Cross-sectional associations of personal efforts and beliefs and depressive symptoms among older adults in India

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Whilst there is growing evidence on the increased vulnerability of older adults to depression, there is limited research on potentially mitigative factors against symptoms of depression at a population level. This research examined associations of possible protective factors (personal efforts and beliefs) and depressive symptoms among older adults in India. This cross-sectional study used data from the Longitudinal Aging Study in India with 31,464 respondents aged 60 years and above. Depressive symptoms were assessed using the 10-item Centre for Epidemiologic Studies Depression Scale. Multivariable linear regression was used while exploring the associated factors of depressive symptoms. The mean score of depressive symptoms was 2.94 (CI 2.92, 2.96). Older adults who engaged in moderate [aCoef: −0.11, CI −0.18, −0.05], vigorous [aCoef: −0.09, CI −0.16, −0.03], or both types of physical activity [aCoef: −0.10, CI −0.19, −0.02] had lower likelihood of depressive symptoms in comparison to those who were physically inactive. Older adults who participated in social activities were less likely to have depressive symptoms [aCoef: −0.44, CI −0.50, −0.39] compared to their socially inactive counterparts. Further, older adults who perceived religion as very important [aCoef: −0.29, CI −0.41, −0.17], who had high life satisfaction [aCoef: −0.78, CI −0.82, −0.73], who had good self-perceived health [aCoef: −0.29, CI −0.33, −0.25] and those who had high self-perceived social standing [aCoef: −0.39, CI −0.47, −0.31] had lower likelihood of depressive symptoms in comparison to their respective counterparts. Physical activity, social participation, voluntary work and financial contribution to family, religiosity, life satisfaction, self-perceived health and self-perceived social standing are associated with lower likelihood of depressive symptoms among community-dwelling older adults in this study. Future longitudinal studies should explore these factors that can guide interventions against depression in old age.

Complex health and wellbeing needs of the rapidly growing older adult population continue to challenge the health care and social systems in both developed and developing countries. Amidst the developing countries, India shares this dynamic population demographic, having the second largest proportion of older adults in the world1. A major contributor to the disease burden is the incidence of late life depression in older adults that presents considerable economic and social concerns for many countries2,3. This continues to be a major public health concern in India, with additional country specific barriers4,5. Some of the barriers for mental health service provision for older adults at a macro level include large variation in population demographics between regions, fragmented health and social support services, varied distribution of support services between states, lack of public awareness on older adult mental health and a large reliance on familial support structures6. At a micro level, the seriousness of late-life depression is due to its prolonged trajectory and negative impacts on the individual's quality of life. Presence of depressive symptoms in older adults if not intervened early, could result in increased morbidity from development of debilitating cognitive conditions such as dementia, worsening of other co-existing health conditions such as cardiovascular disease and fatal consequences such as suicide7,8.

Adults in old age commonly encounter significant and sometimes life altering stressors such as loss of spouse, retirement, changes to familial support system and presence of more than one long-term health condition9. The vulnerability of older adults to depression could be explained as their response to significant stressors. How the

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Individuals respond to stressors depending on their biophysical, psychological and socio-demographic context\textsuperscript{10}. In addition, response to stress varies from person to person and also depends on available coping resources, both intrinsic and extrinsic\textsuperscript{11}. In this research, we conceptualise the response of older adults to stressors in late life as influenced by an interaction between their bio-psycho-socio-demographic context and intrinsic and extrinsic coping resources for desirable positive outcomes (Fig. 1).

Intrinsic resources that have a protective effect against depression can be categorised into individual efforts and individual beliefs. Individual efforts such as pursuing an active and healthy lifestyle, being socially engaged and actively involved in familial responsibilities\textsuperscript{12–14} have been widely reported as contributing to healthy ageing, a sense of purpose, empowerment and quality of life\textsuperscript{15}. Additionally, individual beliefs such as having a positive perspective on oneself and in life in general are likely to have protective effects by improving self-efficacy to cope with stress\textsuperscript{16}. Individuals with high self-efficacy are more likely to seek social and professional support, and take initiative to combat depressive symptoms\textsuperscript{16}. Religious and cultural beliefs are being increasingly recognised by mental health professionals as supporting the individual to have an alternative perspective on life changes due to stressors and to improve connections to promote wellbeing\textsuperscript{17}. Extrinsic resources comprise external support systems that are available to the individual such as familial support, social support networks, public health programmes, awareness of mental health and well-being, and professional support system. In the Indian context, there exist additional layers of complexities such as inequitable access to above extrinsic resources for particular population cohorts such as the socially deprived, people belonging to lower caste and some regions making them more vulnerable to depression\textsuperscript{18}. In addition, employment status, education and awareness of support programmes are frequently pointed out by researchers as factors associated with late life depression\textsuperscript{19}.

Stressors can be potential growth opportunities, where older adults positively adapt to changes in their life, develop positive coping strategies, identify new support resources and continue to experience wellbeing. However, when stressors are multiple and overwhelming, and beyond the individual’s coping resources, they may succumb to the negative consequences such as depression. This is an important consideration for health professionals and policy makers. An individual who is struggling to cope with the stressors could be helped by professional interventions. At a macro level this also means the public health policy makers could promote protective intrinsic behaviours by increasing awareness, screening programmes to identify depressive symptoms and to execute targeted programmes for vulnerable populations.

Emerging international population-based research reveals a positive picture, describing older adults as having resilience potential and generally able to cope well with stressors and experience wellbeing in late life\textsuperscript{20–22}. These research reports are from developed countries where there is an established and sound social support structure. However, in the Indian context, the health and social care experience of older adults is largely varied due to socioeconomic diversity, absence of a central social support system, lack of focussed outreach public health programmes for older adults and support schemes that are varied across states and regions\textsuperscript{6,23}. In the recent decades, there is an emerging awareness of older adult health and wellbeing, and informal support programmes offered by not-for-profit organisations\textsuperscript{24}.

Whilst there is growing evidence on the increased vulnerability of Indian older adults to depression, there is a limited research on factors that are protective and potentially mitigative against symptoms of depression at a population level in the Indian context. In this research, we examined the associations of posited protective factors (personal efforts and beliefs) and late life depressive symptoms at an individual level and related socio-demographic characteristics among older adults in India using a large nationally-representative data.

**Methods**

**Data.** The present cross-sectional study is based on data from the first wave of the Longitudinal Aging Study in India (LASI) collected during 2017–18\textsuperscript{25}. LASI is a national representative longitudinal survey of middle- and older-aged Indians (i.e., aged 45 years or older) and their spouses who reside in the same households, irrespective of age. The LASI provides rich information on demographics, morbidity, health behaviour factors, and

![Figure 1. Older adults’ response to stressors—Indian context.](https://doi.org/10.1038/s41598-022-17578-1)
physical health of the aging population in India. The LASI survey adopted a multistage stratified area probability cluster sampling design. It is a nationally representative survey of 72,250 older adults aged 45 and above across all states and union territories of India. LASI is envisioned to be conducted every two years for the next 25 years.

The LASI survey is conceptually comparable to the United States Health and Retirement Study (HRS) and other HRS-type surveys in various countries, including China (China Health and Retirement Longitudinal Survey) and England (English Longitudinal Study of Ageing). Along with its uniqueness of comparability with studies in other countries, LASI also considered features unique to India, including its institutional and cultural characteristics. LASI is conducted through a partnership of the International Institute of Population Sciences (IIPS), Harvard University, and the RAND Corporation. Since we are interested in exploring the determinants of multimorbidity among the older adults, we restrict our attention to the subsample of the Indian older adults and limit our sample to respondents aged 60 or above. The present study data set contains 31,464 respondents, 16,366 women, and 15,098 men.

**Variable description.** Outcome variable. The respondents’ depressive symptoms were assessed using the Centre for Epidemiologic Studies Depression Scale (CES-D). Seven negative symptoms (difficulty concentrating, feeling depressed, low energy, fear of something, feeling alone, bothered by things, and everything is an effort) and three positive symptoms (difficulty concentrating, feeling depressed, low energy, fear of something, feeling alone, bothered by things, and everything is an effort) were among the ten items (feeling happy, hopeful, and satisfied). In the week leading up to the interview, response possibilities included rarely or never (< 1 day), occasionally (1 or 2 days), often (3 or 4 days), and most or all of the time (5–7 days). Negative symptoms were scored zero in the rarely or never (< 1 day) and occasionally (1 or 2 days) categories, and one in the often (3 or 4 days) and most or all of the time (5–7 days) categories. The scale was used as continues variable for analysing the association.

**Explanatory variables.** The variables were categorized as personal effort, personal beliefs and socioeconomic & demographic attributes.

1. Socioeconomic and demographic attributes

   Socio-economic status was coded as poorest, poorer, middle, richer and richest. Socio-economic status was assessed using monthly per capita expenditure (MPCE). The MPCE is measured using household consumption data. Sets of 11 and 29 questions on the expenditures on food and non-food items, respectively, was used to canvas the sample households. Food expenditure was collected based on a reference period of seven days, and non-food expenditure was collected based 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. Employment was coded as never worked, currently working, not working and retired. Education was coded as not educated/ primary not completed, primary completed, secondary completed and higher & above. Awareness of welfare scheme was coded as no and yes. Age group was coded as 60–69 years, 70–79 years and 80 + years. Gender was coded as male and female.

   Caste was categorized as Scheduled Tribe, Scheduled Caste, Other Backward Class and others. The Scheduled Caste includes a group of population which is socially segregated and financially/economically by their low status as per Hindu caste hierarchy. The Scheduled Castes and Scheduled Tribes are among the most disadvantaged socioeconomic groups in India. The OBC are the group of people who were identified as “educationally, economically and socially backward”, and are considered low in traditional caste system. The “other” caste category is identified of having higher social status. Religion was categorized as Hindu, Muslim, Christian and Others. Place of residence was categorized as rural and urban. Region was categorized as North, Central, East, Northeast, West and South.

2. Personal effort factors

   Physical activity was coded as inactivity, only moderate, only vigorous and both moderate & vigorous. Quit tobacco consumption was coded as never consumed, currently consuming and quit. Social participation was coded as no and yes. The LASI survey collected information on whether a person goes out of the house for eating, goes outdoors for relaxing, plays outdoor games or exercises, visits relatives, attends cultural events, attends religious functions and attends group meetings. Voluntary work was coded as no and yes. Looking after children and grandchildren was coded as no and yes. Financial contribution to family/others was coded as no and yes.

3. Personal belief factors

   Importance of religion was coded as not important, somewhat important and very important. Life satisfaction was coded as high, medium and low. Self-perceived health was coded as good (very good and excellent) and poor (fair and poor). Self-perceived social standing was assessed using ladder technique and the question was “Think of the ladder with 10 stairs as representing where people stand in our society. At the top of the ladder are the people who are the best off—those who have the most money, most education, and best jobs. At the bottom are the people who are the worst off—who have the least money, least education, and the worst jobs or no jobs. The higher up you are on this ladder, the closer you are to the people at the very top and the lower you are, the closer you are to the people at the very bottom of your society”. A score of 0–10 was recoded into high (8–10) medium (4–7) and low (0–3).

**Statistical analysis.** Descriptive analysis along with mean was calculated for measuring initial results. Additionally, multiple linear regression was used while exploring the association between the outcome and explanatory variables. The regression estimates were reported at 95% CI (Confidence Interval). The results were
presented in the form of unadjusted and adjusted coefficients. The svyset command was used to adjust the analysis for complex survey design. The individual weights were used to make the estimates nationally representative. STATA version 14 was used for the analysis. Model-1 represents the unadjusted estimates whereas model-2 represents the adjusted estimates (adjusted for personal effort, personal beliefs, and socioeconomic and demographic attributes).

**Results**

Table 1 presents the sample characteristics. A proportion of 11.3% of the sample was aged 80 years and above and 52.6% were females in the current study. A proportion of 74.4% older adults were physically inactive. Also, 34% of the respondents were current consumers of smoked/smokeless tobacco, whereas 5.8% quit the tobacco consumption. A proportion of 85.6% of older adults reported participation in social activities and 30.7% reported engagement in voluntary work. Little more than 17% looked after children/grandchildren in the household, whereas only 5.8% contributed to the household financially. On the other hand, 78.8% of older adults reported that religion is very important to them. A proportion of 45.5% of older participants had high life satisfaction, whereas 52.7% had a good self-rated health and 7% had a high self-perceived social standing.

Table 2 presents the mean score of depressive symptoms among study population by their background characteristics. Overall, mean depressive symptom was 2.94 (CI 2.92, 2.96). Older adults who did both moderate and vigorous physical activity had on average 2.99 depressive symptoms (2.91–3.08). older adults who were currently consuming tobacco had slightly higher mean score of depressive symptoms than those who never consumed tobacco. Socially active older adults had only 2.88 symptoms on average compared to 3.28 symptoms among socially inactive older adults. Similarly, those who did voluntary work had 2.88 symptoms compared to 2.96 symptoms among those who did not do voluntary work. Score of depressive symptoms was high among those who perceived religion as not important (mean score: 3.70, CI 3.55–3.85), those who had low life satisfaction (mean score: 3.67, CI 3.64–3.71), those who had poor perceived health (mean score: 3.31, CI 3.28–3.34), and those who had low perceived social standing (mean score: 3.07, CI 3.03–3.10) in comparison to their respective counterparts.

Table 3 provides the adjusted and unadjusted regression estimates of depressive symptoms by background characteristics. While considering the personal effort factors, the following associations were observed. Older adults who engaged in moderate [aCoef: −0.11, CI: −0.18, −0.05], vigorous [aCoef: −0.09, CI: −0.16, −0.03], or both moderate and vigorous physical activity [aCoef: −0.10, CI: −0.19, −0.02] had lower likelihood of depressive symptoms in comparison to those who were physically inactive. Similarly, older adults who quit tobacco consumption were less likely to have depressive symptoms [uCoef: −0.10, CI: −0.18, −0.01] in comparison to those who never consumed tobacco. Older adults who participated in social activities were less likely to have depressive symptoms [aCoef: −0.44, CI: −0.50, −0.39] compared to their socially inactive counterparts. Those who reported involvement in voluntary work had lower likelihood of depressive symptoms [aCoef: −0.09 CI: −0.16, −0.01] compared to their counterparts with no voluntary work. Also, older adults who looked after children/grandchildren [uCoef: −0.09, CI: −0.15, −0.04] or contributed to family financially [aCoef: −0.13, CI: −0.20, −0.06] were likely to have depressive symptoms in comparison to those who did not look after children or did not contribute financially, respectively.

On the other hand, considering factors which are linked to individuals' personal belief, older adults who perceived religion as very important [aCoef: −0.29, CI: −0.41, −0.17], who had high life satisfaction [aCoef: −0.78, CI: −0.82, −0.73], who had good self-perceived health [aCoef: −0.29, CI: −0.33, −0.25] and those who had high self-perceived social standing [aCoef: −0.39, CI: −0.47, −0.31] had lower likelihood of depressive symptoms in comparison to their respective counterparts. Furthermore, older adults with higher education were less likely to have depressive symptoms [aCoef: −0.23, CI: −0.31, −0.15] in comparison to those with no formal education. Also, older adults who had awareness of welfare schemes had lower likelihood of depressive symptoms [aCoef: −0.23, CI: −0.31, −0.15] in comparison to those who were unaware of such schemes.

**Discussion**

Older people report depressive symptoms when they are distressed or worried about the implication of their symptoms. Similarly, self-neglecting behaviours and medical comorbidities were reported higher among older depressed persons. A previous study found that about 60% to 70% of depressed patients had at least one, while 30% to 40% had two or more, somatic or psychiatric comorbidities, and had an impaired response and remission rate during treatment. Depression occurring in older patients is often undetected or inadequately treated, and this is particularly common in older age groups because older old persons may show less mood and motivational symptoms compared with younger old persons. On the other hand, other health-related problems and disability may also lead older people to mention several symptoms, which makes screening instruments necessary to identify those who are under stress or depressed. The current study using the CES-D scale of screening for depressive symptoms, explored its possible protective factors (intrinsic as well as extrinsic) among older Indian adults. The current findings confirmed the hypothesis that personal efforts and beliefs have significant negative association with depressive symptoms among older adults.

Several follow-up and cross-sectional studies have documented that engagement in leisure and non-leisure time physical activity is associated with lower risk of depressive symptoms among older adults. However, some studies found that only higher intensity activity is associated with improved mental wellbeing. The findings of our study show that older persons who engage in either moderate or vigorous or both types of physical activities were less likely to suffer from depressive symptoms. The findings need to be confirmed with future prospective cohort studies or intervention trials.
### Variables

| Variables                                      | n   | %    |
|-----------------------------------------------|-----|------|
| **Socioeconomic and demographic attributes**  |     |      |
| Age (mean, sd)                                | 69.2 (7.5) |     |
| **Age group (in years)**                      |     |      |
| 60–69                                         | 18,410 | 58.5 |
| 70–79                                         | 9501  | 30.2 |
| 80+                                           | 3553  | 11.3 |
| **Gender**                                    |     |      |
| Male                                          | 14,931 | 47.5 |
| Female                                        | 16,533 | 52.6 |
| **Employment**                                |     |      |
| Never worked                                  | 8308  | 26.4 |
| Currently working                             | 9397  | 29.9 |
| Not working                                   | 11,469 | 36.5 |
| Retired                                       | 2282  | 7.3  |
| **Education**                                 |     |      |
| Not educated/Primary not completed            | 21,381 | 68   |
| Primary completed                             | 3520  | 11.2 |
| Secondary completed                           | 4371  | 13.9 |
| Higher and above                              | 2191  | 7    |
| **Awareness of welfare schemes**              |     |      |
| No                                            | 12,670 | 40.3 |
| Yes                                           | 18,794 | 59.7 |
| **Socioeconomic status**                      |     |      |
| Poorest                                       | 6829  | 21.7 |
| Poorer                                        | 6831  | 21.7 |
| Middle                                       | 6590  | 21   |
| Richer                                        | 6038  | 19.2 |
| Richest                                       | 5175  | 16.5 |
| **Caste**                                     |     |      |
| Scheduled Class                               | 5949  | 18.9 |
| Scheduled Tribe                               | 2556  | 8.1  |
| Other Backward Class                          | 14,231 | 45.2 |
| Others                                        | 8729  | 27.7 |
| **Religion**                                  |     |      |
| Hindu                                         | 25,871 | 82.2 |
| Muslim                                        | 3548  | 11.3 |
| Christian                                     | 901   | 2.9  |
| Others                                        | 1145  | 3.6  |
| **Region**                                    |     |      |
| North                                         | 3960  | 12.6 |
| Central                                      | 6593  | 21   |
| East                                         | 7439  | 23.6 |
| Northeast                                     | 935   | 3    |
| West                                         | 5401  | 17.2 |
| South                                        | 7136  | 22.7 |
| **Personal effort**                           |     |      |
| **Physical activity**                         |     |      |
| Inactive                                      | 23,408 | 74.4 |
| Only moderate                                 | 2842  | 9    |
| Only vigorous                                 | 3580  | 11.4 |
| Both moderate and vigorous                    | 1634  | 5.2  |
| **Quit tobacco consumption**                  |     |      |
| Never consumed                                | 18,957 | 60.3 |
| Currently consuming                           | 10,686 | 34   |
| Quit                                          | 1820  | 5.8  |
| **Social participation**                      |     |      |
| Continued                                     |     |      |
Age-related losses, such as loss of family members and friends, increase as people age, leading to increased feelings of loneliness and mental illness, whereas, a large number of longitudinal studies suggest that participation in social activities offers a promising mechanism to bolster resilience and protects against depressive symptoms among older adults. The particular importance of social participation in ameliorating the mental health of older individuals which is evident in some Indian studies, is also consistent with our study. Moreover, social engagements may be especially protective for older Indian adults, given the importance of family ties and social connectedness in particular cultural contexts. Similarly, voluntary work in older adults was another protective factor against depressive symptoms in our study which is in line with previous studies that have demonstrated the potential of volunteering in reducing depressive symptoms for older adults.

Another noteworthy finding of the current study was that older adults’ contribution to household functioning in ways of looking after child/grandchild and financial contribution predicted lower depressive symptoms. The possible explanation again centers on the particular importance of societal norms of respect for senior members and connectedness among family ties. Family in Indian populations is considered foundational and integral for their care and support and thus, the protective effects of such support, and its potential to reduce depressive symptoms in older adults, should be investigated further.

Importantly, the current study found religiosity as a predictor against depressive symptoms. The finding is consistent with the larger body of research documenting a protective effect of religiosity and spirituality in regard to depressive symptoms. However, as documented, lack of faith as part of hopelessness may be another symptom that characterizes clinical depression. The association between religiosity and depressive symptoms warrants further exploration using cohort designs, as it might hold potential to inform care approaches in treating Indian older adults with depression, and it is out of scope for the current study. In addition to this, high life satisfaction, good self-perceived health and social status were significantly associated with lower risk of depressive symptoms in this study, and these findings correspond to previous studies showing statistically significant associations between perceived health and wellbeing and depressive disorders.

In this research, it was found that higher levels of education, being retired from work and awareness of social welfare schemes were negatively related to depressive symptoms among older adults. These findings suggest that several socioeconomic variables may play major roles in reducing depressive symptoms, and the possible coping strategies among higher socioeconomic groups need to be further investigated to inform interventions as all the coping strategies may not work well or be of benefit to the wellbeing of socioeconomically poor population.

**Table 1. Socio-economic profile of older adults in India, 2017–18. sd: Standard deviation.**

| Variables                                | n  | %  |
|------------------------------------------|----|----|
| No                                       | 4524 | 14.4 |
| Yes                                      | 26,940 | 85.6 |
| **Voluntary work**                       |    |    |
| No                                       | 21,806 | 69.3 |
| Yes                                      | 9658 | 30.7 |
| **Looking after children/grandchildren** |    |    |
| No                                       | 26,074 | 82.9 |
| Yes                                      | 5390 | 17.1 |
| **Financial contribution to family/others** |    |    |
| No                                       | 29,639 | 94.2 |
| Yes                                      | 1825 | 5.8 |
| **Personal belief**                      |    |    |
| Importance of religion                   |    |    |
| Not important                            | 673 | 2.2 |
| Somewhat important                      | 5873 | 19  |
| Very important                           | 24,346 | 78.8 |
| Life satisfaction                        |    |    |
| High                                     | 13,822 | 45.5 |
| Medium                                   | 6796 | 22.4 |
| Low                                      | 9773 | 32.2 |
| Self-perceived health                    |    |    |
| Good                                     | 16,582 | 52.7 |
| Poor                                     | 14,882 | 47.3 |
| Self-perceived social standing           |    |    |
| High                                     | 2195 | 7  |
| Middle                                   | 16,142 | 51.3 |
| Low                                      | 13,127 | 41.7 |
| Total                                    | 31,464 | 100 |
| Variables                          | Mean  | 95% CI  |
|-----------------------------------|-------|---------|
| **Socioeconomic and demographic attributes** |       |         |
| **Age group (in years)**          |       |         |
| 60–69                             | 2.92  | 2.9–2.95|
| 70–79                             | 2.91  | 2.87–2.95|
| 80+                               | 3.07  | 3–3.13  |
| **Gender**                        |       |         |
| Male                              | 2.82  | 2.79–2.85|
| Female                            | 3.04  | 3.02–3.07|
| **Employment**                    |       |         |
| Never worked                      | 3.01  | 2.98–3.05|
| Currently working                 | 2.89  | 2.85–2.92|
| Not working                       | 3.00  | 2.97–3.04|
| Retired                           | 2.53  | 2.47–2.6 |
| **Education**                     |       |         |
| Not educated/Primary not completed| 3.09  | 3.06–3.11|
| Primary completed                 | 2.74  | 2.68–2.79|
| Secondary completed               | 2.57  | 2.52–2.62|
| Higher and above                  | 2.52  | 2.45–2.58|
| **Awareness of welfare schemes**  |       |         |
| No                                | 2.87  | 2.84–2.9 |
| Yes                               | 2.98  | 2.96–3.01|
| **Socioeconomic status**          |       |         |
| Poorest                           | 3.14  | 3.09–3.18|
| Poorer                            | 2.92  | 2.88–2.96|
| Middle                            | 2.87  | 2.82–2.91|
| Richer                            | 2.88  | 2.84–2.93|
| Richest                           | 2.85  | 2.8–2.9 |
| **Caste**                         |       |         |
| Scheduled Class                   | 3.18  | 3.13–3.23|
| Scheduled Tribe                   | 2.85  | 2.81–2.9 |
| Other Backward Class              | 2.94  | 2.91–2.97|
| Others                            | 2.79  | 2.76–2.83|
| **Religion**                      |       |         |
| Hindu                             | 2.97  | 2.95–2.99|
| Muslim                            | 2.83  | 2.77–2.89|
| Christian                         | 2.91  | 2.85–2.97|
| Others                            | 2.52  | 2.44–2.61|
| **Region**                        |       |         |
| North                             | 2.96  | 2.91–3   |
| Central                           | 3.32  | 3.26–3.37|
| East                              | 2.98  | 2.94–3.03|
| Northeast                         | 2.50  | 2.45–2.55|
| West                              | 2.36  | 2.31–2.41|
| South                             | 3.02  | 2.98–3.06|
| **Personal effort**               |       |         |
| Inactive                          | 2.96  | 2.94–2.99|
| Only moderate                      | 2.85  | 2.78–2.91|
| Only vigorous                     | 2.83  | 2.77–2.89|
| Both moderate and vigorous         | 2.99  | 2.91–3.08|
| **Quit tobacco consumption**      |       |         |
| Never consumed                    | 2.92  | 2.89–2.94|
| Currently consuming               | 2.97  | 2.94–3   |
| Quit                              | 2.95  | 2.87–3.04|
| **Social participation**          |       |         |
| No                                | 3.28  | 3.22–3.34|
| Continued                         |       |         |
The overall implication of the findings is that socioeconomic characteristics of the aged population in India play significant roles in their risk for depression and these significant factors should be taken into consideration to deliver effective mental health prevention interventions that would promote healthy ageing.

Implications for practice. There is the need for paying attention to the unmet mental health needs of older Indian population as ageing in the country comes with its associated challenges. The current findings have important implications for government, health-practitioners and individuals engaged in social work practice. Given the higher prevalence of depressive symptoms among community-dwelling older adults in India\textsuperscript{62}, efforts are called for to reduce the risk of depressive symptoms which may occur as part of increased exposure to the age-related life stressors, by enhancing the possible protective factors including personal efforts and beliefs.

In particular, among impoverished depressive people, whose life pressures can be severe, encouraging appropriate involvement in physical, social and spiritual activities or incorporating factors of personal beliefs into a therapeutic regimen may have a benefit\textsuperscript{63,64}. Furthermore, findings of this research indicate that bolstering support networks and encouraging active involvement in the household and filial relationships through financial contribution to family and looking after children may prevent depressive symptoms among senior members of the family\textsuperscript{65–68}. Thus, coupling clinical services for depressive disorder with physical, social, spiritual, and family related activities is suggested. Also, in addition to formal interventions, strengthening existing social and family support networks are important areas to explore in the prevention and treatment of depression among older Indian adults. Similarly, those who report that religion is important in their lives, could be encouraged to participate in related activities, which could aid in coping when facing further age-related stressful events and ameliorate depressive symptoms.

Apart from this, the following strategies could be followed as part of enhancing the personal beliefs and in turn, overall wellbeing of older adults. Firstly, we recommend government initiatives such as increasing older adults’ active engagement through incentivising and acknowledging volunteering work, increasing income through old age pension, providing subsidised health insurance cover to ameliorate their overall welfare. These can be crucial preliminary steps in bettering their socioeconomic status and decreasing depression risk and improving their quality of life\textsuperscript{69,70}. Secondly, an effective multidisciplinary network of health services could be established for screening of older persons for mental illnesses enabling timely access to mental health services, and these services should be extended to rural areas where the depression prevalence is higher in comparison to urban areas\textsuperscript{61}. Thirdly, health-promotional activities such as promoting awareness, and increasing opportunities

### Table 2. Mean CES-D score among older adults by background characteristics, 2017–18. CI Confidence Interval.

| Variables                              | Mean | 95% CI   |
|----------------------------------------|------|----------|
| Yes                                    | 2.88 | 2.86–2.9 |
| No                                     | 2.96 | 2.94–2.99|
| Yes                                    | 2.88 | 2.85–2.92|
| Looking after children/grandchildren   |      |          |
| No                                     | 2.94 | 2.92–2.97|
| Yes                                    | 2.90 | 2.85–2.94|
| Financial contribution to family/others |      |          |
| No                                     | 2.95 | 2.93–2.98|
| Yes                                    | 2.65 | 2.57–2.72|
| Personal belief                        |      |          |
| Importance of religion                 |      |          |
| Not important                          | 3.70 | 3.55–3.85|
| Somewhat important                    | 3.24 | 3.19–3.28|
| Very important                         | 2.92 | 2.9–2.94 |
| Life satisfaction                      |      |          |
| High                                   | 2.54 | 2.52–2.57|
| Medium                                 | 3.21 | 3.17–3.25|
| Low                                    | 3.67 | 3.64–3.71|
| Self-perceived health                  |      |          |
| Good                                   | 2.60 | 2.57–2.62|
| Poor                                   | 3.31 | 3.28–3.34|
| Self-perceived social standing         |      |          |
| High                                   | 2.44 | 2.37–2.5 |
| Middle                                 | 2.90 | 2.87–2.92|
| Low                                    | 3.07 | 3.03–3.1 |
| Total                                  | 2.94 | 2.92–2.96|
| Variables                           | Model-1                                  | Model-2                                  |
|------------------------------------|------------------------------------------|------------------------------------------|
|                                    | Unadjusted Coef. (95% CI) | Adjusted Coef. (95% CI)                  |
| Socioeconomic and demographic attributes |                               |                                          |
| Age group (in years)               |                               |                                          |
| 60–69                              | −0.15*(−0.22, −0.09)          | −0.16*(−0.22, −0.1)                      |
| 70–79                              | −0.05(−0.12, 0.02)            | −0.09*(−0.15, −0.02)                     |
| 80+                                | Ref                         | Ref                                      |
| Gender                             |                               |                                          |
| Male                               | Ref                         | Ref                                      |
| Female                             | 0.2*(0.16, 0.24)            | 0.04(−0.01, 0.09)                        |
| Employment                         |                               |                                          |
| Never worked                       | Ref                         | Ref                                      |
| Currently working                  | −0.22*(−0.27, −0.17)         | −0.03(−0.12, 0.06)                       |
| Not working                        | −0.02(−0.07, 0.03)           | 0.01(−0.05, 0.05)                       |
| Retired                            | −0.56*(−0.63, −0.48)         | −0.13*(−0.21, −0.04)                     |
| Education                          |                               |                                          |
| Not educated/Primary not completed | Ref                         | Ref                                      |
| Primary completed                  | −0.25*(−0.31, −0.19)         | −0.1*(−0.16, −0.05)                      |
| Secondary completed                | −0.35*(−0.41, −0.29)         | −0.08*(−0.14, −0.02)                     |
| Higher and above                   | −0.61*(−0.69, −0.54)         | −0.23*(−0.31, −0.15)                     |
| Awareness of welfare schemes       |                               |                                          |
| No                                 | −0.02(−0.06, 0.02)           | −0.2*(−0.24, −0.16)                      |
| Yes                                | Ref                         | Ref                                      |
| Socioeconomic status               |                               |                                          |
| Poorest                            | Ref                         | Ref                                      |
| Poorer                             | −0.12*(−0.18, −0.06)         | −0.02(−0.08, 0.03)                       |
| Middle                             | −0.23*(−0.29, −0.17)         | −0.07*(−0.13, −0.02)                     |
| Richer                             | −0.22*(−0.28, −0.16)         | −0.03(−0.09, 0.02)                       |
| Richest                            | −0.32*(−0.38, −0.26)         | −0.05(−0.11, 0.02)                       |
| Caste                              |                               |                                          |
| Scheduled Class                    | Ref                         | Ref                                      |
| Scheduled Tribe                    | −0.34*(−0.41, −0.27)         | −0.08*(−0.15, −0.01)                     |
| Other Backward Class               | −0.11*(−0.16, −0.05)         | −0.06*(−0.11, 0.0)                       |
| Others                             | −0.28*(−0.34, −0.22)         | −0.04(−0.1, 0.02)                        |
| Religion                           |                               |                                          |
| Hindu                              | Ref                         | Ref                                      |
| Muslim                             | 0.02(−0.04, 0.09)            | 0.01(−0.06, 0.06)                        |
| Christian                          | −0.31*(−0.38, −0.25)         | −0.01(−0.08, 0.07)                       |
| Others                             | −0.5*(−0.59, −0.41)          | −0.39*(−0.48, −0.3)                      |
| Region                             |                               |                                          |
| North                              | Ref                         | Ref                                      |
| Central                            | 0.45*(0.38, 0.52)            | 0.36*(0.29, 0.43)                        |
| East                               | 0.13*(0.07, 0.2)             | −0.03(−0.09, 0.04)                       |
| Northeast                          | −0.44*(−0.47, −0.32)         | −0.35*(−0.43, −0.27)                     |
| West                               | −0.44*(−0.51, −0.37)         | −0.31*(−0.38, −0.25)                     |
| South                              | 0.25*(0.19, 0.31)            | 0.12*(0.06, 0.18)                        |
| Personal effort                    |                               |                                          |
| Physical activity                  |                               |                                          |
| Inactive                           | Ref                         | Ref                                      |
| Only moderate                      | −0.10*(−0.17, −0.03)         | −0.11*(−0.18, −0.05)                     |
| Only vigorous                      | −0.19*(−0.25, −0.13)         | −0.09*(−0.16, −0.03)                     |
| Both moderate and vigorous         | −0.07(−0.16, 0.02)           | −0.10*(−0.19, −0.02)                     |
| Quit tobacco consumption           |                               |                                          |
| Never consumed                     | Ref                         | Ref                                      |
| Currently consuming                | 0.04*(0, 0.08)               | −0.03(−0.07, 0.02)                       |
| Quit                               | −0.1*(−0.18, −0.01)          | −0.05(−0.13, 0.02)                       |
| Social participation               | Continued                   |                                          |
to engage in physical and social activities would aid in enhancing their personal beliefs, increase life satisfaction and improve their overall quality of life\textsuperscript{27,72,73}. However, additional research is required to explore effective approaches to implement the above mentioned strategies into practice among diverse older Indian cohorts.

**Strengths and limitations.** In this study, we examined both personal efforts and personal beliefs as separate aspects of the individuals’ intrinsic resources to potentially mitigate depressive symptoms. A major strength of this study is the large sample size of the study participants, providing information on older adults aged 60 years and above residing in rural and urban areas of the country and the inclusion of a wide range of potentially confounding variables. The study had a cross-sectional design, not allowing for causality measurements and hence, we did not focus on causal pathways. Furthermore, the self-report of several variables such as depressive symptoms, tobacco use and importance of religion are subject to measurement errors and limited to the measures that were part of the survey. Further, information on stressful life events associated with late-life depression including death of relatives, friends or caregivers and other socioeconomic stress factors like deterioration of financial status\textsuperscript{74}, was not collected and should be included in future studies. Similarly, other potential factors related to late-life depression (demographic and clinical) such as prior history of depression, psychotherapy, psychiatric medication/psychiatric disorders; current psychiatric medication; social support; and comorbidities were not included in the current analyses. Although social participation and self-perceived health partly covered some of them, future studies using multiple waves of the LASI data, should investigate the longitudinal associations of protective factors of late-life depression by including all these factors. Finally, respondents who were institutionalised were not included in the survey, and thus we may have underestimated the prevalence of depressive symptoms in the current study.

**Conclusion**

Personal efforts such as physical activity, social participation, voluntary work and financial contribution to family and personal beliefs such as religiosity, higher life satisfaction, good self-perceived health and a higher self-perceived social standing are identified to be associated with lesser likelihood of depressive symptoms in older persons. Future longitudinal studies should focus on determining the associations of these factors with

| Variables | Model-1 | Model-2 |
|-----------|---------|---------|
|           | Unadjusted Coef. (95% CI) | Adjusted Coef. (95% CI) |
| No        | Ref     | Ref     |
| Yes       | −0.49*(−0.55, −0.44) | −0.44*(−0.5, −0.39) |
| **Voluntary work** | | |
| No        | Ref     | Ref     |
| Yes       | −0.14*(−0.19, −0.1) | −0.09*(−0.16, −0.01) |
| **Looking after children/grandchildren** | | |
| No        | Ref     | Ref     |
| Yes       | −0.09*(−0.15, −0.04) | −0.04(−0.09, 0) |
| **Financial contribution to family/others** | | |
| No        | Ref     | Ref     |
| Yes       | −0.32*(−0.4, −0.24) | −0.13*(−0.2, −0.06) |
| **Personal belief** | | |
| **Importance of religion** | | |
| Not important | Ref | Ref |
| Somewhat important | −0.15*(−0.28, −0.01) | −0.14*(−0.27, −0.02) |
| Very important | −0.52*(−0.64, −0.39) | −0.29*(−0.41, −0.17) |
| **Life satisfaction** | | |
| High | −1.02*(−1.07, −0.98) | −0.78*(−0.82, −0.73) |
| Medium | −0.50*(−0.55, −0.45) | −0.36*(−0.41, −0.31) |
| Low | Ref | Ref |
| **Self-perceived health** | | |
| Good | −0.58*(−0.62, −0.55) | −0.29*(−0.33, −0.25) |
| Poor | Ref | Ref |
| **Self-perceived social standing** | | |
| High | −0.65*(−0.73, −0.57) | −0.39*(−0.47, −0.31) |
| Middle | −0.21*(−0.25, −0.17) | −0.2*(−0.24, −0.16) |
| Low | Ref | Ref |

**Table 3.** Regression estimates for depression among older adults in India, 2017–18. Ref: Reference; CI: Confidence interval; *if p < 0.05; Model-1 represents the unadjusted estimates; Model-2 represent the adjusted estimates (adjusted for personal effort, personal beliefs and socioeconomic and demographic attributes).
depression in old age that can be used to guide interventions. These potentially protective factors may also help in formulating public health initiatives to reduce the risk of depression and improve quality of life among older adults in the Indian context.

**Ethics approval and consent to participate.** The survey agencies that conducted the field survey for the data collection have collected prior informed consent (written and verbal) from all the participants. The Indian Council of Medical Research (ICMR) extended the necessary guidance and ethical approval for conducting the LASI survey. All methods related to the current analysis were carried out in accordance with relevant guidelines and regulations by the Indian Council of Medical Research (ICMR).

**Data availability**
The study uses secondary data which is available in the public repository of International Institute for Population Sciences, Mumbai, accessible through [https://www.iipsindia.ac.in/content/lasi-wave-i](https://www.iipsindia.ac.in/content/lasi-wave-i).

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**References**
1. United Nations. World population prospects 2019, [https://population.un.org/wpp/Download/Standard/Population/](https://population.un.org/wpp/Download/Standard/Population/) (2019).
2. Ferrari, A. J. et al. Global, regional, and national burden of 12 mental disorders in 204 countries and territories, 1990–2019: A systematic analysis for the Global Burden of Disease Study 2019. *Lancet Psychiatry* **9**, 137–150 (2022).
3. Horackova, K. et al. Prevalence of late-life depression and gap in mental health service use across European regions. *Eur. Psychiatry* **37**, 19–25 (2019).
4. Grover, S. & Malhotra, N. Depression in elderly: A review of Indian research. *J. Geriatr. Mental Health* **2**, 4–15 (2015).
5. Sagar, R. et al. The burden of mental disorders across the states of India: The Global Burden of Disease Study 1990–2017. *Lancet Psychiatry* **7**, 148–161 (2020).
6. Kashuri, A. Challenges to Healthcare in India—The Five As. *Indian J. Commun. Med.* **43**, 141–143 (2018).
7. Ly, M. et al. Late-life depression and increased risk of dementia: A longitudinal cohort study. *Transl. Psychiatry* **11**, 1–10 (2021).
8. van den Berg, K. S. et al. Clinical characteristics of late-life depression predicting mortality. *Aging Ment. Health* **25**, 476–483 (2021).
9. World Health Organization. *World report on ageing and health*. World Health Organization, [https://apps.who.int/iris/handle/10665/186463](https://apps.who.int/iris/handle/10665/186463) (2015), accessed 14 March 2022.
10. Laird, K. T. et al. Psychobiological factors of resilience and depression in late life. *Transl. Psychiatry* **9**, 1–18 (2019).
11. Rosowsky, E. Chapter 3: Resilience and personality disorders in older age. In *Resilience in aging—concepts, research and outcomes* (eds Resnick, B. et al.) 31–49 (Springer, 2011).
12. Bakshi, S. & Pathak, P. Aging and the socioeconomic life of older adults in India: An empirical exposition. *SAGE Open* **6**, 215824015624130 (2016).
13. Chiao, C., Weng, L.-J. & Botticello, A. L. Social participation reduces depressive symptoms among older adults: An 18-year longitudinal analysis in Taiwan. *BMC Public Health* **11**, 292 (2011).
14. Friedman, S. M. Lifestyle (medicine) and healthy aging. *Clin. Geriatr. Med.* **15**, 1–13 (2021).
15. Taylor, M. G. & Carr, D. Psychological resilience and health among older adults: A comparison of personal resources. *J. Gerontol.: Ser. B* **76**, 1241–1250 (2021).
16. Stanley, M. A. et al. Older adults’ preferences for religion/spirituality in treatment for anxiety and depression. *Aging Ment. Health* **15**, 334–343 (2011).
17. Srivastava, S. et al. Factors associated with psychiatric disorders and treatment seeking behaviour among older adults in India. *Sci. Rep.* **11**, 1–13 (2021).
18. Zenebe, Y. et al. Prevalence and determinants of depression among old age: a systematic review and meta-analysis. *Ann. Gen. Psychiatry* **20**, 55 (2021).
19. Abdi, S. et al. Understanding the care and support needs of older people: A scoping review and categorisation using the WHO international classification of functioning, disability and health framework (ICF). *BMJ Geriatr. Care Commun.* **1**, 1–15 (2019).
20. Saravankumar, P. et al. Social connectedness and self-perceived health of older adults in New Zealand. *Health Soc. Care Commun.* **11**, 1–15 (2019).
21. Wei, J. Understanding the care and support needs of older people: A scoping review and categorisation using the WHO international classification of functioning, disability and health framework (ICF). *BMJ Geriatr. Care Commun.* **11**, 1–15 (2019).
22. Lee, H. et al. Physical activity and depressive symptoms in older adults. *Geriatr. Nurs.* **35**, 37–41 (2014).

---

23. Balaraj, Y. et al. Health care and equity in India. *Health Soc. Care Commun.* **76**, 1241–1250 (2021).
24. Hafeez, S. 10 NGOs which have revolutionised healthcare in India. [https://www.giveindia.org/blog/10-ngos-which-have-revolutionised-healthcare-in-india/](https://www.giveindia.org/blog/10-ngos-which-have-revolutionised-healthcare-in-india/) (2021).
25. International Institute for Population Sciences (IIPS), NPHCE, MoHFW, et al. *Types of household headship and associated life satisfaction among older adults in India: Findings from LASI survey, 2017–18*. BMC Geriatr. **22**, 1–13 (2022).
26. WHO WHO. WHO guidelines on physical activity and sedentary behaviour: At a glance. [https://www.who.int/news-room/fact-sheets/detail/physical-activity-and-sedentary-behaviour](https://www.who.int/news-room/fact-sheets/detail/physical-activity-and-sedentary-behaviour) (2015), accessed 14 March 2022.
27. Lacruz, M. E. Incomplete remission in depression: Role of psychiatric and somatic comorbidity. *Dialogues Clin. Neurosci.* **10**, 453–460 (2008).
28. Kok, R. M. & Reynolds, C. F. III. Management of depression in older adults: A more somatic presentation? *J. Affect. Disord.* **170**, 196–202 (2015).
29. Hegeman, J. M. et al. Depression in later life: A more somatic presentation? *J. Affect. Disord.* **170**, 196–202 (2015).
30. Kessler, R. C. et al. Age of onset of mental disorders: A review of recent literature. *Curr. Opin. Psychiatry* **20**, 359 (2007).
31. Kessler, R. C. et al. Screening for serious mental illness in the general population. *Arch. Gen. Psychiatry* **60**, 184–189 (2003).
32. Ku, P.-W. et al. Physical activity and depressive symptoms in older adults: 11-year follow-up. *Am. J. Prev. Med.* **42**, 355–362 (2012).
33. Ku, P.-W., Fox, K. R. & Chen, L.-J. Physical activity and depressive symptoms in Taiwanese older adults: A seven-year follow-up study. *Prev. Med.* **48**, 250–255 (2009).
34. Lee, H. et al. Physical activity and depressive symptoms in older adults. *Geriatr. Nurs.* **35**, 37–41 (2014).
37. Heesch, K. C., Burton, N. W. & Brown, W. J. Concurrent and prospective associations between physical activity, walking and mental health in older women. *J. Epidemiol. Community Health* 65, 807–813 (2011).

38. Smith, T. L. et al. Effect of walking distance on 8-year incident depressive symptoms in elderly men with and without chronic disease: The Honolulu–Asia Aging Study. *J. Am. Geriatr. Soc.* 58, 1447–1452 (2010).

39. Chen, L.-J. et al. Relationships of leisure-time and non-leisure-time physical activity with depressive symptoms: a population-based study of Taiwanese older adults. *Int. J. Behav. Nutr. Phys. Act.* 9, 1–10 (2012).

40. Ansari, S., Muhammad, T. & Dhar, S. M. How does multi-morbidity relate to feeling of loneliness among older adults? Evidence from a population-based survey in India. *J. Popul. Ageing*, 1, 1. https://doi.org/10.1007/s12062-021-09343-5 (2021).

41. Alpass, F. M. & Neville, S. Loneliness, health and depression in older males. *Aging Ment. Health* 7, 212–216 (2003).

42. Smith, J. M. Toward a better understanding of loneliness in community-dwelling older adults. *J. Psychol.* 146, 293–311 (2012).

43. Glass, T. A. et al. Social engagement and depressive symptoms in late life: longitudinal findings. *J. Aging Health* 18, 604–628 (2006).

44. Liu, H. et al. Continued social participation protects against depressive symptoms across the retirement transition: Longitudinal evidence from three waves of the China Health and Retirement Longitudinal Survey. *Geriatr. Gerontol. Int.* 19, 972–976 (2019).

45. Santini, Z. I. et al. Formal social participation protects physical health through enhanced mental health: A longitudinal mediation analysis using three consecutive waves of the Survey of Health, Ageing and Retirement in Europe (SHARE). *Soc. Sci. Med.* 251, 112906 (2020).

46. Brinda, E. M. et al. Health, Social, and Economic Variables Associated with Depression Among Older People in Low and Middle Income Countries: World Health Organization Study on Global AGEing and Adult Health. *Am. J. Geriatr. Psychiatry* 24, 1196–1208 (2016).

47. Banerjee, K. & Baker, T. Social engagement and depressive symptoms among middle-aged and older adults in India. *Innov. Aging* 5, 212–213 (2021).

48. Rajkumar, A. P. et al. Nature, prevalence and factors associated with depression among the elderly in a rural south Indian community. *Int. Psychogeriatr.* 21, 372–378 (2009).

49. Grover, S. et al. Relationship of loneliness and social connectedness with depression in elderly: A multicentric study under the aegis of Indian Association for Geriatric Mental Health. *J. Geriatr. Mental Health* 5, 99 (2018).

50. Liu, H. & Lou, V. W. Q. Patterns of productive activity engagement as a longitudinal predictor of depressive symptoms among older adults in urban China. *Aging Ment. Health* 21, 1147–1154 (2017).

51. Guo, Q., Bai, X. & Feng, S. National participation and depressive symptoms among Chinese older adults: A study on rural–urban differences. *J. Affect. Disord.* 239, 124–130 (2018).

52. Choi, E. I. et al. Social participation and depressive symptoms in community-dwelling older adults: emotional social support as a mediator. *J. Psychiatr. Res.* 137, 589–596 (2021).

53. Srivastava, S. et al. Association of family structure with gain and loss of household headship among older adults in India: Analysis of panel data. *PLoS ONE* 16, 1–17 (2021).

54. Lorenz, L., Doherty, A. & Casey, P. The role of religion in buffering the impact of stressful life events on depressive symptoms in older adults. *Gerontol.: Ser. B* 56, 99 (2018).

55. Li, M. & Dong, X. The association between filial piety and depressive symptoms among US Chinese older adults. *J. Gerontol. Geriatr. Aging Int.* 43, 321–335 (2018).

56. Stearns, M. et al. Religiosity and depressive symptoms in older adults compared to younger adults: Moderation by age. *J. Affect. Disord.* 238, 522–525 (2018).

57. McKenzie, D. P. et al. Pessimism, worthlessness, anhedonia, and thoughts of death identify DSM–IV major depression in hospitalized, medically ill patients. *Psychosomatics* 51, 302–311 (2010).

58. Jegel-Karpas, D. Number of Illnesses, self-perceived health, and depressive symptoms: the moderating role of employment in older adulthood and old age. *Work Aging Retirement* 1, 382–392 (2015).

59. Kwong, E. et al. Does subjective social status predict depressive symptoms in Chinese elderly? A longitudinal study from Hong Kong. *J. Epidemiol. Commun. Health* 74, 882–891 (2020).

60. Lee, E. S. & Zhang, Y. Religiosity as a protective factor of psychological well-being among older black, white and Asian Christians in the United States. *Aging Int.* 43, 321–335 (2018).

61. Stens, M. et al. Changes in social engagement and depressive symptoms: A longitudinal analysis with older Korean Americans. *J. Immigr. Minor. Health* 11, 7–12 (2009).

62. Pilania, M. et al. Prevalence of depression among the elderly (60 years and above) population in India, 1997–2016: a systematic review and meta-analysis. *BMC Public Health* 19, 832 (2019).

63. Lee, L.-I., Arthur, A. & Avis, M. Using self-efficacy theory to develop interventions that help older people overcome psychological barriers to physical activity: A discussion paper. *Int. J. Nurs. Stud.* 45, 1690–1699 (2008).

64. Slade, M. Mental illness and well-being: the central importance of positive psychology and recovery approaches. *BMJ Health Serv. Res.* 10, 1–14 (2010).

65. Li, M. & Dong, X. The association between filial piety and depressive symptoms among US Chinese older adults. *Gerontol. Geriatr. Med.* 4, 2333721418778167 (2018).

66. Jeon, G.-S., Choi, K. & Cho, S.-I. Impact of living alone on depressive symptoms in older Korean widows. *Int. J. Environ. Res. Public Health* 14, 1191 (2017).

67. Srivastava, S. et al. The association of widowhood and living alone with depression among older adults in India. *Sci. Rep.* 11, 1–13 (2021).

68. Muhammad, T. & Srivastava, S. Why rotational living is bad for older adults? Evidence from a cross-sectional study in India. *J. Popul. Ageing*, 1. https://doi.org/10.1007/s12062-026-09314-4 (2020).

69. He, H., Xu, L. & Fields, N. Pensions and depressive symptoms of older adults in China: The mediating role of intergenerational support. *Int. J. Environ. Res. Public Health* 18, 3725 (2021).

70. Gao, X. & Feng, T. Public pension, labor force participation, and depressive symptoms across gender among older adults in rural China: a moderated mediation analysis. *Int. J. Environ. Res. Public Health* 17, 3193 (2020).

71. Muhammad, T. et al. Socioeconomic and health-related inequities in major depressive symptoms among older adults: A Wagstaff decomposition analysis of data from the LASI baseline survey, 2017–2018. *BMJ Open* 12, e054730 (2022).

72. Wang, Y., Li, Z. & Fu, C. Urban-rural differences in the association between social activities and depressive symptoms among older adults in China: A cross-sectional study. *BMC Geriatr.* 21, 569 (2021).

73. Muhammad, T. & Maurya, P. Social support moderates the association of functional difficulty with major depression among community-dwelling older adults: Evidence from LASI, 2017–2018. *BMC Popul. Health* 22, 317 (2022).

74. Fiske, A., Gatz, M. & Pedersen, N. L. Depressive symptoms and aging: The effects of illness and non-health-related events. *J. Gerontol.: Ser. B* 58, P320–P328 (2003).

Author contributions
Conceived and designed the research paper: P.S., S.S. and T.M.; analyzed the data: S.S.; Contributed agents/materials/analysis tools: P.S. and T.M.; Wrote the manuscript: P.S., T.M. and S.S.; Refined the manuscript: P.S. and T.M. All authors read, reviewed and approved the manuscript.
Competing interests
The authors declare no competing interests.

Additional information
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