Financial Protection in Health among the Elderly – A Global Stocktake

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ABSTRACT
Universal Health Coverage is one of the key targets of the Sustainable Development Goals and it implies that everyone can access the healthcare they need without suffering financial hardship. In this paper, we use a large set of household surveys to examine if older populations are facing different degrees of financial hardship compared to younger populations. We find that while differences in average age structures between countries are not systematically associated with higher financial risk related to out-of-pocket health expenditures, there are large differences in financial hardship between younger and older households within countries. Households with more elderly members are more likely to face catastrophic and impoverishing out-of-pocket health payments compared to younger households, and this age gradient is stronger for the poorest segments of the population. Making progress toward Universal Health Coverage will require extension and improved targeting of benefit packages and financial protection to meet the health needs of older adults, and especially the poorest and most vulnerable segments of elderly populations.

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Introduction
Reduced fertility and improved survival cause population aging—rising shares of elderly citizens—in almost all parts of the world. Only sub-Saharan Africa has so far withstood the trend due to slower declines in birth rates and the toll of the HIV pandemic. While increased survival to old age is a positive population outcome, it is commonly considered to burden productivity and economic growth, and strain systems of social security. Especially for health systems, an increasing population share of the elderly is often thought to threaten progress toward Universal Health Coverage (UHC)—ensuring that everyone can access the healthcare they need without suffering financial hardship. Such financial hardship is indicated when households’ out-of-pocket medical expenditures (OOPEs) exceed a catastrophic household budget share where other basic needs—such as food, clothing and education—become compromised, or when OOPEs push households under the poverty line.

If health coverage is insufficient, the elderly are particularly exposed to catastrophic and impoverishing OOPEs, as they face a double burden of decreasing earnings and increasing OOPEs due to higher and more complex healthcare needs. In fact, studies that examine the relationship between old age and catastrophic OOPEs using cross-sectional household survey data find strong positive correlations in high, upper middle-, lower middle-, and low-income countries. Less is known about the link with impoverishing OOPEs, but the available evidence points in the same direction. Importantly, both indicators overtstate the degree of financial protection in health if substantive shares of the elderly forgo healthcare because it is unaffordable, and therefore do not accrue OOPEs.

Several factors may offset the negative effects of population aging on earnings and financial protection. In low- and middle-income countries with rapidly declining fertility rates, dependency ratios will continue to reduce for some time, despite an increase in the number of elderly citizens. Aging may lead to quicker adoption of productivity-enhancing technical innovations. Importantly, if aging coincides with reductions in the age-standardized burden of disease—morbidity compression or healthy aging—this may extend productive work lives and limit increases in healthcare needs. Also, when social health coverage is extended, the elderly often benefit the most.

The empirical evidence on the link between population aging and OOPEs is limited, and results are mixed. For a panel of 143 countries over the 1995–2008 period, Ke, Saksena and Holly find a positive association with

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an increasing population share aged 65 and older only for upper middle-income countries in models that control for country fixed effects, GDP, fiscal capacity, health financing mix, and disease patterns. Similar analysis by Younsi, Chakroun and Nafaa\(^4\) for 167 countries over the 1993–2013 period suggests a positive association of per capita OOPEs for high-income countries and a negative association for low-income countries.

The absence of a clear positive association between an increasing elderly population share and aggregate OOPEs in such between-country analyses may alleviate concerns of a rapid decline in financial protection as populations globally grow older. The between-country analyses, however, do not shed light on the large gaps in financial protection between old and young households within countries which, if not addressed through targeted policies, will continue to pose an important obstacle to UHC achievement.

The present paper examines the effects of aging from both the between- and within-country angles and is novel in at least two regards. First, it provides the first between-country estimates of the relationship of population aging with catastrophic and impoverishing OOPEs using a panel of 118 countries which represents 86% of the world population. Secondly, it presents a massive—and, to the best of our knowledge, the first—systematic multi-country analysis of the relationship between the share of elderly household members and financial protection within countries, including an investigation of wealth gradients in the excess financial risk faced by households with a high elderly share. The analytical sample for this analysis includes over 9.6 million household-level observations from 519 surveys collected over the 1991–2018 period in 133 countries representing 89% of the world population.

**Materials and Methods**

**Measuring Financial Protection and Aging**

Our analysis uses six outcome measures to capture the different aspects of financial protection in health. They are described in detail by Wagstaff, Eozenou and Smitz.\(^{13}\) The first measure is the proportion of the population incurring any OOPEs, referred to as positive OOPEs below. The second is the mean share of OOPEs over the total household budget, or OOPE budget share, where the household budget is typically measured by total expenditures. We, moreover, use two indicators of catastrophic OOPEs—the share of households with an OOPEs budget share exceeding 10% and 25%\(^4\)—and two indicators of impoverishing OOPEs, the proportion of the population pushed below the poverty lines of 1.90 and 3.20\(^2\) international dollars\(^2\) per capita/day because of OOPEs.

Ideally, we would analyze the effects of aging and financial protection using individual level data on total expenditures and OOPEs. However, as household surveys typically collect expenditure data at the household level and not the individual level, our unit of analysis is the household. Hence, we need to derive a household level measure of aging. To this end, we define a household’s Old-Age Dependency Ratio (OADR) as the number of household members aged over 60, considered old-age dependent, divided by the number of household members of working age, which we define as age 18 to 60:

\[
\text{OADR} = \frac{\# \text{ hh members > 60 years old}}{\# \text{ hh members aged } [18 - 60] \text{ years old}}
\] (1)

The age-60 cutoff follows a standard United Nation’s definition of the elderly.\(^{49}\) We group households into three OADR categories (Figure 1): (1) zero OADR: households without old-age dependents (OADR = 0); (2) low OADR: households with two or more working age members per old-age dependent member (0 < OADR ≤ 0.5); and (3) high OADR: households with less than two working age members per one old-age dependent member (OADR > 0.5).

A limitation of OADRs defined based on chronological age such the one we introduce above ignore that health states and productive potential at a given age vary across time and countries, and between men and women.\(^{50}\) Therefore, in a set of appendix tables, we also provide results for an alternative OADR—the

![Figure 1. Old-age dependency ratio (OADR) definition.](image)
Prospective Old-Age Dependency Ratio (POADR), which takes these sources of heterogeneity into account by relying not on chronological age but remaining life expectancy (RLE) to identify old-age dependents. The POADR is defined as the number of household members with an RLE of less than 15 years, divided by the number of household members 18 or older with an RLE of 15 years or more.

\[
POADR = \frac{\# \text{ hh members with RLE} < 15 \text{ years}}{\# \text{ hh members aged 18 or older with RLE} \geq 15 \text{ years}}
\]

(2)

The country, time, and sex-specific RLE data we use to construct the POADR come from the United Nation’s World Population Prospects 2019 life tables. POADR typically use 15 years of RLE as a cutoff to define old-age dependents because the statistical uncertainty around life table estimates for many countries increases in older cohorts. As a result, shorter RLE thresholds such as 10 years are more prone to measurement error.

We use the same cutoffs to categorize households into zero POADR (POADR = 0), low POADR (0 < POADR ≤ 0.5), and high POADR (OADR > 0.5) categories as for the OADR.

**Between-Country Analysis**

Following the two earlier studies of determinants of OOPES across countries, we use fixed effects panel data models to estimate the association of a rising population share of the elderly with indicators of financial protection. Specifically, using an unbalanced panel of 407 country-year observations, we estimate

\[
y_{it} = \alpha + \beta_{OADR} \cdot OADR_{it}^{high} + \nu_i + \beta' x_{it} + e_{it}
\]

(3)

\(y_{it}\) is the respective financial protection indicator of country \(i\) in year \(t\), \(\alpha\) a constant, \(OADR_{it}^{high}\) the share of a country’s households in the high OADR category as defined above and \(\beta_{OADR}\) its regression coefficient, \(\nu_i\) a time-invariant country fixed effect, and \(x_{it}\) and \(\beta'\) vectors of covariates and corresponding coefficients representing GDP per capita, total health expenditure as a percentage of GDP, and the current health expenditure shares of five types of health financing, namely government-financed programs, social health insurance, compulsory private insurance, voluntary health insurance, and nonprofit schemes. \(e_{it}\) is a random error term assumed to be normally distributed. We estimate impacts on five financial protection indicators, namely household’s mean OOPE budget share, the rate of catastrophic spending at 10 and 25% and impoverishment at the 1.90 USD and 3.20 USD international dollar poverty lines. Sample means for all financial protection indicators are shown in the rightmost column of Table 3. The coefficient of interest is \(\beta_{OADR}\) which represents the effect of a one percentage point increase in the share of households in the high OADR category on the respective financial protection indicator.

Our country-level dataset was derived from 410 nationally representative household surveys from 118 countries for which we were able to compute our financial protection indicators and population shares in the OADR categories. The surveys span the 2000–2015 period, and the sampled countries represent 86% of the current world population (Table 1). The financial protection datapoints are publicly available from the Health Equity and Financial Protection Indicators (HEFPI) database.

Data on all other variables in model (2) come from the World Health Organization’s Global Health Expenditure Database (GHED).

**Within-Country Analysis**

For our within-country analysis we use micro-data from 517 household surveys collected between 1991 and 2018, which include the 407 surveys in our between-country analysis. The 517 surveys, of which half were conducted after 2007, are from 133 countries which together represent 89% of the current world population (Table 2). The surveys cover more than 80% of the population in all world regions, except for Middle East and North Africa (68%) and Latin America and the Caribbean (72%). Moreover, they represent over 90% of the populations of low- and middle-income countries, and 61% of high-income country populations. Altogether, the pooled micro-data contain over 9.6 million household level observations, which corresponds to 36.8 million individuals.

| Table 1. Sample description for between-country analysis. |
|-----------------------------------------------|
| # observations/ | # countries | % population |
| surveys            |            |              |
| Total             | 410        | 118          | 86%        |
| East Asia and Pacific | 37        | 11           | 87%        |
| Europe and Central | 235       | 37           | 77%        |
| Asia              |            |              |            |
| Latin America and Caribbean | 35 | 18 | 69% |
| Middle East and North Africa | 8 | 6 | 63% |
| South Asia         | 20         | 7            | 99%        |
| Sub-Saharan Africa | 73         | 38           | 90%        |
| North America      | 2          | 1            | 90%        |
| Low-income         | 47         | 22           | 88%        |
| Lower middle-income | 115    | 37           | 94%        |
| Upper middle-income | 168    | 32           | 91%        |
| High-income        | 80         | 27           | 53%        |
Our within-country analysis of aging and financial protection has two parts. The first, descriptive part compares average financial protection outcomes between households in the three OADR categories. As OOPEs tend to be a regressive source of health financing, especially in middle- and high-income countries, and even more so among elderly households, this analysis includes a view of the degree to which regressivity in OOPEs varies by OADR. We measure regressivity using the Kakwani index which is computed using the concentration index (CI) of OOPEs and the Gini coefficient of total consumption. The CI measures socioeconomic inequalities in the distribution of OOPEs and is graphically represented by the area between the concentration curve of OOPEs and the line of equality in a space where cumulative OOPEs are plotted against the cumulative population distribution ranked according to a living standards measure. Its values range from −1 and 1, where a negative CI indicate concentration of OOPEs among the worse-off, 0 perfect equality in OOPEs, and a positive CI concentration of OOPEs among the better-off. Empirical studies using consumption as a living standard measure typically find a positive CI for OOPEs. The concentration curve for the distribution of total consumption is the Lorenz curve, and its CI is the Gini coefficient which measures the degree of inequalities in total consumption. The Kakwani index (K) is computed by subtracting the Gini coefficient (G) from the CI of OOPEs: $K_C^{OOPE} = CI^{OOPE} - G^C$, $K_C^{OOPE} \in [1; -2]$. When $K_C^{OOPE}$ is negative, OOPEs are regressive ($CI^{OOPE} < G^C$) and the smaller $K_C^{OOPE}$, the more regressive are OOPEs, i.e. the poor are paying a larger share of total OOPEs compared to their share in total consumption. Conversely, $K_C^{OOPE} > 0$ denotes progressive OOPEs, as the better-off are using a larger share of their consumption for OOPEs than the poor.

The second part of our within-country analysis employs a regression model to assess the extent to which financial protection systematically varies, within countries, between older and younger households, and

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**Table 2. Sample description for within-country analysis.**

|                | # surveys | # countries | % population | # households/observations | # individuals |
|----------------|-----------|-------------|--------------|---------------------------|---------------|
| East Asia and Pacific | 41        | 11          | 87%          | 3,735,411                 | 36,729,233    |
| Europe and Central Asia | 286      | 40          | 85%          | 3,282,598                 | 10,015,128    |
| Latin America and Caribbean | 45      | 22          | 72%          | 597,729                   | 2,343,880     |
| Middle East and North Africa | 19      | 8           | 68%          | 203,982                   | 1,164,713     |
| South Asia | 26        | 8           | 100%         | 413,035                   | 2,269,043     |
| Sub-Saharan Africa | 93        | 42          | 97%          | 905,063                   | 4,692,725     |
| North America | 7         | 1           | 90%          | 475,373                   | 1,298,929     |
| Low | 125       | 54          | 92%          | 1,533,585                 | 7,652,548     |
| Lower middle | 203       | 62          | 98%          | 5,143,149                 | 20,124,708    |
| Upper middle | 144       | 36          | 91%          | 1,986,285                 | 6,466,914     |
| High | 45        | 26          | 61%          | 930,172                   | 2,545,063     |

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**Table 3. Association of country share of households in high old-age dependency category with indicators of financial protection.**

|                        | (1)  | (2)  | (3)  | (4)  | (5)  | N   | Mean (%) |
|------------------------|------|------|------|------|------|-----|----------|
| OOPE budget share      | 0.250| 0.897| 0.924| 0.902| 0.940| 410 | 4.941    |
| p-value                | (.111)| (.315)| (.325)| (.331)| (.329)|     |
| Catastrophic OOPE (10%)| 0.189**| 0.023| -0.027| -0.064| -0.065| 410 | 8.422    |
| p-value                | (.023)| (.807)| (.786)| (.518)| (.463)|     |
| Catastrophic OOPE (25%)| 0.034| -0.034| -0.041| -0.048**| -0.045**| 410 | 1.699    |
| p-value                | (.188)| (.162)| (.159)| (.099)| (.089)|     |
| Impoverishing OOPE (1.905) | -0.040**| -0.020**| -0.013| -0.008| -0.005| 410 | 0.708    |
| p-value                | (.044)| (.038)| (.167)| (.429)| (.572)|     |
| Impoverishing OOPE (3.205) | -0.016| -0.003| 0.009| 0.008| 0.013| 380 | 1.078    |
| p-value                | (.566)| (.875)| (.675)| (.681)| (.466)|     |
| Country fixed effects  | x    | x    | x    | x    | x    |     |
| GDP per capita (2011 Intl. $) | x    | x    | x    | x    | x    |     |
| Total health expenditure (% of GDP) | x    | x    | x    | x    | x    |     |
| Health financing mix   | x    | x    | x    | x    | x    |     |

Coefficients are the percentage point association of a one percentage point increase in countries’ share of households in the high old-age dependency category with the respective financial protection outcome, sample means of which are reported in the rightmost column. p-values based on country-level clustered standard errors shown in parentheses. *p < 0.10, **p < 0.01. OOPE = Out-of-pocket health expenditures. N = number of observations. Health financing mix variables are the shares of the following in current health expenditure: government financed schemes, social health insurance, compulsory private insurance, voluntary health insurance, and nonprofit schemes.
what role household socioeconomic status plays in this relationship. For this analysis, we pool the micro-data from all 517 surveys and estimate the following regression using ordinary least squares (OLS):

\[
Y_{cht} = \alpha + \delta Year_t + \sum_{a=2}^{3} \rho_a^{OADR} OADR_{chta} + \sum_{q=2}^{5} \beta_q^{QUINT} QUINT_{chtq} + \sum_{a=2}^{3} \sum_{q=2}^{5} \gamma_{aq}^{OADR} OADR_{chta} QUINT_{chtq} + \sum_{c=1}^{132} \mu_c + \varepsilon_{cht}
\]

(4)

In (3), the dependent variable \(Y_{cht}\) is measured for country \(c\), household \(h\), and year \(t\), with \(Y_{cht} = \{1/0\}\) indicator of household having any OOPEs; OOPes household budget share; 1/0 indicator on catastrophic payments at 10% threshold; 1/0 indicator on catastrophic payments at 25% threshold; 1/0 indicator on impoverishing payments at 1.90 USD poverty line; 1/0 indicator on impoverishing payments at 3.20 USD poverty line), \(\delta\) is a linear trend over the included survey years, \(\sum_{c=1}^{132} \mu_c\) are time-invariant country fixed-effects (133 countries), and \(\varepsilon_{cht}\) is a normally distributed random error term. The effect of household age on our dependent variables is introduced directly through \(\sum_{a=2}^{3} \rho_a^{OADR} OADR_{chta}\) and through an interaction term with household quintile categories \(\sum_{a=2}^{3} \sum_{q=2}^{5} \gamma_{aq}^{OADR} OADR_{chta} QUINT_{chtq}\) to capture the varying effect of household age depending on socio-economic status. Finally, household socioeconomic status is also controlled for directly with \(\sum_{q=2}^{5} \beta_q^{QUINT} * QUINT_{chtq}\).

**Results**

**Between-Country Analysis**

Table 4 presents an overview of key household characteristics by OADR category for our full sample and broken down by world region and country income groups. Almost 70% of the households in our sample have no members older than 60 (zero OADR category). The share of households with less than two working age members per elderly dependent (high OADR) increases with aggregate income from 15% in low-income countries to 27% in high-income countries.

Average household size is largest in the low OADR category, where it amounts to 7.3, followed by the zero OADR category with an average of five household members. It is smallest in the high OADR category, at 4.2 members. This general pattern holds across all world regions and income groups, but there are important differences in levels, as households are on average much larger in low-income countries than in middle- and high-income countries. We can see similar patterns for household average age.

Finally, we observe similar rates of poverty between zero and high OADR households, which tend to lie somewhat below those in the low OADR category. On average, about 22% of high and 23% of zero OADR households are classified as poor, compared to almost 27% in the low OADR category. This pattern holds
Table 4. Basic sample characteristics (within-country analysis).

|                        | Average age | Average age dependency | Proportion of households |
|------------------------|-------------|------------------------|--------------------------|
|                        | Zero        | Low                     | High                     | Zero       | Low                     | High                     |
|                        | dependency  | dependency              | dependency               | dependency | dependency              | dependency               |
| East Asia and Pacific  | 25.7        | 34.6                    | 43.1                     | 0.00       | 0.28                    | 0.83                     | 76%                     | 8%                      | 16%                     |
| European and Central   | 29.8        | 38.0                    | 53.2                     | 0.00       | 0.30                    | 0.92                     | 65%                     | 7%                      | 27%                     |
| Latin America and      | 24.6        | 34.0                    | 46.4                     | 0.00       | 0.28                    | 0.92                     | 73%                     | 8%                      | 19%                     |
| Caribbean              | 22.2        | 30.9                    | 40.0                     | 0.00       | 0.24                    | 0.90                     | 77%                     | 13%                     | 10%                     |
| Middle East and North  | 22.2        | 30.5                    | 39.7                     | 0.00       | 0.26                    | 0.75                     | 70%                     | 15%                     | 15%                     |
| Africa                 | 20.5        | 27.5                    | 34.5                     | 0.00       | 0.25                    | 0.84                     | 75%                     | 13%                     | 12%                     |
| North America          | 29.7        | 39.1                    | 51.7                     | 0.00       | 0.30                    | 1.04                     | 72%                     | 2%                      | 26%                     |
| Low income             | 22.1        | 29.2                    | 36.9                     | 0.00       | 0.26                    | 0.81                     | 73%                     | 12%                     | 15%                     |
| Lower middle income    | 26.7        | 35.9                    | 46.3                     | 0.00       | 0.28                    | 0.88                     | 68%                     | 10%                     | 22%                     |
| Upper middle income    | 29.5        | 38.0                    | 53.4                     | 0.00       | 0.29                    | 0.92                     | 68%                     | 7%                      | 26%                     |
| High income            | 30.6        | 40.2                    | 59.8                     | 0.00       | 0.30                    | 1.01                     | 69%                     | 3%                      | 27%                     |

Table 5. Descriptive statistics (within-country analysis).

Population weighted means (519 household surveys).

Descriptive Analysis

We now turn to OOPE patterns among households in the different OADR categories. Table 5 presents the mean rates of the financial protection indicators in our three OADR categories for our full sample, and by geographic region and income group. Figures 2–7 show the ratio of exposure to OOPE risk between the high OADR category and the zero OADR category for all countries in our sample, where the ratios indicate the factor by which...
which exposure of high OADR households is higher (values > 1) or lower (values < 1) than among zero OADR households.

Overall, over 70% of households in our dataset report positive OOPEs, and this share tends to be higher among low and high OADR households compared to zero OADR households. The percentage of households with positive OOPEs also increases with aggregate income levels in all age categories. Rather than indicating better health coverage, the lower rates of positive OOPEs in low-income countries are, however, more likely suggestive of financial barriers to using health services, which, if prohibitively high, cause households to forgo care altogether.

While the share of household with positive OOPEs is similar between low OADR and high OADR households, we see that the OOPE budget share increases significantly in household age. It amounts to 4.5% among high OADR households on average, compared to less than 3% for zero OADR households. This pattern of an increasing OOPE budget share with household age holds across all country income groups and world regions except Africa where OOPE budget shares are similar in the low and high OADR categories. On
average, the OOPE budget share among elderly households is highest in middle-income countries and in the Europe and Central Asia, Latin America and Caribbean and Middle East and North Africa regions.

The last three columns in the upper part of Table 5 show the average value of the Kakwani index for the different household age categories. OOPEs represent a regressive source of financing for health across all country income groups and all world regions except East Asia and the Pacific where they are slightly progressive. On average, rates of regressiveness are similar across the different OADR categories, but there are important regional differences: High OADR households are the group with the least regressive OOPEs in low-income countries and in the Middle East and North Africa, South Asia, and Africa regions, whereas they
are the group with the most regressive OOPEs in upper middle- and high-income countries and Europe and Central Asia and North America.

We also examine differences across age groups in financial protection by comparing the incidence of catastrophic OOPEs at the 10% (Figure 4) and 25% thresholds and impoverishing payments at the extreme poverty line with is set at 1.90 USD per capita/day for low-income countries, at 3.20 USD for lower middle-income countries, and at 5.50 USD for upper middle- and high-income countries.

The prevalence of catastrophic OOPEs increases strongly with household age. On average, 13% (3%) of households in the high OADR category report OOPEs of more than 10% (25%) of household budgets, more than twice the rate at which catastrophic payments are experienced in the zero OADR category. The highest rates and the largest age-gradients of catastrophic spending are found in the Europe and Central Asia, Latin America and Caribbean, and Middle East and North Africa regions, and in upper middle- and high-income countries. South Asia and Africa, by contrast, show a lower prevalence and less pronounced increases of catastrophic spending with household age.

Rates of medical impoverishment are, on average, similar for high and low OADR households and lowest for zero OADR households. This pattern holds across all country-income groups and world regions except...
Middle East and North Africa where the highest rates of impoverishment are found among low OADR households.

All results in this section are robust to using the POADR instead of the OADR to define old-age dependency (Supplementary Table S3).

Regression Analysis
While the previous descriptive analysis gave us preliminary insights to the patterns of aging and financial protection, we now turn to our regression analysis to see if these patterns hold when controlling for socio-economic status, time trends, and country fixed effects. In Table 6, we report the predicted values and marginal effects \( \frac{dY}{dX} \) for our six financial protection indicators over each OADR category, each expenditure quintile, and the interaction of the OADR categories with the first and fifth expenditure quintiles.

With a sample of over 9.6 million observations, all reported results in Table 6 are statistically significant at the 1% level. Households with more elderly members are significantly more exposed to financial risk due to OOPEs. High OADR households are on average more likely (+9.4 percentage points) to spend 10% or more of their budget on OOPEs compared to low OADR households, and also more likely (+2.4 percentage points) to incur OOPEs above the 25% catastrophic threshold. Impoverishment due to OOPEs is more likely among elderly households compared to younger households as well.

While richer households are on average less likely than poorer households to be exposed to financial risk due to OOPEs, the age gradient in financial protection is statistically significant across all expenditure quintiles, and it is wider within the poorest quintile (Table 6 and Figure 8). High OADR households in quintile 1 on average have an almost 11 percentage points higher chance to spend over 10% of their budget on OOPEs and a 4.3 percentage points higher chance to spend over 25% compared to low OADR households. The same age difference among households in quintile 5 is about +7.2 percentage points for catastrophic payments at 10% and +0.1 percentage points for catastrophic payments at 25%. A similar pattern holds for impoverishment, where age differences are mostly noticeable within the poorest, quintile 1 households.

The regression results we present above are obtained without weighing our household observations, but they are qualitatively robust to the application of survey-specific sample weights, weights which reflect each country’s share of the world population, and weights which assign equal weight to each country (Supplementary Tables S4-S6). Moreover, the results are qualitatively similar when we use the POADR instead of the OADR to identify households with high old-age dependency ratios (supplementary Table S7).

Discussion
In line with the existing literature on the impacts of population aging on levels of OOPEs, our between-country analysis does not detect systematic differences in the effect of aging on average financial protection. This finding may reflect improvements over time in age-standardized health status, or healthy aging—a phenomenon documented across countries of all income groups\(^\text{42}\) under which average population health, healthcare needs and, therefore, financial risk from OOPEs may remain constant. A less optimistic, alternative explanation would be that average population health does deteriorate under aging, but that increases in forgone care due to financial reasons leave OOPE indicators unchanged.\(^\text{34,56}\) The similarity of results between our chronological age and our RLE-based OADR estimates, however, suggests that even when healthy aging is accounted for, the role of population aging for countries’ average financial protection outcomes remains small.

The picture is radically different when we focus on differences in financial protection between younger and older households within countries. Here, we find that households with more elderly dependent members are more likely to face catastrophic and impoverishing payments for health compared to younger households, and that this household age gradient is stronger for the poorest segments of the population—a finding that has important policy implications for targeting of vulnerable population segments facing high financial risk due to OOPEs.

A limitation of our analysis is that it is largely descriptive: While we control for some correlates of financial protection and the share of elderly household members in our between- and within-country regression models, we cannot rule out that unobserved covariates drive our results. For instance, bias would arise if survey responses on who belongs to the core household within which resources are shared varied not only between countries—the country fixed effects in our models would adjust for this—but also within countries across surveys collected at different points in time. A further limitation relates to our use of consumption as the denominator of our financial protection variables. While consumption-based indicators are standard in the literature, and appealing because of their broad availability, alternative welfare measures like income and wealth may yield different results, as access to them typically varies with age. For example, consumption-based OOPE risk
Table 6. Pooled sample OLS results.

| Share spending OOP (%) | Marginal effects | OOP budget share (%) | Marginal effects | Catastrophic payments at 10% | Marginal effects | Catastrophic payments at 25% | Marginal effects | Impoverishing payments at $1.9 | Marginal effects | Impoverishing payments at $3.2 | Marginal effects |
|------------------------|------------------|----------------------|------------------|-----------------------------|------------------|-----------------------------|------------------|--------------------------------|------------------|--------------------------------|------------------|
| Predicted $E(Y|X = \hat{X})$ | $dY/dX$ | Predicted $E(Y|X = \hat{X})$ | $dY/dX$ | Predicted $E(Y|X = \hat{X})$ | $dY/dX$ | Predicted $E(Y|X = \hat{X})$ | $dY/dX$ | Predicted $E(Y|X = \hat{X})$ | $dY/dX$ | Predicted $E(Y|X = \hat{X})$ | $dY/dX$ |
| Zero OADR | 77.0 | 4.3 | 5.0 | 0.9 | 0.5 | 0.9 | 2.8 | 77.0 |
| (se) | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| Low OADR | 83.7 | 6.7 | 3.1 | 0.8 | 7.4 | 2.4 | 1.3 | 0.4 | 0.6 | 0.1 | 1.1 | 0.2 |
| (se) | 0.04 | 0.04 | 0.01 | 0.01 | 0.03 | 0.03 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| High OADR | 81.8 | 4.8 | 4.7 | 2.4 | 14.4 | 9.4 | 3.2 | 2.3 | 0.8 | 0.2 | 1.3 | 0.5 |
| (se) | 0.03 | 0.03 | 0.01 | 0.02 | 0.03 | 0.03 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| Poorest (Q1) | 72.9 | 3.1 | 7.8 | 2.2 | 1.8 | 7.8 |
| (se) | 0.03 | 0.04 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| Q2 | 77.9 | 5.0 | 2.9 | 0.2 | 7.1 | 0.7 | 1.4 | 0.8 | 1.1 | 0.7 | 1.5 | 0.1 |
| (se) | 0.03 | 0.04 | 0.00 | 0.04 | 0.02 | 0.03 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| Q3 | 79.6 | 6.7 | 2.8 | 0.2 | 7.0 | 0.8 | 1.2 | 1.0 | 0.4 | 1.4 | 1.1 | 0.3 |
| (se) | 0.03 | 0.04 | 0.00 | 0.04 | 0.02 | 0.03 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| Q4 | 80.5 | 7.6 | 2.8 | 0.3 | 6.9 | 1.0 | 1.1 | 1.0 | 0.1 | 1.6 | 1.2 | 0.2 |
| (se) | 0.03 | 0.04 | 0.00 | 0.04 | 0.02 | 0.03 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| Richest (Q5) | 80.4 | 7.5 | 2.7 | 0.3 | 6.6 | 1.2 | 1.2 | 1.0 | 0.0 | 1.8 | 0.1 | 1.3 |
| (se) | 0.02 | 0.04 | 0.00 | 0.04 | 0.02 | 0.03 | 0.01 | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 |
| Zero OADR*Q1 | 71.5 | 2.4 | 5.6 | 1.4 | 1.5 | 1.0 | 1.5 |
| (se) | 0.04 | 0.06 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| Low OADR*Q1 | 78.7 | 7.2 | 3.2 | 0.8 | 7.7 | 2.1 | 1.7 | 0.4 | 2.0 | 0.6 | 1.2 | 0.2 |
| (se) | 0.08 | 0.09 | 0.01 | 0.05 | 0.05 | 0.06 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| High OADR*Q1 | 75.1 | 3.7 | 5.6 | 3.1 | 16.3 | 10.7 | 5.6 | 4.3 | 2.7 | 1.2 | 2.8 | 1.9 |
| (se) | 0.08 | 0.09 | 0.02 | 0.07 | 0.07 | 0.07 | 0.05 | 0.05 | 0.03 | 0.03 | 0.03 | 0.03 |
| Zero OADR*Q5 | 78.4 | 2.3 | 4.9 | 0.0 | 0.0 | 0.0 | 0.1 |
| (se) | 0.03 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| Low OADR*Q5 | 86.1 | 7.7 | 3.3 | 1.0 | 8.2 | 3.2 | 0.7 | 0.2 | 0.2 | 0.1 | 0.1 | 0.2 |
| (se) | 0.08 | 0.09 | 0.02 | 0.07 | 0.07 | 0.07 | 0.03 | 0.03 | 0.01 | 0.01 | 0.01 | 0.01 |
| High OADR*Q5 | 84.9 | 6.5 | 4.2 | 1.9 | 12.1 | 7.2 | 1.3 | 0.1 | 0.1 | 0.2 | 0.2 | 0.1 |
| (se) | 0.05 | 0.06 | 0.01 | 0.01 | 0.05 | 0.05 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 |

F-Stat | 6566.2 | 11,803.4 | 3936.4 | 2474.5 | 3573.8 | 4371.1 |
P-value | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

N = over 9.6 million observations from 519 household surveys. OLS regression results all include country fixed effects and use heteroscedasticity-consistent robust standard errors.
measures overestimate financial risk for households where incomes exceed consumption—a likely outcome for households with a large share of working age members. Conversely, households with more assets have additional mechanisms for coping high OOPEs at their disposal—an effect favoring older households if age is positively related to asset accrual. Unfortunately, because data on income and wealth are far less available than data on consumption, we are unable to test these hypotheses.

**Conclusions**

The gradual aging of populations will likely play a minor role for the population level dynamics of OOPEs compared to income growth, medical innovation, and price inflation in the health sector. 45,57–64 If health coverage schemes are absent or insufficiently funded—as is the case in most low- and middle-income countries—these factors will, however, further exacerbate the excess exposure to financial hardship and forgone care of the elderly with their heightened need for complex and continuous care. Making progress toward UHC will therefore require extension and greater targeting of benefit packages and financial protection to the health needs of older adults, in particular those living in poverty. It will also require a strong emphasis on health promotion and disease prevention at all ages to slow the rise in non-communicable diseases (NCDs)—cardiovascular disease, cancer, and neurological and musculoskeletal conditions—effective coverage of which strains both health system and fiscal capacity. For example, covering 80% of populations with an essential UHC package which includes NCD interventions is estimated to require a quadrupling of health spending in low-income countries and a more than tripling in lower middle-income countries, to 6% and 10% of gross national incomes, respectively—spending shares akin to those in high-income countries. 65 Most of this spending will be funded and executed by the public sector. 66 Therefore, while economic growth will continue to make more resources for health available in the developing world, achieving UHC for the elderly and beyond will require a continued commitment of governments to

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*Figure 8. Predictive margins for catastrophic and impoverishing OOPE (pooled OLS), by wealth quintile. OADR = Old-age dependency ratio. CI = 95% Confidence interval.*
health as a public spending priority and to reforms which enhance the efficiency of revenue collection and health-care purchasing.

Notes

1. The 10 and 25% catastrophic spending indicators are those adopted for the tracking of Sustainable Development Goal (SDG) of Universal Health Coverage.47
2. These two absolute poverty lines are those used for the SDG of poverty eradication.48
3. Expressed in purchasing power parity (PPP) adjusted 2011 US$.
4. Our within-country analysis includes 110 more surveys than our between-country analysis because the health-care spending share of GDP and health financing mix control variables in our between-country model are only available for the subset of 407 surveys collected in the 2000–2015 period.

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Disclosure Of Potential Conflicts Of Interest

No potential conflict of interest was reported by the authors.

Data Availability Statement

The data used for our between-country panel analysis are provided in data supplement 1 (to be added). Data are available from the authors upon request.

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