Shifting age and education of grandparents in South Asia: Older Yet Higher Educated

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Abstract

Grandparents are integral to family support systems and provide essential physical financial and emotional care, as well as the transmission of cultural practices and wealth to grandchildren. In South Asia, grandparents also play active caregiving roles and commonly co-reside on the same household. While previous research has examined grandparenting roles and sociodemographic trends separately, there remains a significant gap in under- standing the intersection of changing grandparents' characteristics and grandparental role due to the changing sociodemographic trends of a country within the context of South Asia. This study investigates how sociodemographic changes at national level can affect the average age, sex, and education of grandparents in South Asia. Using the latest revised data from the United Nations and the Wittgenstein Center for Global Human Capital, we estimated and forecasted the number of living grandparents available for the focal of different age groups from 2020 to 2100. In addition to the number of grandparents, we also forecasted the distribution of their age, sex, and education. Our findings indicate that the number of grandparents is expected to increase in the future as a result of the increasing life expectancy in the region. Notably, future grandparents will be both older and better educated than before. Differences in age and education distributions between grandfathers and grandmothers will narrow down over time. Drawing from previous research and current findings from this study we provide an overview of how grandparental care may change in the future, influenced by grandparents' age, sex, and education. Policymakers could benefit from this study by creating policies that incorporate the shifting nature of grandparental care based on the change in sociodemographic characteristics of grandparents to increase the female labour force participation by leveraging the aging population more effectively.

Introduction

Grandparents play a pivotal role in the family support system, offering care and resources to grandchildren both during their lifetimes and posthumously. They provide physical care, financial support, emotional support, and the transmission of values and cultural practices to grandchildren. Even after death, grandparents contribute to grandchildren's wealth through intergenerational wealth transmission. In cases where parents are absent or cannot provide primary care (due to living arrangements, illness, death, time demanding paid job etc.), grandparents usually become the primary caregivers(Cowling et al., 2015; Martin et al., 2021; Zhao et al., 2018). Grandparental care and support benefit not only the grandchildren but also extend to other family members. For instance, when grandparents take care responsibility for grandchildren, parents get more time to participate in the formal paid job, which eases the burden of workload and care responsibilities (Compton & Pollak, 2014; Posadas & Vidal-Fernandez, 2013). Parents can also greatly benefit

from the advice and emotional support that grandparents can offer from their own parenting experience (Coall & Hertwig, 2010; Nie et al., 2023).

In South Asia, grandparenting is not only socially expected but also highly integrated into the family system, largely due to the high prevalence of multi- generational households and co-residence. The UN's Demographic Year Book 2022 showed that around 30 percent of households in South Asia are three- generational households, and around 1 percent are skipped generational households (where parents are absent and grandchildren live with grandparents), where grandparents live under the same roof as their grandchildren (UN, 2022). Grandparents in Asia actively participate in raising their grandchildren, often taking on daily responsibilities such as school drop-offs and pick-ups. They play a crucial role in imparting cultural values by sharing stories and involving grandchildren in traditional festivities and rituals (Knodel & Teerawichitchainan, 2018). This active engagement helps transmit cultural heritage across generations and builds intergenerational solidarity. Asian grandparents often provide financial support for their grandchildren's education and contribute to the family's overall economic stability, including transferring wealth to their children and grandchildren (Silverstein & Zhang, 2020).

Despite the extensive body of literature on demographic changes, education expansion, and socioeconomic development in South Asia, there is a significant gap in understanding how these shifts impact at a family level, particularly the change in sociodemographic characteristics of family members and caregiving roles associate with these characteristics. South Asia has experienced substantial demographic shifts and projected to continue experiencing them until the end of the century, including declining fertility rates and increasing life expectancy, which profoundly alter the age-sex structure of populations (UN,2024). While many studies show that South Asia's population is expected to age and highlight the challenges this will bring, the impact of this aging population at informal care supply and demand within family is still not well explored. Additionally, the type of informal care supply within family have not been examined in relation to the dramatic improvements in educational attainment (K. C. et al., 2024) across all countries in this region. Though some studies have shown that with changing fertility and mortality, Number of grandparents in south Asian family increases in future (Alburez-Gutierrez et al., 2023), but the details on the characteristics of these grandparents such as age, sex and education, which influence the type of care they can provide to grandchildren and other family members, is yet to be known.

Exploring shifting sociodemographic characteristics of grandparents and caregiving role associate with it is important as South Asian families rely heavily on informal care due to the region's lack of well-established formal childcare systems. Therefore, this study looks at how changing socio demographic trend in South Asia will reshape the characteristics of grandparents and what this could mean for the future of caregiving. As the countries experience socio demographic transition, characteristic of grandparents shifts too which further change the ability to provide care for their

grandchildren and other family members. Understanding how grandparents' roles and characteristics change over time can help policymakers create more effective plans, ensuring that resources are directed where they are most needed. If grandparents are better equipped to provide care, this could allow other family members, especially women who typically take on child caregiving duties, to enter the workforce. As a result, policies could be designed to support this shift. On the other hand, recognizing situations where grandparents may be less capable of providing care can highlight areas where formal caregiving services will need to be strengthened.

In the background section, we have described in details the importance of grandparents in family system especially for caregiving roles, changing sociodemographic trends in South Asian countries and the importance of studying these changes for understanding future grandparenting.

2.1 Background

2.1.1 Importance of Grandparents in Family System

The family serves as the foundation of society, with the interrelationships and exchanges of care within families contributing to broader economic patterns at a macro level (DeCarlo, 2018). In South Asia, the family assumes a particularly critical role, often acting as the primary source of financial, physical, and emotional support for its members. Due to limited social welfare systems and childcare support, individuals in this region heavily rely on family networks to meet their care needs. For instance, adult men, typically the sons, provide financial support, while adult women, often daughters-in-law, manage household chores, childcare, and elderly care (Das Gupta et al., 2003). Women, in particular, bear the majority of unpaid care responsibilities, dedicating significant time to caregiving tasks, averaging 11.7 hours per day in Bangladesh, 7.5 hours in Nepal, and 5.6 hours in India (Hitkari, 2023). Given that women contribute approximately 80 percent of the total unpaid care work hours in the region, policies aimed at increasing female labor force participation must consider the informal care demand within families. Grandparents, therefore, play a vital role in providing care, enabling parents to engage in other essential activities, including workforce participation (Dommaraju & Wong, 2022; Zahra et al., 2023). The collective contributions of all family members to care and support within the family system ultimately shape patterns of formal care demand, labor force participation, and national economic outcomes.

Family systems theory, proposed by Bowen (1966), suggests that changes in the needs and abilities of one family member influence the entire family unit. In the context of grandparental care in South Asia, this theory offers a framework for understanding how changes in the age, sex, and education of grandparents affect the supply and demand of informal care for all family members. For example, younger and healthier grandparents are more capable of providing physical support to their grandchildren, but they often face challenges in balancing paid and unpaid work, limiting their availability for caregiving (Hamilton & Suthersan, 2021) . Conversely, older grandparents, who may experience poorer health, often have a reduced capacity for physical care and may require assistance from other family members. Gender plays a significant role in shaping grandparental care. Research indicates that grandmothers are more likely than grandfathers to provide care (Buchanan & Rotkirch, 2018; Fuller-Thomson et al.,

1997; Reitzes & Mutran, 2004; Zanasi et al., 2023). Educational background further influences the nature of care provided by grandparents; for instance, those with higher levels of education tend to engage more in activities that promote intellectual and emotional development, such as reading or playing with grandchildren, while lower-educated grandparents are more likely to assist with practical day-to-day tasks (Di Gessa et al., 2022; Zanasi & Sieben, 2024). Furthermore, grandparents with greater financial resources can contribute to the family's economic stability through intergenerational wealth transfers, which aligns with the linked lives theory, positing that the advantages and disadvantages experienced by one generation can significantly affect the well-being of subsequent generations.

2.1.2 Importance of Age and Education of Grandparents for grandparental care

The education level of grandparents impacts not only their own lives but also the well-being of their families. Higher-educated grandparents tend to be healthier, allowing them to spend more quality time with their grandchildren (Song & Mare, 2019). Since higher education is linked to lower fertility rates (Adhikari et al., 2023), these grandparents tend to have fewer children, and their children are likely to follow the same pattern, resulting in fewer grandchildren. This allows grandparents to spend more time and resources on each grandchild. Additionally, higher-educated grandparents often have more wealth due to the higher incomes associated with education, enabling them to provide greater financial support to their families (Psacharopoulos, 1994). Higher-educated grandparents are more likely to remain active in the labor force until later in life (Zaccagni et al., 2024), which allows them to offer financial but potentially less physical support to their grandchildren.

Literature has suggested that higher educational attainment among grandparents is also associated with better cognitive development, more educational activities, and better academic performance in grandchildren (Di Gessa et al., 2022; McGarrigle et al., 2018; Sheppard & Monden, 2018). Educated grandparents are better equipped to utilize resources such as books, educational toys, and extracurricular activities, fostering an enriching environment for their grandchildren. In contrast, grandparents with lower educational attainment often adopt a more traditional approach, focusing on day-to-day support such as caregiving, feeding, and meeting basic needs. They emphasize physical well-being and instill values through life skills and cultural traditions (McGarrigle et al., 2018). Research indicates that individuals with lower levels of education often have limited knowledge about health risks and preventive measures, leading to poorer health outcomes (Hassen et al., 2022). This lack of awareness can result in higher rates of chronic illnesses and reduced overall health (Raghupathi & Raghupathi, 2020), which can negatively affect their ability to provide effective care and support within the family.

The age of grandparents plays a significant role in the care and support they provide to their grandchildren. Older grandparents often accumulate more wealth and life experience, which allows them to support their families through intergenerational transfers (Shwalb & Hossain, 2017). However, their health tends to decline as they age, which can place additional demands on the family to care for them, which can strain family finances. Older grandparents may not have as many years left to spend with their grandchildren, which can limit duration for intergenerational relationships. On the other hand, younger grandparents are usually more physically active,

allowing them to engage more in household tasks and play with their grandchildren. They have more years ahead to foster stronger bonds. However, many younger grandparents are still working, which can limit their time to spend with grandchildren and provide the informal care to them. Additionally, a large number of younger grandparents in South Asia belong to the "grandsandwich generation" who are responsible to care for both young grandchildren and their parents (Alburez-Gutierrez et al., 2021). This dual responsibility can make it challenging for them to dedicate enough time to their grandchildren.

2.1.3 Socio-demographic Shift in South Asia

South Asia has experienced a significant demographic transition in recent decade from high birth and death rates to low and controlled birth and death rates. Total fertility rates (TFR) have dramatically declined from 6.14 live births per woman in 1950 to 2.39 in 2015, with projections indicating a further drop to 1.9 by 2050. Concurrently, the mean age at first birth has increased from around 18 in 1950 to about 23 in 2022. Life expectancy has also seen a remarkable rise, from approximately 42 years in 1950 to 70 years in 2015, and is projected to reach 75 years by 2050 and nearly 83 years by the end of the century. These shifts are reshaping the age structure of the population, with the average age expected to increase significantly (UN, 2024).

Education in South Asia is also expanding alongside these demographic transitions. In 1950, around three-quarters of the South Asian population had no formal education. This figure dropped to 26.1 percent in 2020 and is projected to decrease to almost zero (0.2 percent) by 2100. The gender gap in educational attainment has also narrowed significantly, from 27 percent more women than men having no formal education in 1950 to 17 percent more in 2020, with an expected reduction to only 1 percent gap by 2100 (Lutz et al., 2018). These educational improvements align with the demographic metabolism theory (Lutz, 2013), which posits that each new generation will have better access to education, leading to an overall increase in educational attainment over time.

Drawing on demographic transition and demographic metabolism theories, the future in South Asia is likely to see more grandparents who are older and better educated than in the past. As life expectancy continues to rise, more individuals will live long enough to become grandparents. However, with people continuing to delay childbirth, the age at which they become grandparents will also increase. These shifts in the age, and education of grandparents are expected to reshape traditional family support systems. With more women gaining education and potentially entering the workforce, caregiving roles within families are likely to shift. Also, the changing age and education of future grandparent can change the nature of care they provide to grandchildren than before. While this study only look into how the age, sex and education of future grandparents can change and doesn't directly explore the specific type of care grandparents offer, it uses the findings from past research to examine how grandparents' sociodemographic characteristics influence their caregiving roles and ability to support their families.

3. Estimating and forecasting number of grandparents by age, sex and education

The age distribution of grandparents at the time of the focal individual's birth was estimated using a two-sex, time-variant kinship model, as outlined in Caswell (2022). This model begins by estimating the age distributions of the focal's mother and father, who are assumed to be the only biological parents at the time of the focal's birth. The age distribution of the parents is inferred from age-specific fertility rates for each country. Given that grandparents are the parents of the focal's parents, their age distribution at the time of the focal's birth was derived by combining the age distribution of the mother's parents at the mother's birth and the father's parents at the father's birth, adjusted by the age distribution of the focal's parents at the time of birth. The model's core formula is:

$$K(x+5, t+5) = U_t K(x,t) + \beta(x,t)$$

Here, the vector K(x,t) represents the number of grandparents of age x at time t. Ut is the survival matrix, representing the surviving grandparents from age x to x+5. β(x,t) represents the recruitment of new grandparents, which varies depending on the type of kin in the model. Since no new biological grandparents can appear after the birth of a grandchild (this model does not account for step-kin), the recruitment term is:

$$\beta(x,t) = 0$$

Therefore, the expected number of grandparents at age x+5 and time t+5 is the number of surviving grandparents from age x to x+5 at time t to t+5.

We estimated and forecasted number of grandparents for a focal, defined as a randomly selected individual of a specific age from the population, from 2020 to 2100 using the median estimates of fertility and survival probabilities from the 2024 revision of World Population Prospects (uter et al., 2024). To estimates the grandparents from both patrilineal and matrilineal side, we required the input (fertility rates, survival probability rates0 for both male and female. Since WPP do not provide the fertility rates for male, we used female age-specific fertility rates and adjusted them according to the male age distribution, based on the differences in the mean ages of fatherhood for males and mean age at childbearing for females in each country. The mean ages for childbearing and fatherhood were sourced from (Schoumaker, 2019). For each country, the difference, Δ, between the mean age at fatherhood and the mean age at childbearing is calculated. Male age-specific fertility rates were then derived by adding this difference to the female age-specific fertility rates.

$$Fx(m) = Fx(f) + \Delta$$

Δ reflects the difference in mean age at fatherhood and mean age at childbearing. This Δ is closely aligning with the average spousal age difference at marriage documented in (Dommaraju, 2024) in respective South Asian countries. This close alignment further validates the method used to estimate male fertility in South Asia, where births out-of-wedlock are rare. Δ is kept constant over the study periods because of the data limitation for mean age at fatherhood.

To incorporate education alongside the age and sex of grandparents, we then used new datasets from the 2023 revision of the Wittgenstein Centre for Demography and Global Human Capital

(WIC) (K. C. et al., 2024). This data provides the population proportion across six educational groups: no education, some primary, primary, lower secondary, upper secondary, and higher secondary, available for each country, sex, five-year age group, and five-year period from 2020–2025 to 2095-2100. We compared the age, sex, country, and time periods between our estimated grandparents' data and the WIC's education data. Once it matched, we applied the education distribution to the number of grandparents, assuming they follow the same educational distribution as the general population. The different sets of education data is used for three different Shared Socioeconomic Pathways (SSPs): SSP1, SSP2 and SSP3 to examine how grandparent education changes under different socioeconomic scenarios. Each SSP scenario represents distinct trajectories of future socioeconomic development: SSP1, or the "Sustainability" scenario, envisions a future where countries prioritize sustainable development and strive for greater equality. In this scenario, there is a rapid expansion of education, with significant investments made to ensure broad access to education for all. This leads to substantial improvements in human capital across countries and regions, with a focus on sustainable growth and social equity. SSP2, known as the "Middle of the Road" scenario, reflects a future that continues along current global trends. Here, educational progress proceeds steadily, much like it has in recent decades. The scenario assumes moderate improvements in education and human capital without major disruptions or rapid advancements, maintaining a consistent pace of development. SSP3, referred to as the "Regional Rivalry" scenario, describes a world where countries and regions become more isolated and inward-focused, concentrating on their own interests. Under this scenario, economic growth is slow, and progress in education and social welfare is limited. As a result, this pathway leads to greater inequality between countries and regions, with some areas experiencing significant setbacks in educational development (O'Neill et al., 2017).

Result

Grandparents living longer: more grandmothers than grandfathers

By using the data from 2024 revision of WPP, we estimated and forecasted the number of grandparents for a focal of specific age group by grandparent's age and sex from 1950to 2100. Figure 1 shows the average number of grandfathers and the average number of grandmothers alive for the focal of age 0-4 years in seven South Asian countries from 1950 to 2100. Focal of each age group can have at most two grandmothers and two grandfathers (from both matrilineal and patrilineal sides). However, not all grandparents are alive when the focal is born and reach up to the specific age, resulting in at most four but often fewer than four living grandparents. The figure 1 indicates that the number of living grandparents rises over the period, starting around two grandparents in 1950 to reaching close to four grandparents by 2100.

Result indicates that there will consistently be more living grandmothers than grandfathers in each country. The number of living grandparents is higher in the Maldives and Nepal, with the smallest gap between the number of living grandfathers and grandmothers. Conversely, Afghanistan, Pakistan, and Bangladesh have the lowest number of living grandparents, with a larger difference between the number of living grandmothers and grandfathers.

The number of grandparents a focal has not only varies by country and over time but also significantly depends on the focal's age. For instance, as shown in the figure, a focal aged 0-4 years typically has nearly four living grandparents. However, as the focal's age increases, the average number of living grandparents declines. This decline occurs because, as the focal gets older, their grandparents are also older and have a lower survival probability at older ages. Furthermore, since women generally have a higher survival probability than men in older age, and grandmothers are relatively younger than grandfathers due to the difference in age specific fertility pattern between male and female there will be more grandmothers alive than grandfathers as the focal ages (for empirical result see Appendix 1).

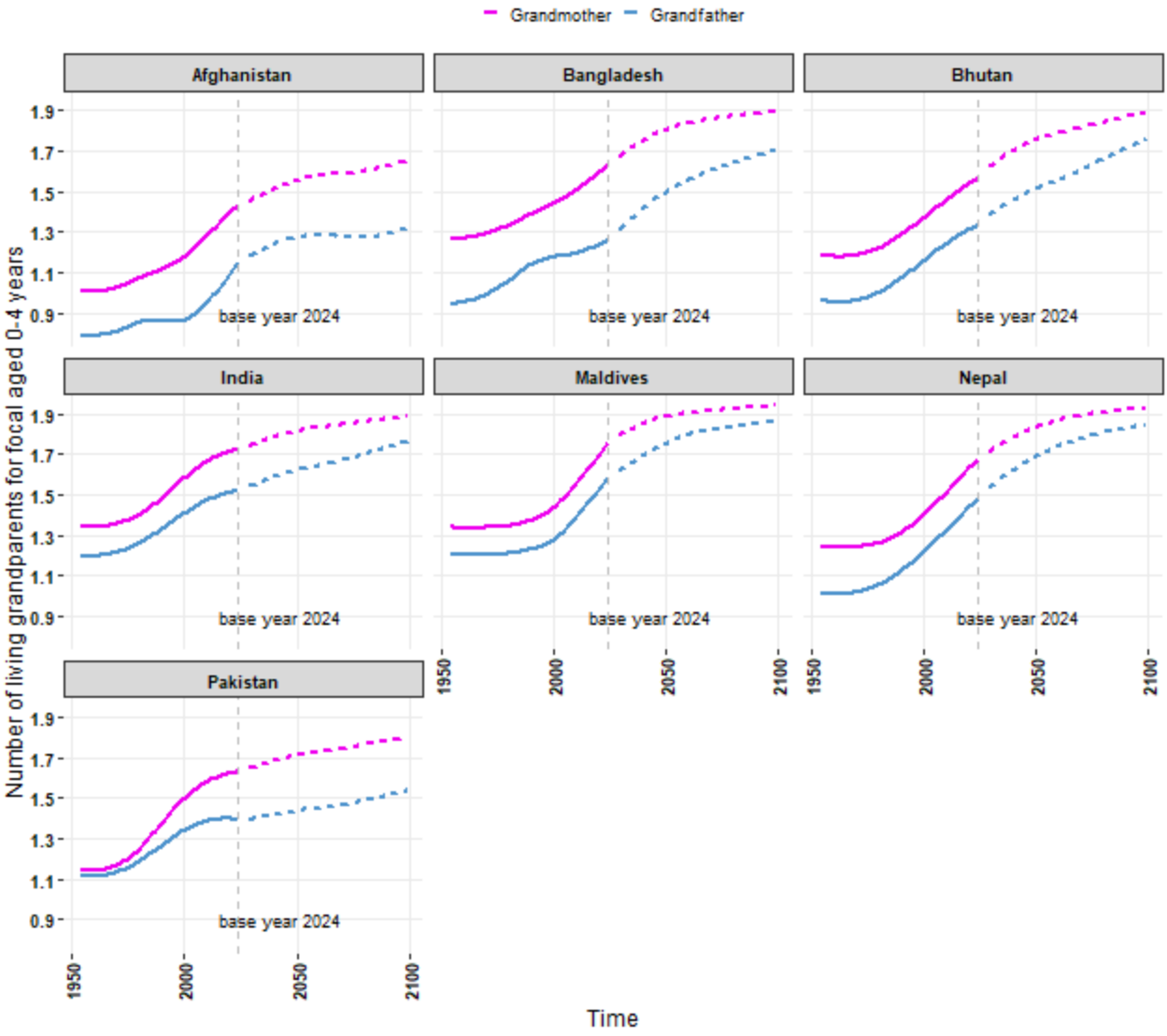

Figure 1: Estimated and projected average number of grandparents alive to a focal of age 0-4 years from 1950 to 2100

Future grandparents will be older and better educated

Knowing the mere number of grandparents does not adequately capture the potential role they play within the family support system, especially in terms of providing care for grandchildren. Therefore, it is crucial to also consider their characteristics, such as age, sex, and education, which directly influence both their ability and need to provide support. Figure 2 shows the projected age distribution of living grandfathers and grandmothers in India across different time periods, segmented by the age of the focal, ranging from 0-4 years to 25-29 years. The age distribution of grandparents varies by time, sex, and the age of the focal, with a noticeable shift towards older

ages over time and as the focal grows older. In the future, while more grandparents are expected to be alive, these grandparents will generally be older than before. For instance, for a focal aged 0-4 years, the mean age of grandmothers is forecasted to be around 53 years in 2024, increasing to approximately 59 years by 2094. Similarly, the mean age of grandfathers is expected to rise from about 57 years in 2024 to 63 years in 2094. The age distribution of grandparents also changes with the age of the focal. As the focal ages, the number of living grandparents decreases, and a higher proportion of the surviving grandparents will be grandmothers, who tend to be younger than grandfathers. Compare to the focal of age 0-4 years, grandparents of focal aged 25-29 is expected to be older. For a focal aged 25-29 years, the mean age of grandmothers is projected to increase from 72 years in 2024 to around 80 years by 2094, while the mean age of grandfathers is expected to rise from 75 years to approximately 83 years over the same period. For the age, sex distribution of grandparents in other countries see Appendix2.

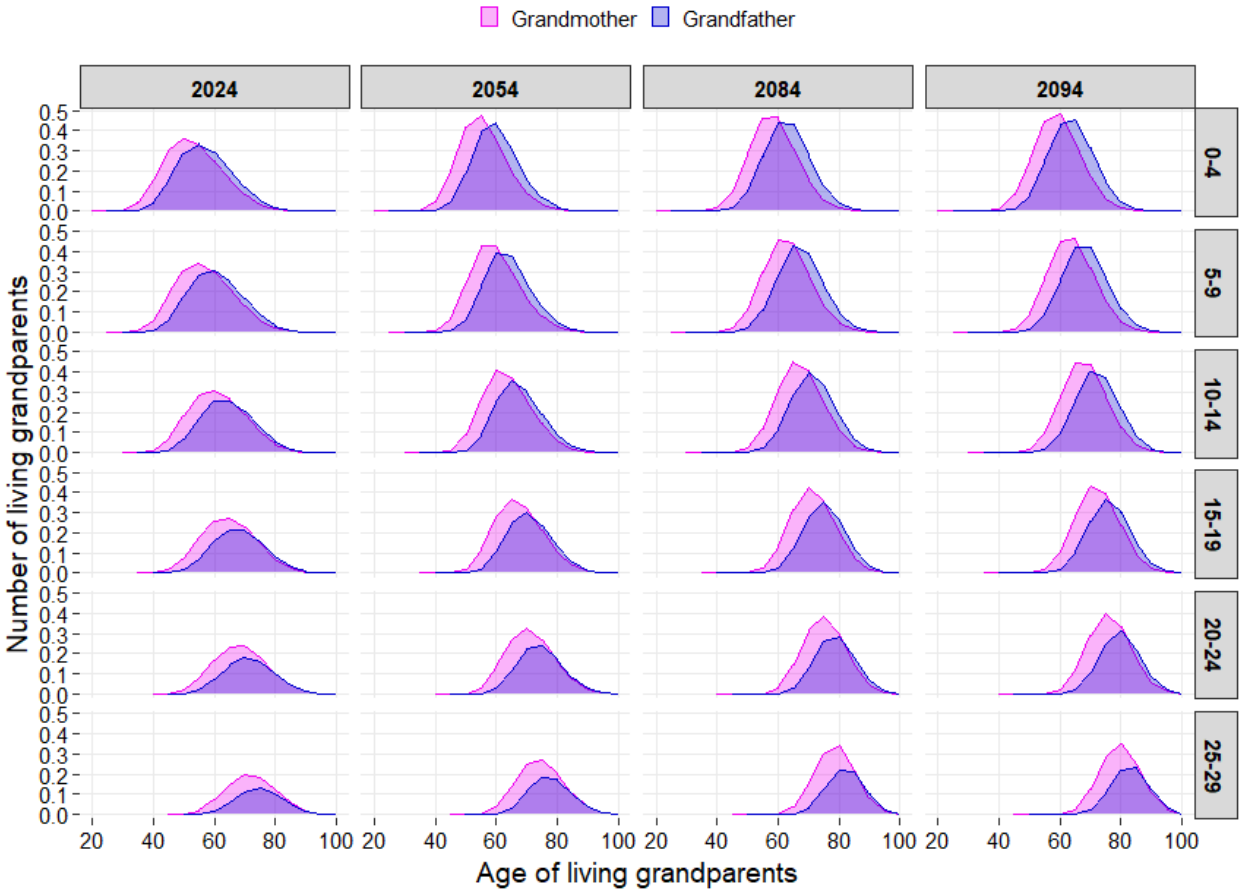

Figure 2: Projected average number of grandparents by age and sex for focal of different age (age of focal shows the starting age of five years age group) from 2020 to 2100 in India

Once the number of grandparents is estimated and forecasted by age and sex using a time- variant two-sex kinship model, we applied the education distribution from the Wittgenstein Centre for Demography and Global Human Capital (WIC) to the grandparents based on their age and sex for each country and time period. As the education distribution is available for five years' time period,

we chose the grandparent's number, age and sex distribution for mid-year of such five years period. For example, the education distribution of 2020-2024 is applied to the grandparents of 2022.

Figure 3 shows the age and education (from SSP2) distribution of grandmothers at different time periods for a focal of age 0-4 years in each country. The education levels of grandmothers is expected to increase toward higher education over time. In 2020-2024, the majority of grandmothers had no formal education or only incomplete primary education. However, as time progresses, education expand, with most grandmothers having at least upper secondary education. The education distribution of grandmothers varies across countries. For instance, in 2020-2024, nearly all grandmothers of focal in Afghanistan have no formal education but in the same time period, the majority of grandmothers in the Maldives and India has secondary and above education. Such differences in education distribution of grandmothers also persist over the projection time period. Since the education of grandparents depends on their age and sex, older focal who typically have older grandparents also have a higher share of grandparents with lower education. The full empirical result for grandparents, including grandfather, for a focal of different age group is given in Appendix 3.

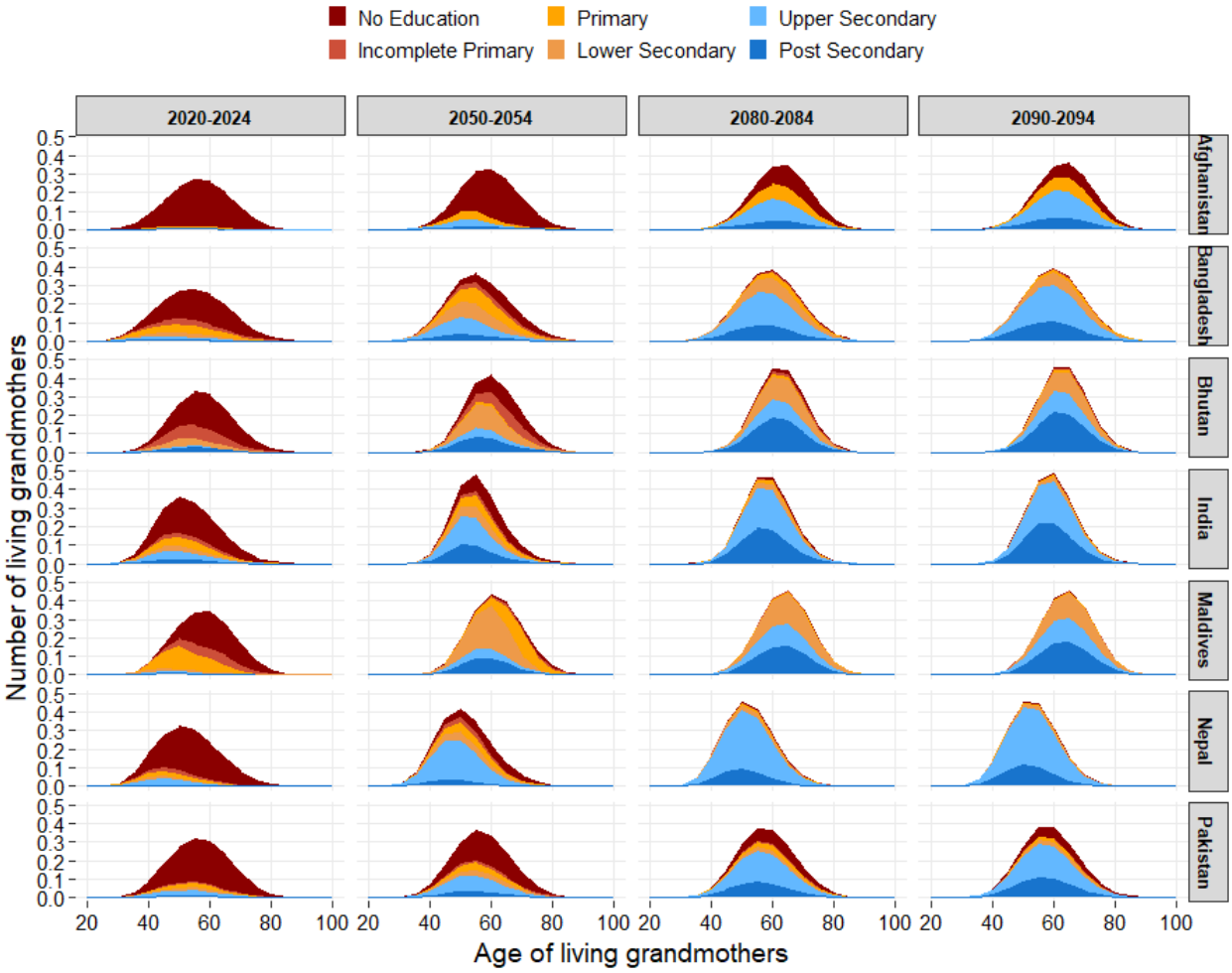

Figure 3: Average number of grandparents by age, sex and education to a focal of age 0-4 years from 2020 to 2100

In addition to SSP2, we then added education distribution to grandparents' data from remaining two education scenarios. Figure 4 shows the proportion of grandmothers with each education level (without considering age) under three Shared Socioeconomic Pathway (SSP) for all studied countries from 2020 to 2100. Under SSP1, there is a marked increase in the educational attainment of grandmothers over time. By 2100, the vast majority of grandmothers are projected to have at least a primary level of education, with a significant proportion reaching secondary and post-secondary education levels. The share of grandmothers with no formal education diminishes sharply throughout the century, eventually becoming negligible or entirely absent. Under SSP2, the education levels of grandmothers show a more moderate shift compared to SSP1. While there is a noticeable increase in the proportion of grandmothers with higher levels of education, such as secondary and post-secondary education, the change is less pronounced than in SSP1. By 2100, a significant proportion of grandmothers still have no formal education or only primary education, though the share is lower compared to earlier years. While under SSP3, the distribution of education levels among grandmothers remains largely skewed towards lower levels of education throughout the century. There is only a modest increase in the proportion of grandmothers with primary and above education, and a considerable proportion of grandmothers remains without any formal education even by 2100

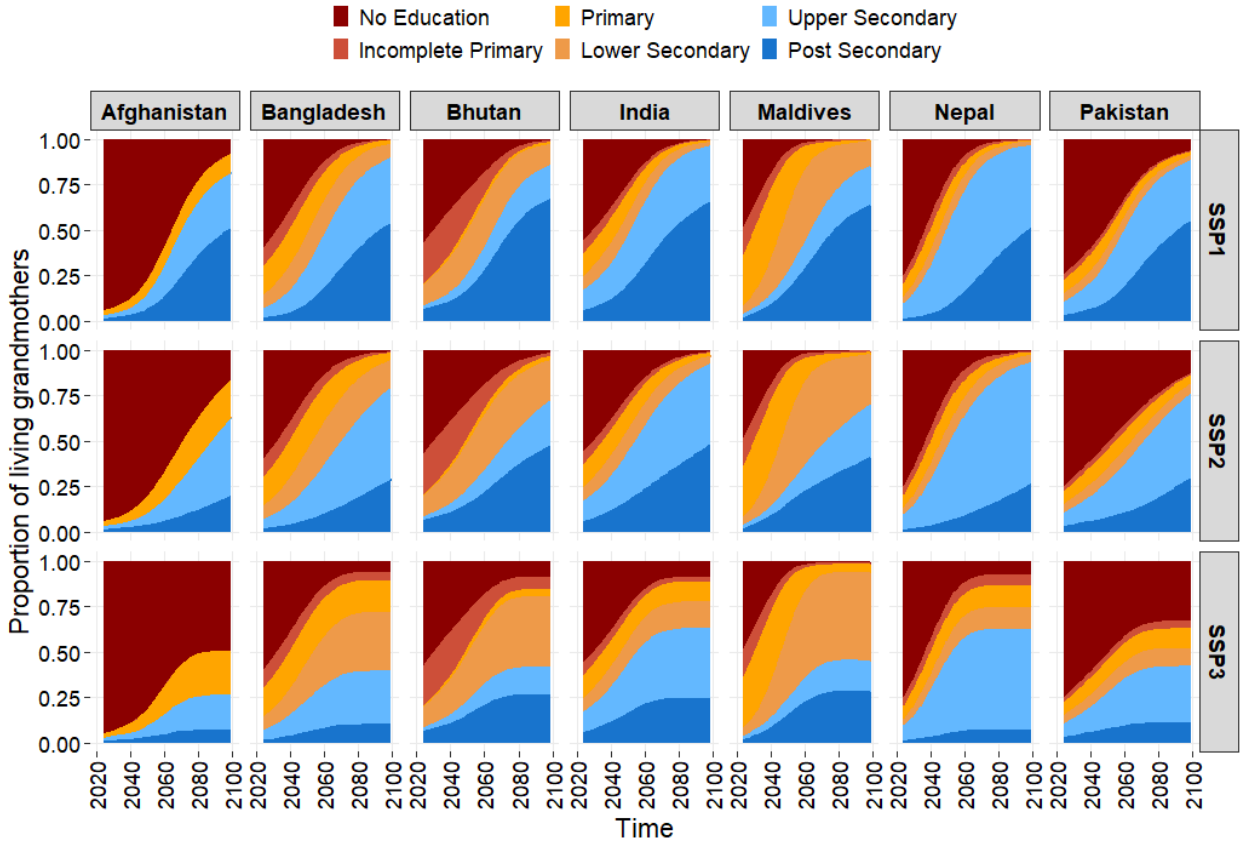

Figure 4: Proportion of grandmothers by education level for focal aged 0-4 from 2020 to 2100 under different shared socioeconomic pathways (SSPs)

These results provide four key insights into the future age, sex, and education of grandparents in South Asia. First, the number of living grandparents will increase, meaning that future grandchildren will have more grandparents available. Among them, the proportion of grandmothers will be relatively higher than that of grandfathers. Second, future grandparents will generally be older, which may present challenges in providing care due to age-related physical limitations. Notably, grandmothers are expected to be younger than grandfathers, suggesting they may be more active in caregiving roles. Third, grandparents are projected to be better educated than previous generations, although their education levels will vary depending on future education expansion. Some scenarios indicate a significant increase in highly educated grandparents, while others show a more moderate rise; nonetheless, future grandparents will generally have higher education levels than before. Fourth, the age, sex, and education of grandparents will also depend on the age of their grandchildren. As grandchildren grow older, grandparents are likely to be older, fewer in number, and have relatively lower educational attainment.

Knowing this information is crucial for developing policies regarding grandparental care demands and needs. Understanding countries will have grandparents with specific sex, age and education levels at different times helps in formulating targeted policies. These policies can address the type of grandparental care that grandparents of specific age, sex and education can pro- vide to ensure that support systems are tailored to the capabilities and needs of grandparents in each country over time. This data is particularly important for planning social support systems in light of changing educational development.

What does change in grandparents' age, sex, and education tell us about future grandparental care

We started the paper by discussing the importance of understanding age, sex and education of grandparents to understand the grandparental care and involvement they could provide based on their socio-demographic characteristics. The main aim of this paper is to estimate and forecast the number of grandparents alive to a grandchildren of specific age groups in future. It does not directly study what kind of grandparental care the future grandparent can provide but we try to draw inference on what these changing age, sex and education composition of grandparents can tell us about potential change in future grandparental care based on the existing literature and the findings of this study.

As life expectancy continues to increase across South Asian countries along with the delayed childbirth, a growing number of individuals will live to become grandparents, with many experiencing grandparenthood later in life. This study shows that future grandparents will be thus on average older than before. This aging trend suggests that while the number of living grandparents per child is expected to increase, their capacity to provide physical care may decline due to age-related health issues. Older grandparents may encounter difficulties in handling physically demanding caregiving tasks, potentially transferring these responsibilities to younger family members or necessitating formal care services to meet grandchildren's physical needs. Additionally, with more grandparents living into older age, the burden on the "sandwich

generation", those caring for both young children and elderly parents could increase. This demographic shift may require greater attention to support systems and policies that address the dual caregiving demands faced by middle-aged adults.

The gender composition of grandparents also plays a crucial role in determining the nature of care provided. The result of this study highlights that there will consistently be more grandmothers alive than grandfathers over the study period. For younger focal (0-4 years old), there are small difference between number of grandfathers and grandmothers alive at each year but among them the grandfathers are relatively older than grandmothers. Such finding suggest that grandmothers could engage more in physical grandparental care than grandfathers because of being young. However, as the age of the focal increases, a shift occurs where grandmothers are more likely to be present in older age groups than grandfathers who died earlier. This shift indicates that grandmothers will play a crucial role in long-term care, and have more time for generational exchange with grandchildren than grandfathers. Traditionally, grandmothers are more involved in hands-on caregiving tasks, such as nurturing and daily child-rearing activities. With continuation of grandmothers living longer time with grandchildren, we could expect to continuation of the similar care in future. However, as the population ages, the continued prominence of grandmothers in caregiving roles may place additional demands on them, especially as they themselves age and potentially require care. This situation highlights the dual role of grandmothers as both caregivers and care recipients, necessitating targeted support systems to address their unique needs.

One of the most dramatic shifts we observed in this study is the increase in educational attainment among future grandparents. The changing educational composition of grandparents in South Asia, marked by increase in proportion of grandparents in higher level of education, is expected to have diverse impacts on the nature of grandparental care. As an increasing number of future grandparents expected to attain higher levels of education, they are likely to contribute more significantly to the cognitive and emotional development of their grandchildren. Educated grandparents often engage in activities that foster intellectual growth, such as helping with homework and providing financial support for educational and extracurricular pursuits. Moreover, their better health and longer life expectancy enable them to offer sustained support over extended periods, potentially easing some caregiving responsibilities for parents. However, literature from the Global North suggests that highly educated grandparents are less inclined to provide direct physical care for their grandchildren. If this trend persists, there may be a growing demand for formal childcare services in South Asia in the future. Even though the number of grandparents with higher education increases over period, result also shows a notable proportion of grand-parents with lower education including no formal education. These grandparents with lower educational attainment may focus more on practical and day-to-day caregiving tasks. These grandparents often provide essential support, such as preparing meals, managing household chores, and offering hands-on care, which is crucial for the daily functioning of the family. Despite possibly having fewer financial resources, they may contribute to the stability and wellbeing of their grandchildren through the provision of physical care and the transmission of cultural values and life skills.

In conclusion, based on the existing literature and findings from this study, it is clear that the characteristics and roles of South Asian grandparents are undergoing significant transformations due to sociodemographic changes. The anticipated increase in both the number and age of grandparents, along with higher levels of educational attainment, indicates a shift in the nature of grandparental involvement and the types of care they provide. While aging grandparents may reduce the physical caregiving capacity in future, their better educational backgrounds could improve the quality of financial, emotional, and intellectual support they offer. Furthermore, as more grandparents are likely to have higher education, the challenges associated with older grandparents may be mitigated to some extent by the healthier lifestyles typically adopted by educated individuals. Thus, the experience of being older grandparents may not be as challenging as currently perceived. The persistent gender differences, with grandmothers more likely to survive longer and thus play a critical role of both care provider and care recipient, highlight the need for policies that support these dynamics. Policy- makers should consider these potential changes to ensure that support systems effectively harness the contributions of grandparents, addressing the potential gaps in care provision due to age related limitations and leveraging the increased human capital for the benefit of family welfare and intergenerational solidarity.

Limitation

While this study is the first to provide an understanding of how the characteristics of grandparents, such as age, sex, and education, evolve in the future and their potential implications for grandparental care in South Asia, it is important to acknowledge that it has several limitations. Firstly, the study assumes a constant age difference between the mean age at childbirth and fatherhood throughout the study period, which may not hold true over time. If this difference changes over time, we will also observe the change in age distribution between grandfathers and grandmothers. Due to a lack of data on how this age difference might vary, we have kept it time-invariant.

Secondly, the kinship model does not directly incorporate education as an input; instead, we applied education distribution based on the kin's age, sex, and time. As a result, the model does not fully capture the direct influence of education on the age at which individuals become grandparents. For example, women with lower education levels generally have children at younger ages than those with higher education levels. This suggests that those who become grandparents earlier may have lower levels of education, while those who become grandparents later may have higher levels. However, the educational trends in the data, based on the demographic metabolism theory, indicate that younger cohorts generally have higher education levels, while older cohorts have lower levels. Although the overall composition of grandparents' education is not significantly affected by this limitation, disaggregating the data by both age and sex may lead to underrepresentation of younger, less educated grandparents and overrepresentation of older, more educated ones. To address this issue, a multistate kinship model that includes education as a stage variable can be used. In the next phase of our research, we will use this model to estimate and forecast grandparents based on age, sex, and education by addressing this issue.

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