Title: The impact of wealth Gradients on Dementia Health Expectancies: Unveiling Disparities Across Caste and Religion in India

Author: Poulami Barman[1,2], Nandita Saikia[2], Gabriele Doblhammer[1,3]

[1]Institute for Sociology and Demography, University of Rostock,
[2]International Institute for Population Sciences, Mumbai, India
[3]German Center for Neurodegenerative Disease, Bonn, Germany

Abstract:

India is witnessing rapid aging due to the demographic shifts. With the proportion of aged population projected to reach 347 million by 2050, this will result in significant burden of neurodegenerative disorders such as dementia. Prior research shows that socio-economic disparities contribute to differences in LE, which likely also affect Dementia Health Expectancy (DHE) in India. The financial and cultural obstacles faced by different social groups may exacerbate the marginalisation and wealth disparities. Furthermore, these wealth disparities limit healthcare access and utilization, influencing early detection and management of dementia. So, our study investigates the contribution of wealth gradients on the disparity of DHE between the different caste and religious groups. We utilize harmonized Longitudinal Aging Study of India – Diagnostic Assessment of Dementia (LASI-DAD) and National Family Health Survey (NFHS 5) data for analysis. The impetus for this research stems from our investigation into the disparities in DHE associated with caste and religious groups. Thus far, we have estimated the dementia-free health expectancy and life expectancy with dementia among social groups and the next step is to identify the contribution of wealth to these DHE. By addressing this contribution, we aim to identify discrepancies in DHE among caste and religious groups.

Introduction:

It is anticipated that the prevalence of dementia will increase significantly in the ensuing decades also in low and middle-income countries, making it a crucial public health issue (Ferri et al., 2005; Prince et al., 2012; Prince et al., 2013) and India is not an exception. Due to the country's distinctive demographic and social composition, the impact of dementia has become more challenging (Ravindranath & Sundarakumar, 2021). India is a nation with rapid ageing with current elderly population of 153 million (aged 60 and above) and witnessing a surge in the elderly population (with a projection of 347 million by 2050) (UNFPA,2023). Because of this demographic shift, the incidence and prevalence of neurodegenerative disorders are also a burdening concern (Ravindranath & Sundarakumar, 2021). This not only has an impact on health but also has an impact on the nation's social cohesion and economic prosperity (Kumar et al., 2019; Sathianathan & Kantipudi, 2018). Over the last decades, with increasing life expectancy, researchers have begun to explore whether these gains in years in life expectancy

are healthy years or years lived with disease and disability (Robine & Ritchie, 1991). Since the risk of dementia is greatest in later life, it is interesting to know how the number of years with neurodegenerative disorders is likely to be affected by the reduction in old-age mortality.

The majority of research on Dementia Health Expectancies has come from high-income nations with longitudinal ageing studies and similar cultural heritage, such as the United Kingdom (UK), the United States (US), and Australia (Farina et al., 2020); (Ritchie et al., 1994); (Wang et al., 2023). There are a few isolated findings from low and middle-income nations that extend knowledge in this field (Andrade et al., 2019); (Ashby-Mitchell et al., 2015); (Muangpaisan et al., 2012). The comparative studies between high-income countries (HICs) and middle-and low-income countries (LMICs) have highlighted the disparities in the burden of dementia. Studies indicated that HICs tend to experience longer Dementia-free life expectancy (DemFLE) compared to LMICs, which implies the differences in healthcare utilization, social factors and overall population health management (Langa et al., 2008). According to (Prince et al., 2016), countries with higher income generally exhibit overall increased life expectancy due to better healthcare infrastructures, which results in improved cognitive health outcomes with longer DemFLE. In contrast, the studies showed that LMICs encounter inadequate healthcare resources and socio-economic disparities, resulting in shorter DemFLE and a higher burden of dementia. A study from the middle-income country Cuba (Llibre Rodriguez et al., 2008) reported that DemFLE at age 60 was lower than that in HICs. This suggests that individuals from LMICs may spend a greater portion of their lives in later years with dementia.

Previously, there was a paucity of research on Dementia Health Expectancies in India. The findings from (Gupta & Sudharsanan, 2022; Kumari M, Mohanty S K, 2020) reveal that the social disparities in life expectancy indicate that the multifaceted socio-economic factors can influence health outcomes in India. According to (Gupta and Sudharsanan, 2022), the religious and caste-based disparities in healthcare utilization contribute to the differences in life expectancy in India. These socio-economic factors, responsible for differences in life expectancies, are intertwined with the socio-economic risk factors of dementia. (Chandra et al., 1998) also highlighted that the variations in healthcare utilization and accessibility between social groups can impact the early detection and management of Dementia. Previous research in India investigated the socioeconomic gradient hypothesis (Banerjee S, 2021) and concluded that the health-seeking behaviour of the older Indian population is positively associated with their socioeconomic status (SES). Socially marginalised groups have financial and cultural barriers, which ultimately lead to a lack of affordability for healthcare utilisation and affect dementia outcomes.

It is evident from previous research that the variations in risk factors for dementia can directly contribute to the disparities in Dementia Health Expectancies in India and these disparities vary among social groups of caste and religion. The caste and religion, which are inextricably related and a proxy for socioeconomic status, have a major impact in India. The hierarchical social stratification of caste and religion can influence access to resources and health outcomes. Implementing caste-based employment, education, and health schemes has enabled socially deprived groups to access the benefits. As a consequence, those belonging to upper castes but economically disadvantaged are unable to keep pace in terms of educational and professional advancement. Furthermore, even after accessing the benefits, the socially deprived groups

remain disadvantaged due to their identity in society. They may encounter prejudice and discrimination, which can lead to disparities in wage gaps. This raises the question of whether the disparities in wealth levels within each caste and religion contribute to the observed differences in dementia health expectancy (dementia-free and with dementia) in India.

This study aims to fill the paucity of research on how wealth gradients intersect with caste and religion to affect dementia health expectancies in India. We hypothesise that and greater wealth among higher social groups are associated with better dementia health expectancies. Understanding these disparities is crucial for more equitable health outcomes in India.

Research question:

How does wealth differentially contribute to disparities in dementia-free and with-dementia life expectancies across various caste and religious groups in India?

Hypotheses:

H1: The contribution of wealth to dementia health expectancy differs between higher and lower castes

H2: The contribution of wealth to dementia health expectancy differs across religious groups

Data & Methods

Data

Our study is based on two types of data, the harmonized LASI- Diagnostic Assessment of Dementia data from the first wave of the Longitudinal Aging Study in India (LASI) for the prevalence of dementia and fifth round of the National Family Health Survey (NFHS 5) for estimating mortality:

LASI is a nationally representative longitudinal survey conducted between 2017 and 2019 that provides data on cognition, mental and physical health, and social networks of the aging population in India. For the dementia assessment we have used the LASI- Diagnostic Assessment of Dementia data, which is subsample study from Longitudinal Aging Study (LASI) in India. Out of 72,262 respondents in LASI survey around 4,906 participants aged 60 and above took part in this in-depth dementia assessment((Lee et al. 2019). To maintain national representation and to ensure sufficient numbers of respondents with cognitive impairment, the survey used a two-stage stratified random sampling approach and oversampled respondents at a higher risk of cognitive impairment (Lee et al. 2019). The survey used Clinical Dementia Rating(CDR) (Lee et al. 2023; Morris 1993) to assess dementia among the participants. Then employing the imputation models on the subset of LASI-DAD participants with a CDR score. The probabilistic dementia status were predicted for all LASI respondents aged 60 and older without a clinical dementia classification(Lee et al. 2023). The CDR total score of 1 or higher was classified as indicator of dementia.

We utilized NFHS-5 data to compute the Age-Specific Death Rate (ASDR) and life expectancy at age 60 by caste and religion. The advantage of NFHS data is that, unlike Sample Registration

System data, it enables the calculation of death statistics according to socioeconomic characteristics such as caste, religion and region. NFHS-5 is a large-scale, cross-sectional, and nationally representative conducted between 2019 and 2021. It collects data from 636,699 households and encompasses 825,954 individuals residing within them. Regarding mortality, NFHS-5 aimed to capture overall mortality, and data were collected at the national and district levels. During the survey, participants were asked for information about any deaths that occurred among household members within a 2-year reference period. A total of 80,667 deaths were recorded.

Variables

We have used the following variables for our analysis:

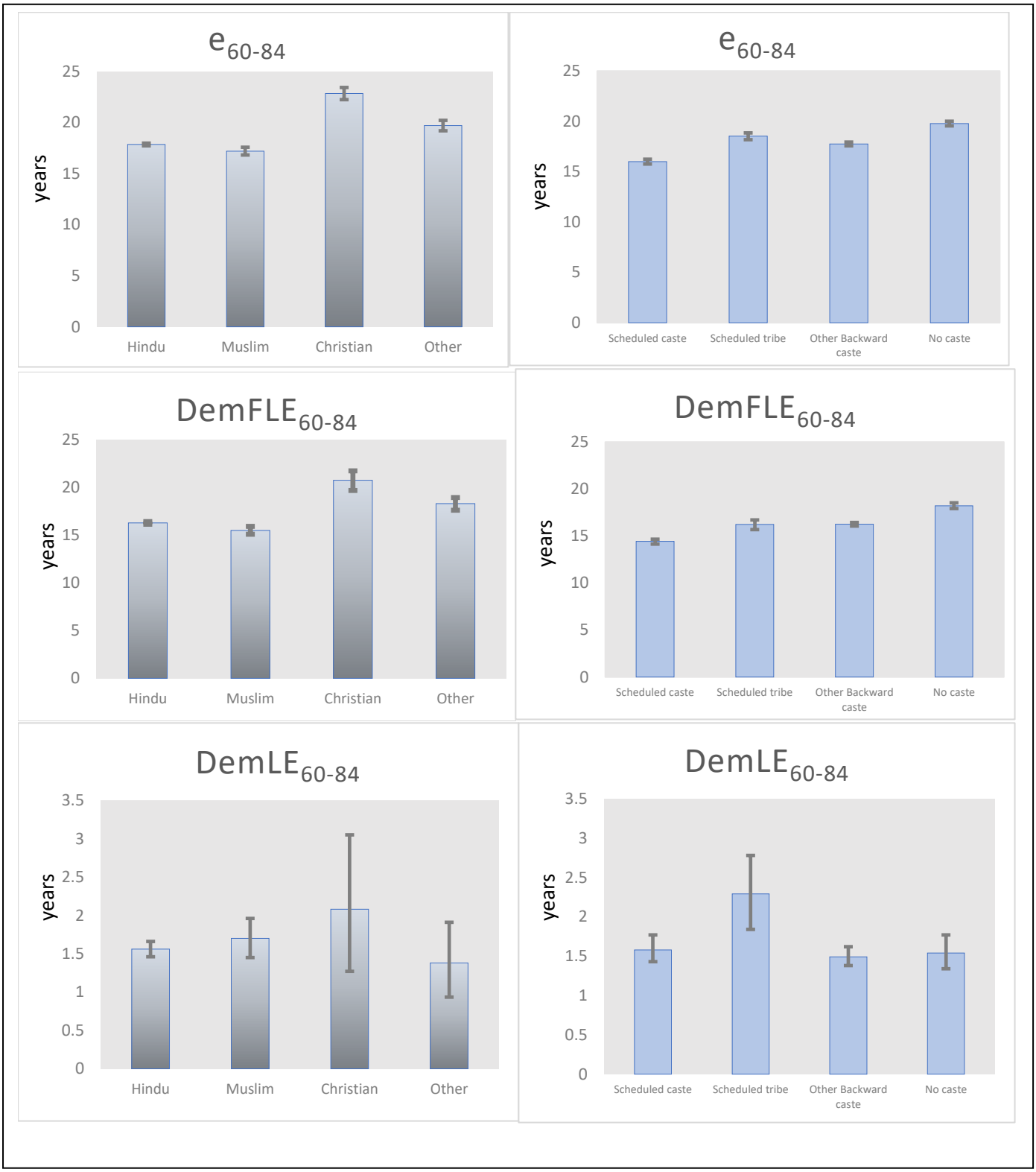
Caste data has been collected for Scheduled Caste (SC), Scheduled Tribe (ST), Other Backward Classes (OBC), and general/no caste. Similarly, the 'religion' variable consists of seven categories: Hindu, Muslim, Christian, Sikh, Buddhist, Jain, Other religion and religion not stated. Due to sample size constraints, we recoded this variable into four categories: Hindu, Muslim, Christian, and other. To estimate the contribution of wealth gradient among the caste and religious groups, the data on the wealth quintile provided by the NFHS data have been used. The wealth quintile in NFHS is measured based on the assets and household characteristics. The wealth index is divided into five equal quintiles: poorest, poorer, middle, richer and richest. Harmonized LASI provides total household wealth which includes household durables and valuables, financial and non-financial assets. For constructing wealth index in the harmonized LASI data, we will utilize the similar approach that is being used in Demographic Health Surveys (DHS) (Saravanakumar et al. 2022; Shea O. Rutstein Sarah Staveteig 2014). Using principal component analysis, we can incorporate housing quality (number of rooms, separate kitchen) and household amenity (water and toilet facility availability of electricity and cooking fuel) with total household wealth in order to construct the composite wealth index. Then the overall composite score can be divided into five wealth quintiles: poorest, poorer. middle, richer and richest.

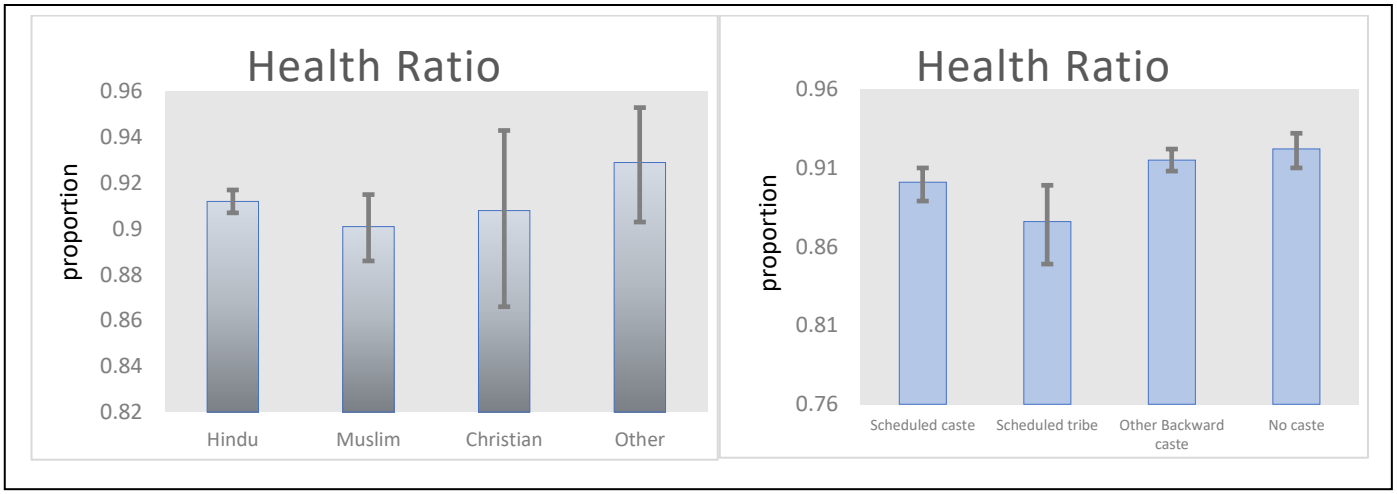
Methods

From the NFHS-5 dataset, we used the information on recent household deaths to estimate mortality from age 60 until age 85. For adult mortality, we only consider the deaths within two years before the interview to minimize the potential recall bias (Gupta and Sudharsanan 2022). for calculating the single-year deaths from the household we assumed that, for a two-year period, a person aged x at the time of the interview contributed on average one-half of a person-year of exposure at age x; one whole person-year by the person aged x + 1 and one-half of a person-year of exposure at age x + 2, symbolically (Dhakad and Saikia 2023). After calculating the death rates for ages 60 to 85, we smoothed them by applying the Gompertz-Makeham model. We did this for total mortality and each social group separately. (Missov and Lenart 2013; moultrie et al 2013 under 5 mortality) . As the NFHS underestimates national level mortality rates, we used UN life tables for India for the year 2019-2020 (UN- Model Life Tables- 2019-2020) and adjusted the smoothed total death rates from the NFHS-5 to the death rates from UN life tables. For the adjustment we calculated the age-specific (x) calibration

factor $C_x = \frac{M_x^{UN}}{M_x^{NFHS}}$, where M signifies the smoothed death rates from the respective dataset. We assumed this calibration factor to be constant across each social group. Next, the age-specific calibrated death rates and population-at-risk data from NFHS 5 is being used to compute life expectancy between age 60 and 84 by caste, religion using the method by Andrew Hinde (Hinde 2014). We applied the Sullivan method to estimate Dementia-free Life Expectancy (DemFLE) and Life Expectancy with Dementia (DemLE) for individuals aged 60 years to 84 (Sullivan,1971). We bootstrapped 95 percent confidence intervals assuming a Poisson distribution (Hendi 2023; Brouhns et al. 2005) for the age-specific deaths and the number people with dementia with 1000 replications. Next, we know that inequalities in DemFLE and DemLE in caste and religious groups are function of 1) inequalities in mortality rates between castes and religions (mortality effect), and 2) inequalities in the prevalence of dementia (dementia effect). To obtain information on the contribution of wealth to the inequalities in dementia health expectancy, we further decompose the mortality and dementia effect by wealth using the decomposition method developed by Nusselder and Looman (Nusselder and Looman 2004).

Preliminary Result:





Our preliminary findings suggest that the dementia-free life expectancy, life expectancy with dementia and health ratio (DemFLE/LE) differs between higher and lower castes and between religious groups. Christians had the highest $e_{60\text{-}84}$ (22.84; 95% CI: 22.24,23.43), the highest $DemFLE_{60\text{-}84}$ (20.76; 95% CI: 19.69,21.75) but it had also highest life years with dementia (2.08, 95% CI 1.27,3.05). Although, Christians had highest $e_{60\text{-}84}$ and $DemFLE_{60\text{-}84}$, they spent 9% of their $e_{60\text{-}84}$ with dementia which is almost equivalent to the Muslims (9.8%) who had the lowest $e_{60\text{-}84}$ (17.19; 95% CI: 16.82,17.58) and $DemFLE_{60\text{-}84}$ (15.5; 95% CI 15.10,15.93). Scheduled tribes had the second highest $e_{60\text{-}84}$ (18.53; 95% CI: 18.18,18.85) after General caste or no caste in India, still they spent more years (12%) of their $e_{60\text{-}84}$ with dementia compared to the individuals from other caste groups.

Next steps & discussion:

This study will be the first study in India to bring noteworthy findings on the complex interactions of caste, creed and SES. Our study's preliminary findings suggest social differences in $e_{60\text{-}84,}$ $DemFLE_{60\text{-}84}$ and $DemLE_{60\text{-}84}$ in India. This allows us to investigate the questions such as:

Despite having highest $e_{60\text{-}84}$ and $DemFLE_{60\text{-}84}$, why Christians spend more proportion of life years with dementia compared to the Muslims who have the lowest $e_{60\text{-}84}$ and $DemFLE_{60\text{-}84}$?

Despite having second highest $e_{60\text{-}84}$ and $DemFLE_{60\text{-}84}$, why Scheduled tribes spend more proportion of life years with dementia compared to castes with low $e_{60\text{-}84}$ and $DemFLE_{60\text{-}84}$?

Is there role of wealth for these discrepancies in the findings?

Our preliminary findings indicate that there are disparities in dementia health expectancy among different religious and caste groups. Nevertheless, despite having a high life expectancy, the marginalized castes (STs) still spent more proportion of years with dementia. Conversely, religious groups like Christians are also experiencing more proportion of years with dementia despite exhibiting the highest level of $e_{60\text{-}84}$ and $DemFLE_{60\text{-}84.}$ Consequently, we intend to extend our research further in order to ascertain whether the wealth distribution among Indian

older adults from different castes and religions contribute to the discrepancies in dementia health expectancies observed among them.

In conclusion, this study is a critical step towards understanding and addressing the adverse impact of neurodegenerative diseases in a diverse and dynamic society like India. However, this study has several limitations which can be emphasised for further comprehensive studies. This study will aid in developing targeted interventions and policies tailored for individuals from different castes and religions, with varying socio-economic status, to enhance successful aging and ensure equitable healthcare utilization.

References

Andrade, F. C. D., Corona, L. P., & Oliveira Duarte, Y. A. de (2019). Educational Differences in Cognitive Life Expectancy Among Older Adults in Brazil. *Journal of the American Geriatrics Society*, *67*(6), 1218–1225. https://doi.org/10.1111/jgs.15811

Ashby-Mitchell, K., Jagger, C., Fouweather, T., & Anstey, K. J. (2015). Life expectancy with and without cognitive impairment in seven Latin American and Caribbean countries. *PloS One*, *10*(3), e0121867. https://doi.org/10.1371/journal.pone.0121867

Banerjee, S. Determinants of rural-urban differential in healthcare utilization among the elderly population in India. *BMC Public Health* **21**, 939 (2021). https://doi.org/10.1186/s12889-021-10773-1

Chandra, V., Ganguli, M. [M.], Pandav, R., Johnston, J., Belle, S., & DeKosky, S. T. (1998). Prevalence of Alzheimer's disease and other dementias in rural India: The Indo-US study. *Neurology*, *51*(4), 1000–1008. https://doi.org/10.1212/wnl.51.4.1000

Chiang, C. L. (1972). On Constructing Current Life Tables. *Journal of the American Statistical Association*, *67*(339), 538. https://doi.org/10.2307/2284435

Dhakad, M., & Saikia, N. (Eds.) (2023). *Sustainable Development Goals Series*. *Adult Mortality in India: Trends, Socio-economic Disparities and Consequences* (1st ed.). Singapore: Springer Singapore.

Farina, M. P., Hayward, M. D., Kim, J. K., & Crimmins, E. M. (2020). Racial and Educational Disparities in Dementia and Dementia-Free Life Expectancy. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences*, *75*(7), e105-e112. https://doi.org/10.1093/geronb/gbz046

Ferri, C. P., Prince, M., Brayne, C., Brodaty, H., Fratiglioni, L., Ganguli, M. [Mary], . . . Scazufca, M. (2005). Global prevalence of dementia: A Delphi consensus study. *Lancet (London, England)*, *366*(9503), 2112–2117. https://doi.org/10.1016/S0140-6736(05)678890

Gupta, A., & Sudharsanan, N. (2022). Large and Persistent Life Expectancy Disparities between India's Social Groups. *Population and Development Review*, *48*(3), 863–882. https://doi.org/10.1111/padr.12489

Hinde, A. (2014). *Demographic Methods*. Routledge. https://doi.org/10.4324/9780203784273

Kumar, C. S., George, S., & Kallivayalil, R. A. (2019). Towards a Dementia-Friendly India. *Indian Journal of Psychological Medicine*, *41*(5), 476–481. https://doi.org/10.4103/IJPSYM.IJPSYM_25_19

Kumari M, Mohanty S K (2020). Caste, religion and regional differentials in life expectancy at birth in India: Cross-sectional estimates from recent National Family Health Survey. *BMJ Open*, *10*(8), e035392. https://doi.org/10.1136/bmjopen-2019-035392

Langa, K. M., Larson, E. B., Karlawish, J. H., Cutler, D. M., Kabeto, M. U., Kim, S. Y., & Rosen, A. B. (2008). Trends in the prevalence and mortality of cognitive impairment in the United States: Is there evidence of a compression of cognitive morbidity? *Alzheimer's & Dementia : The Journal of the Alzheimer's Association*, *4*(2), 134–144. https://doi.org/10.1016/j.jalz.2008.01.001

Lee, J., Meijer, E., Langa, K. M., Ganguli, M. [Mary], Varghese, M., Banerjee, J., . . . Dey, A. B. [Aparajit Ballav] (2023). Prevalence of dementia in India: National and state estimates from a nationwide study. *Alzheimer's & Dementia : The Journal of the Alzheimer's Association*, *19*(7), 2898–2912. https://doi.org/10.1002/alz.12928

Llibre Rodriguez, J. J., Ferri, C. P., Acosta, D., Guerra, M., Huang, Y., Jacob, K. S., . . . Prince, M. (2008). Prevalence of dementia in Latin America, India, and China: A population-based cross-sectional survey. *Lancet (London, England)*, *372*(9637), 464–474. https://doi.org/10.1016/S0140-6736(08)61002-8

Mathuranath, P. S., Cherian, P. J., Mathew, R., Kumar, S., George, A., Alexander, A., . . . Sarma, P. S. (2010). Dementia in Kerala, South India: Prevalence and influence of age, education and gender. *International Journal of Geriatric Psychiatry*, *25*(3), 290–297. https://doi.org/10.1002/gps.2338

Missov, T. I., & Lenart, A. (2013). Gompertz-Makeham life expectancies: Expressions and applications. *Theoretical Population Biology*, *90*, 29–35. https://doi.org/10.1016/j.tpb.2013.09.013

Morris, J. C. (1993). The Clinical Dementia Rating (CDR): Current version and scoring rules. *Neurology*, *43*(11), 2412–2414. https://doi.org/10.1212/wnl.43.11.2412-a

Moultrie T, Dorrington R, Hill A, Hill K, Timaeus I, Zaba B (2013) Tools for demographic estimation. International Union for the Scientific Study of Population, Paris

Muangpaisan, W., Petcharat, C., & Srinonprasert, V. (2012). Prevalence of potentially reversible conditions in dementia and mild cognitive impairment in a geriatric clinic. *Geriatrics & Gerontology International*, *12*(1), 59–64. https://doi.org/10.1111/j.1447-0594.2011.00728.x

Muhammad, T. (2022). The role of religiosity and religious participation in the relationship between depressive symptoms and cognitive impairment among older Indian adults. *Scientific Reports*, *12*(1), 11915. https://doi.org/10.1038/s41598-022-14744-3

Muhammad, T., Pai, M., Kumar, M., & Sekher, T. V. (2023). Multiple socioeconomic risks and cognitive impairment among older men and women in India. *Dialogues in Health*, *2*, 100119. https://doi.org/10.1016/j.dialog.2023.100119

Nusselder, Wilma J.; Looman, Caspar W. (2004): Decomposition of differences in health expectancy by cause. In *Demography* 41 (2), pp. 315–334. DOI: 10.1353/dem.2004.0017.

Prince, M., Acosta, D., Ferri, C. P., Guerra, M., Huang, Y., Llibre Rodriguez, J. J., . . . Liu, Z. [Zhaorui] (2012). Dementia incidence and mortality in middle-income countries, and

associations with indicators of cognitive reserve: A 10/66 Dementia Research Group population-based cohort study. *Lancet*, *380*(9836), 50–58. https://doi.org/10.1016/S0140-6736(12)60399-7

Prince, M., Ali, G.-C., Guerchet, M., Prina, A. M., Albanese, E., & Wu, Y.-T. (2016). Recent global trends in the prevalence and incidence of dementia, and survival with dementia. *Alzheimer's Research & Therapy*, *8*(1), 23. https://doi.org/10.1186/s13195-016-0188-8

Prince, M., Bryce, R., Albanese, E., Wimo, A., Ribeiro, W., & Ferri, C. P. (2013). The global prevalence of dementia: A systematic review and metaanalysis. *Alzheimer's & Dementia : The Journal of the Alzheimer's Association*, *9*(1), 63-75.e2. https://doi.org/10.1016/j.jalz.2012.11.007

Ravindranath, V., & Sundarakumar, J. S. (2021). Changing demography and the challenge of dementia in India. *Nature Reviews Neurology*, *17*(12), 747–758. https://doi.org/10.1038/s41582-021-00565-x

Ritchie, K., Mathers, C. [C.], & Jorm, A. [A.] (1994). Dementia-free life expectancy in Australia. *Australian Journal of Public Health*, *18*(2), 149–152. https://doi.org/10.1111/j.1753-6405.1994.tb00216.x

Robine, J. M., & Ritchie, K. (1991). Healthy life expectancy: Evaluation of global indicator of change in population health. *BMJ (Clinical Research Ed.)*, *302*(6774), 457–460. https://doi.org/10.1136/bmj.302.6774.457

Sathianathan, R., & Kantipudi, S. J. (2018). The dementia epidemic: Impact, prevention, and challenges for India. *Indian Journal of Psychiatry*, *60*(2), 165–167. https://doi.org/10.4103/psychiatry.IndianJPsychiatry_261_18

Schoen, R. (1978). Calculating life tables by estimating Chiang's a from observed rates. *Demography*, *15*(4), 625–635.

Veron, J., Preston, S. H., Heuveline, P., & Guillot, M. (2002). Demography, Measuring and Modeling Population Processes. *Population (French Edition)*, *57*(3), 591. https://doi.org/10.2307/1535065

Wang, X., Ma, H., Li, X., Heianza, Y., Manson, J. E., Franco, O. H., & Qi, L. (2023). Association of Cardiovascular Health With Life Expectancy Free of Cardiovascular Disease, Diabetes, Cancer, and Dementia in UK Adults. *JAMA Internal Medicine*, *183*(4), 340–349. https://doi.org/10.1001/jamainternmed.2023.0015

Brouhns, Natacha; Denuit *, Michel; van Keilegom, Ingrid (2005): Bootstrapping the Poisson log-bilinear model for mortality forecasting. In *Scandinavian Actuarial Journal* 2005 (3), pp. 212–224. DOI: 10.1080/03461230510009754.

Dhakad, Moradhvaj; Saikia, Nandita (Eds.) (2023): Adult Mortality in India: Trends, Socio-economic Disparities and Consequences. 1st ed. Singapore: Springer Singapore (Sustainable Development Goals Series).

Gupta, Aashish; Sudharsanan, Nikkil (2022): Large and Persistent Life Expectancy Disparities between India's Social Groups. In *Population & Development Rev* 48 (3), pp. 863–882. DOI: 10.1111/padr.12489.

Hendi, Arun S. (2023): Estimation of confidence intervals for decompositions and other complex demographic estimators. In *Demographic research* 49, pp. 83–108. DOI: 10.4054/demres.2023.49.5.

Hinde, Andrew (2014): Demographic Methods: Routledge.

Lee, Jinkook; Banerjee, Joyita; Khobragade, Pranali Yogiraj; Angrisani, Marco; Dey, A. B. (2019): LASI-DAD study: a protocol for a prospective cohort study of late-life cognition and dementia in India. In *BMJ open* 9 (7), e030300. DOI: 10.1136/bmjopen-2019-030300.

Lee, Jinkook; Meijer, Erik; Langa, Kenneth M.; Ganguli, Mary; Varghese, Mathew; Banerjee, Joyita et al. (2023): Prevalence of dementia in India: National and state estimates from a nationwide study. In *Alzheimer's & dementia : the journal of the Alzheimer's Association* 19 (7), pp. 2898–2912. DOI: 10.1002/alz.12928.

Missov, Trifon I.; Lenart, Adam (2013): Gompertz-Makeham life expectancies: expressions and applications. In *Theoretical population biology* 90, pp. 29–35. DOI: 10.1016/j.tpb.2013.09.013.

Morris, J. C. (1993): The Clinical Dementia Rating (CDR): current version and scoring rules. In *Neurology* 43 (11), pp. 2412–2414. DOI: 10.1212/wnl.43.11.2412-a.

moultrie et al 2013 under 5 mortality.

Nusselder, Wilma J.; Looman, Caspar W. (2004): Decomposition of differences in health expectancy by cause. In *Demography* 41 (2), pp. 315–334. DOI: 10.1353/dem.2004.0017.

Saravanakumar, Priya; Balachandran, Arun; Muhammad, T.; Drishti, Drishti; Srivastava, Shobhit (2022): Wealth disparity and frailty among community-dwelling older adults in India. In *BMC public health* 22 (1), p. 2123. DOI: 10.1186/s12889-022-14434-9.

Shea O. Rutstein Sarah Staveteig (2014): Making the demographic and health surveys wealth index comparable. Available online at https://iussp.org/sites/default/files/event_call_for_papers/comparativewealth-draft-iussp.pdf.

UN- Model Life Tables- 2019-2020.