0.985	0.0
<b>Tobacco consumption</b>								
No				-2.6				-5.9
Yes	-0.005	0.003	0.145	-2.6	-0.010	0.007	0.135	-5.9
<b>Alcohol consumption</b>								
No				-8.6				7.2
Yes	-0.015	0.005	0.005	-8.6	0.012	0.006	0.049	7.2
<b>Obesity/overweight</b>								
No				-1.4				1.1
Yes	-0.002	0.001	<0.001	-1.4	0.002	0.002	0.428	1.1
<b>Physical activity</b>								
Frequent				1.5				-11.2
Rarely	-0.001	0.001	0.432	-0.3	-0.003	0.003	0.374	-1.5
Never	0.003	0.002	0.106	1.9	-0.017	0.009	0.076	-9.7
<b>Self-rated health</b>								
Good				4.2				-0.4
Poor	0.007	<0.001	<0.001	4.2	-0.001	0.005	0.889	-0.4
<b>Morbidity</b>								

Continued

Table 4 Continued

Background characteristics	Due to differences in characteristics				Due to differences in coefficients			
	Coef.	SE	P value	Per cent contribution	Coef.	SE	P value	Per cent contribution
No morbidity				2.3				0.2
1	0.001	<0.001	<0.001	0.6	0.002	0.004	0.613	1.0
2+	0.003	<0.001	<0.001	1.7	-0.001	0.003	0.655	-0.9
Wealth index								
Poorest	0.000	<0.001	0.602	0.0	-0.003	0.004	0.445	-1.6
Poorer	0.000	<0.001	0.592	0.0	-0.002	0.003	0.584	-1.1
Middle	0.000	<0.001	0.629	0.0	0.002	0.003	0.528	1.3
Richer	0.000	<0.001	0.804	0.0	0.005	0.003	0.164	2.7
Richest				-0.1				1.3
Religion								
Hindu				-0.2				1.8
Muslim	0.000	<0.001	0.033	0.0	0.005	0.002	0.025	2.6
Christian	0.000	<0.001	0.001	-0.2	0.002	0.002	0.331	1.2
Others	0.000	<0.001	0.353	0.0	-0.003	0.001	0.005	-2.0
Caste								
Scheduled Caste				0.1				-1.2
Scheduled Tribe	0.000	<0.001	0.102	0.1	0.000	0.003	0.890	-0.3
Other Backward Class	0.000	<0.001	0.925	0.0	-0.002	0.006	0.731	-1.2
Others	0.000	<0.001	0.469	0.0	0.000	0.005	0.927	0.3
Place of residence								
Rural				-0.6				4.0
Urban	-0.001	<0.001	<0.001	-0.6	0.007	0.004	0.094	4.0
Region								
North				0.7				-9.2
Central	0.000	<0.001	0.516	0.1	-0.001	0.003	0.702	-0.6
East	0.000	<0.001	0.008	-0.3	-0.006	0.003	0.084	-3.4
Northeast	0.000	<0.001	0.007	0.1	-0.006	0.003	0.026	-3.5
West	0.001	<0.001	0.009	0.3	0.000	0.002	0.946	0.1
South	0.001	<0.001	<0.001	0.6	-0.003	0.004	0.434	-1.9
Constant					0.175	0.047	<0.001	101.2
Total	0.051	0.008	<0.001	29.6	0.122	0.010	<0.001	70.4

p values were not adjusted for multiple testing and may be interpreted as exploratory only.

IADL, instrumental activities of daily living.

analysis observes greater contribution of self-rated health and morbidity status to sex differences in difficulty in ADL and IADL among older individuals. This can be partially attributed to the survival bias, resulting in a selection effect with the strongest men surviving the older age groups.<sup>48 49</sup> Thus, women's generally weaker physique than men might influence sex differences in difficulty in ADL and IADL. Concordantly, an American study found that older women had a worse inflammatory index, contributing to worse overall functioning.<sup>50</sup> Thus, effective interventions are urgently needed to prevent or delay

the onset of disability in older adults, especially women suffering from any morbidity or poor physical health.

Moreover, socioeconomic disadvantages such as poor household living conditions and lower caste status, with India hosting a high proportion of the population of deprived STs, generally contribute to a higher disability prevalence.<sup>20</sup> The findings of our study also show that the proportion of the population who are from households of the poorest wealth quintile or members of SCs has no relationship to disability levels. This is also compatible with the findings of previous studies in India and other

developed countries.<sup>51 52</sup> The present study also found a significant sex disparity explained by rural residence compared with urban areas. Rural women's poor ADL and IADL statuses might reflect inadequate healthcare and health infrastructure.<sup>53</sup> Since higher economic status tends to be associated with better health status, access to healthcare, healthy food and housing,<sup>54</sup> the current results indicate that preventive interventions should focus on the heterogeneous groups of older adults, particularly those belonging to socioeconomically vulnerable groups. Two hypotheses of differential exposure and differential vulnerability have been stated in multiple studies to explain the role of social factors in gender–health associations,<sup>55 56</sup> suggesting that due to the different access to material resources and other social conditions of life, men and women are exposed to different levels of risk, resulting in different health outcomes and women's biological vulnerability make them at increased health risks. Since sex differences in health are enormous, such hypotheses need to be further examined in poor resource settings, including India.

Since there has been nearly no systematic study of the sex differences in the prevalence of disability in India that examined the contribution of various health, demographic and socioeconomic characteristics of the older population with disabilities, we believe that this study adds important information to the existing literature. The analyses provide insights into the disability burden and the sex differentials and its contributing factors in India based on the recent survey data with exhaustive information of the ageing population. However, there are several limitations of the present study to be acknowledged. The data used are cross-sectional and use multivariate decomposition for analysis. Therefore, we cannot establish any causality between functional limitations and different socioeconomic and health-related variables. Also, the dependent variables in our study are two functional health measures, which are combinations of multiple functional task items; and current findings may not be generalisable to individual measures of functional health. Similarly, our data on functional health are based on self-reports. Thus, some of the sex differences we find may be due to how men and women respond to related questions, and mild forms of disability could be underestimated. Hence, future studies may address these issues using more objective and follow-up data with more analytical tools.

## CONCLUSION

Due to the rapidly increasing ageing population, early detection and prevention of disability or preservation of daily functioning for older adults and women in particular should be the highest priority for physicians and health decision-makers. Evidence-based tools need to be developed to help them adequately identify those at high risk of disability. Moreover, the gendered pathways to functional disability need further investigation to inform

policy-makers on successful ageing measures for older men and women.

**Contributors** Conceived and designed the research paper: SS and TM. Analysed the data: SS. Contributed agents/materials/analysis tools: TM and RP. Wrote the manuscript: TM, SS, RP and ART. Refined the manuscript: SS, RP, ART and TM. All authors read, reviewed and approved the manuscript to be published.

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**Patient consent for publication** Not applicable.

**Ethics approval** This study used a publicly available secondary dataset with no information that could lead to the identification of the respondents. The ethical clearance for LASI 2017–2018 was approved by the Joint Ethical Review Board of the International Institute for Population Sciences in collaboration with the Harvard T.H. Chan School of Public Health and the University of Southern California. All participants who agreed to participate in the survey signed an informed consent form, and the data collection procedure followed the relevant guidelines and regulations. The authors asked permission to use the data via an online form, and the data manager has permitted to use the data for the current study. Therefore, prior ethical approval for using these datasets was not necessary.

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**Data availability statement** Data may be obtained from a third party and are not publicly available. The study uses a secondary data that are available on reasonable request through <https://www.iipsindia.ac.in/content/lasi-wave-i>.

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