BMJ Global Health

Can higher spending on primary healthcare mitigate the impact of ageing and non-communicable diseases on health expenditure?

Xiaohui Hou ,[1] Lingrui Liu ,[2,3] Jewelwayne Cain [4]

¹Health, Nutrition and Population Global Practice, World Bank Group, Washington, District of Columbia, USA
²Department of Health Policy and Management, Yale School of Public Health, New Haven, Connecticut, USA
³Center for Methods in Implementation and Prevention Science, Yale School of Public Health, New Haven, CT, USA
⁴Health Nutrition and Population Global Practice, World Bank Group, Washington, District of Columbia, USA

Correspondence to
Dr Xiaohui Hou;
xhou@worldbank.org

ABSTRACT

Introduction Financing healthcare for ageing populations has become an increasingly urgent policy concern. Primary healthcare (PHC) has been viewed as the cornerstone of health systems. While most research has examined the effects of PHC on population health, there is still a relative paucity of analysis on the effects of PHC on health expenditures, particularly, in low-income and middle-income countries. Knowledge on PHC's potential role in mitigating the impact of ageing and non-communicable diseases (NCDs) on health expenditure remains limited.

Methods Using publicly accessible secondary data at country level, this paper examines the impact of ageing and the NCD burden on health expenditures. Regression with the interaction terms is used to explore whether greater expenditures on PHC can mitigate the growing fiscal pressure from ageing and the NCD burden.

Results The empirical evidence shows that a higher share of PHC spending is correlated with lower per capita non-PHC spending, after controlling for population aged 60 and over and NCD burden, and gross domestic product per capita. However, the mitigating effects of PHC spending to reduce non-PHC expenditure caused by ageing and NCDs are not significant.

Conclusions The findings suggest that more PHC spending can potentially lower total health expenditure. However, higher primary health spending cannot fulfil that potential without scrupulous attention to the way it is delivered. More spending on PHC, together with changes in PHC service delivery, highlighting its coordination and referring roles, will put nations on a pathway to achieving universal health coverage more sustainably.

WHAT IS ALREADY KNOWN ON THIS TOPIC
⇒ The unprecedented ageing of the global population.
⇒ The growing non-communicable disease (NCD) burden.
⇒ The increasing financing needs in health consequent on the above.
⇒ The need to allocate health resources more efficiently.

WHAT THIS STUDY ADDS
⇒ This study entails analysis on four rounds of cross-country data, including low-income and middle-income countries.
⇒ A higher proportion of older adults and a greater NCD burden are correlated with higher non-primary healthcare (PHC) expenditure.
⇒ A greater share of primary health spending is correlated with lower non-PHC expenditure.
⇒ The mitigating effects of PHC spending are contingent on the data and model specifications.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY
⇒ To meet the needs of older populations while controlling costs, health systems must harness the potential of PHC.
⇒ Data must be improved to better measure PHC expenditures and the roles of PHC in the health system, particularly in low-income and middle-income countries.

INTRODUCTION

Recent data highlight the unprecedented ageing of the global population.[1 2] The proportion of the global population aged 60 and over is expected to nearly double from 12% in 2015 to 22% in 2050.[3] These trends concern every global region and almost every country. Approximately 80% of that population segment will live in low and middle-income countries (LMICs) by 2050, with the population aged 80 and over expected to triple to 426 million between 2020 and 2050.[3]

Patterns of mortality and morbidity are also changing, as LMICs increasingly face a double burden of disease, including high rates of both infectious and non-communicable diseases (NCDs) and other chronic conditions. These trends spell a daunting challenge for the health and social care systems tasked with meeting care needs among ageing populations.[4] Population ageing results in modest increases in expenditure on acute care but substantial increases

in long-term care expenditures.[5][6] Medical care for older adults often requires expensive technologies and periods of hospitalisation.[5]

Health spending was rising steadily in most countries even before COVID-19, with population ageing a major driver of the trend. In the wake of the pandemic's health and economic 'double shock', subsequent inflation and ongoing instability in the global economy,[7–9] financing healthcare for ageing populations has become an increasingly urgent policy concern for countries at all income levels. Because resources are always finite and often severely limited, their efficient allocation within the healthcare sector is imperative.

In an era of global ageing, the need for care coordination will increase. Primary healthcare (PHC), as the first level of medical services, can serve as a lynchpin in the coordination and integration of care for multiple morbidities while providing person-centred care. PHC can provide proactive preventive care and interventions to manage the burden of NCDs and other chronic illnesses associated with ageing.[10][11] As the first point of contact for patients, PHC has a critical role in early diagnosis, referral and postspecialist or posthospitalisation care. Strong PHC can reduce the costs of inpatient and specialist care.[12][13]

The importance of strengthening PHC systems has been widely researched.[13][14] Its demonstrated benefits include better quality of care, greater access to basic health services, a better patient experience, better population health outcomes and a lower overall burden of disease (revealed, eg, by lower mortality and premature mortality).[10][12][15–17] While most research has examined the effects of PHC on population health and health systems, there is still a relative paucity of data on the effects of PHC on health expenditures, particularly in LMICs.

Acknowledging the scarcity of causal evidence, a few observational studies using cross-sectional data from industrialised countries have found mixed effects of PHC on the level or growth of total healthcare spending.[18–22] Analysing cross-sectional data in 2009–2010 from the Primary Healthcare Activity Monitor for Europe programme, Kringos and colleagues[18] confirmed the positive effects of PHC on population health, unnecessary hospitalisation rates and socioeconomic inequality. Their study also revealed that nations with stronger PHC systems had higher total healthcare expenditures, possibly because sustaining strong PHC institutions was costly and supported innovations such as the decentralisation of service delivery. Nonetheless, comprehensive PHC was associated with lower growth in healthcare spending.[23] For example, in the USA, observational studies identified correlations between lower levels of spending and greater PHC capacity, higher PHC doctor density or higher degrees of PHC orientation (primary care as a health system's orientation).[20][21][23][24] Policymakers, hence, increasingly consider raising PHC spending to improve population health and decrease overall spending, under the premise that spending an extra dollar on PHC can

result in savings of more than one dollar, because people would be healthier, and their demand for specialty, emergency and hospital care would be reduced.[19][23][25][26] Analyses of aggregated data from member countries of the Organization for Economic Co-operation and Development (OECD) find gatekeeping is associated with lower utilisation of health services and lower expenditures.[22][26] However, such empirital analysis in LMICs is very limited.

This study, using the country as the observational unit and 4 years of the latest available data, examines the impact of ageing and NCD burdens on healthcare expenditures and whether greater expenditures on PHC can mitigate this impact. This study can contribute to the literature in three major ways. First, this study is one of the few cross-country time series analyses in this aspect, including non-OECD countries, particularly LMICs. Second, NCD burden and population aged 60 and over are used as explanatory variables to quantify the effects of such demographic and epidemiological trends on health expenditures. Third, the interactions between PHC spending share and population aged 60 and over, and between PHC spending share and the NCD burden, are used to explore whether greater expenditures on PHC can mitigate the growing fiscal pressure from ageing and the NCD burden.

METHODS

Since Newhouse published his seminal study in 1977,[27] studies that analyse determinants of aggregate health expenditures have included institutional features of healthcare systems that may influence the growth of healthcare expenditures among their explanatory variables.[28–30] Most of these studies have focused on features of institutional systems that help contain healthcare costs. One institutional feature included in the studies by Gerdtham and colleagues[28] and Barros[31] is the existence of primary care physicians (or general practitioners) as gatekeepers of the system, a binary variable describing the role of primary care physicians or general practitioners in authorising access to more specialised healthcare.[12][32] In this study, we use a continuous variable, PHC expenditures as a share of total health spending, to capture a country's financing investment in PHC.

Statistical modeling

The basic statistical model specification is as follows:

$$
\begin{aligned}
ln\left(nonPHCexp_{c,y}\right) &= \beta_0 + \beta_1 \frac{PHCexp}{THCexp}_{c,y} + \beta_2 POP60_{c,y} \\
&+ \beta_3 \frac{PHCexp}{THCexp}_{c,y} * POP60_{c,y} \\
&+ \beta_4 NCD60_{c,y} + \beta_5 \frac{PHCexp}{THCexp}_{c,y} \\
&* NCD60_{c,y} + \beta_6 GDP_{c,y} + \mu_{c,y}
\end{aligned}
$$

where the dependent variable is per capita non-PHC expenditures (total health expenditures minus PHC expenditures) in country c in year y; the variable was log-transformed to reduce the skewness of our original data. The independent variable includes PHC expenditures

as a percentage of total healthcare expenditures, $\frac{PHCexp}{THCexp}$, measuring the share of expenditures in PHC; percentage of population aged 60 and over, $POP60_{c,y}$ and the NCD burden in the population aged 60 and over, $NCD60_{c,y}$, which is measured as a percentage of total disease burden in the population aged 60 and over. It was hypothesised that *POP60* and *NCD60* would increase per capita non-PHC expenditures and that investment in PHC can mitigate such impacts. Hence, we introduced two interaction terms to measure the impacts of investment in PHC to mitigate the positive impacts of ageing (β_3) and the NCD burden (β_5). $GDP_{c,y}$ measures gross domestic product per capita for country c in year y.

Model fitting techniques such as the Breusch-Pagan Lagrange multiplier test, the F-test and the Hausman test were used to determine the fitness between pooled ordinary least squares, fixed-effects models and random-effects models and to test the null hypotheses of time-fixed effects, heteroskedasticity and cross-sectional dependence. The findings suggested that fixed-effects models with Huber-White sandwich estimators should be used to correct for heteroskedasticity and model misspecification. Statistical analyses were performed using Stata SE V.15.1 (StataCorp, College Station, Texas), and $p < 0.05$ was considered statistically significant.

Data and variables
Healthcare expenditures
Information on healthcare expenditure indicators, including per capita total health expenditures (also known as current health expenditures in the database), per capita PHC expenditures and PHC expenditures as a percentage of total healthcare expenditures, was obtained from the WHO Global Health Expenditure Database.[33] WHO began publishing PHC spending data in the 2018 Global Health Expenditure database, which included 2016 data, with the most recent update in December 2021 with data for 2019.[34]

From this data set, we derived the independent variable—PHC expenditures as a share of total healthcare expenditures in a particular country-year—as a proxy for investment in PHC. The dependent variable was derived using per capita non-PHC expenditures (total healthcare expenditures minus PHC expenditure) and then log-transformed to reduce the skewness of our original data.

Population ageing
Older adults were defined as aged 60 and over after a comprehensive literature review.[1 2 35 36] To determine the population aged 60 and over as a percentage of the total population, we used the World Bank Group World Development Data Indicators,[37] which gives the country-year demographic parameters, on which we calculated the indicator population ageing for the most complete country-year estimates for 217 countries from 1971 to 2020. (See online supplemental appendix A for details of the mathematical derivation.)

NCD burden associated with older populations
The NCD burden is measured as a percentage of total disease burden in the population aged 60 and over. Disease burden is measured by disability-adjusted life years. Total diseases include injuries; communicable, maternal, neonatal and nutritional diseases; and NCDs. Data were obtained from the Institute for Health Metrics and Evaluation Global Burden of Diseases database.[38]

Final sample
Various data sets were merged, and a stepwise method was used to create the full time series, with each country as the unit of analysis. The resulting collection comprised data for 108 countries (including 33 high-income countries, HICs; 27 upper middle-income countries, UMICs; 30 lower middle-income countries and 18 low-income countries, LICs) through 4 years 2016–2019. (See online supplemental appendix B for details of sample size and missing data pattern.)

Patient and public involvement
Because this study relied on secondary data, all of which are publicly accessible, patients and the public were not involved in the formulation of this research.

RESULTS
We gathered information on 404 country-years using the data identification and extraction technique described above (data units). These data cover 108 countries from 2016 to 2019. The descriptive statistics (mean, SD) of the resultant research sample are shown in table 1. As expected, average annual per capita total healthcare expenditures and PHC expenditures are significantly different according to the national income group, with HICs spending the most (more than US$ 3000 on per capita total healthcare, approximately US $1300 on per capita PHC) and LICs spending the least (on average about US$ 40 on per capita total healthcare, US$ 27 on per capita PHC). LICs spent a greater proportion of overall healthcare expenditures on PHC than HICs. HICs had the greatest proportion of older adults among their total population and the highest NCD burden as a percentage of overall disease burden in the population aged 60 and over. LICs lost the most NCD-related disability-adjusted life years per capita for the population aged 60 and over.

Figure 1 presents the NCD share of total disease burden in the population aged 60 and over for all country groups. The NCD share of total disease is higher in countries with larger shares of ageing population, but such an association is much larger in LICs than in HICs, as demonstrated by the slope of the fitted line. This implies that in LMICs with a rapidly ageing population, the health system needs to adapt to such demographic transitions and be able to better prevent and control NCDs.

Figure 2 presents the relationship among three core independent variables. The vertical and horizontal axes are the PHC as a share of total health expenditure versus

Table 1 Descriptive statistics of key variables

	Low-income countries			
	Year 2016	**Year 2017**	**Year 2018**	**Year 2019**
	(n=15)	**(n=16)**	**(n=18)**	**(n=17)**
	mean (SD)	**mean (SD)**	**mean (SD)**	**mean (SD)**
Total healthcare (THC) expenditure per capita in US$	40 (15)	39 (15)	44 (15)	41 (14)
Primary healthcare (PHC) expenditure per capita in US$	27 (9)	26 (7)	28 (9)	26 (7)
PHC as a share of THC expenditure (%)	69 (12)	68 (12)	66 (13)	65 (12)
Non-PHC expenditures (composition of THC by non-primary healthcare), per capita in US$	13 (9)	13 (9)	16 (10)	15 (9)
Population aged 60 and above (% of total population)	5 (1)	4 (1)	5 (1)	5 (1)
Non-communicable disease (NCD) burden as a share of total disease burden (%) among population aged 60 and above	71 (10)	69 (90)	71 (10)	72 (10)
NCD DALYs lost per capita for population aged 60 and above	85175 (15877)	82117 (14862)	82818 (13903)	81916 (13918)

	Lower middle-income countries			
	Year 2016	**Year 2017**	**Year 2018**	**Year 2019**
	(n=27)	**(n=23)**	**(n=30)**	**(n=27)**
	mean (SD)	**mean (SD)**	**mean (SD)**	**mean (SD)**
Total healthcare (THC) expenditure per capita in US$	94 (56)	94 (60)	108 (69)	104 (64)
Primary healthcare (PHC) expenditure per capita in US$	53 (27)	56 (31)	59 (34)	57 (29)
PHC as a share of THC expenditure (%)	59 (13)	63 (12)	57 (13)	58 (12)
Non-PHC expenditures (composition of THC by non-primary healthcare), per capita in US$	41 (33)	37 (33)	49 (39)	46 (39)
Population aged 60 and above (% of total population)	7 (3)	6 (3)	7 (3)	7 (4)
Noncommunicable disease (NCD) burden as a share of total disease burden (%) among population aged 60 and above	80 (9)	78 (9)	81 (9)	80 (9)
NCD DALYs lost per capita for population aged 60 and above	83970 (13597)	83421 (12047)	2996 (11643)	82108 (10624)

	Upper middle-income countries			
	Year 2016	**Year 2017**	**Year 2018**	**Year 2019**
	(n=19)	**(n=14)**	**(n=20)**	**(n=22)**
	mean (SD)	**mean (SD)**	**mean (SD)**	**mean (SD)**
Total healthcare (THC) expenditure per capita in US$	399 (192)	491 (209)	447 (186)	449 (193)
Primary healthcare (PHC) expenditure per capita in US$	177 (75)	206 (78)	196 (63)	196 (70)
PHC as a share of THC expenditure (%)	47 (11)	44 (11)	47 (12)	46 (13)
Non-PHC expenditures (composition of THC by non-primary healthcare), per capita in US$	222 (133)	285 (156)	251 (146)	253 (147)
Population aged 60 and above (% of total population)	11 (5)	12 (60)	12 (5)	12 (5)
Non-communicable disease (NCD) burden as a share of total disease burden (%) among population aged 60 and above	88 (7)	87 (8)	88 (7)	88 (6)
NCD DALYs lost per capita for population aged 60 and above	84919 (14249)	82085 (14724)	81870 (14534)	80081 (14135)

	High-income countries			
	Year 2016	**Year 2017**	**Year 2018**	**Year 2019**
	(n=31)	**(n=30)**	**(n=33)**	**(n=29)**
	mean (SD)	**mean (SD)**	**mean (SD)**	**mean (SD)**
Total healthcare (THC) expenditure per capita in US$	2970 (2306)	3201 (2418)	3308 (2483)	3332 (2453)
Primary healthcare (PHC) expenditure per capita in US$	1213 (887)	1312 (934)	1357 (957)	1359 (946)
PHC as a share of THC expenditure (%)	43 (7)	43 (7)	43 (8)	42 (7)
Non-PHC expenditures (composition of THC by non-primary healthcare), per capita in US$	1758 (1445)	1888 (1512)	1950 (1560)	1973 (1545)
Population aged 60 and above (% of total population)	22 (5)	23 (5)	22 (6)	24 (5)

Table 1 Continued

	High-income countries							
	Year 2016		Year 2017		Year 2018		Year 2019	
	(n=31)		(n=30)		(n=33)		(n=29)	
	mean (SD)		mean (SD)		mean (SD)		mean (SD)	
Non-communicable disease (NCD) burden as a share of total disease burden (%) among population aged 60 and above	91	(2)	91	(2)	91	(2)	91	(2)
NCD DALYs lost per capita for population aged 60 and above	65842	(10055)	65657	(10012)	65681	(9823)	65886	(9605)

DALYs, Disability Adjusted Life Years.

the NCD share of total disease burden for population aged 60 and over. The size of the circle represents the percentage of population aged 60 and over. The four-panel graph clearly shows a pattern when countries develop and go through a demographic transition. When the population gets older, as demonstrated as the circle size gradually gets larger, more people would get NCDs, as the circle moves from left to right.

Figure 3 examines the relationship between population aged 60 and over and non-PHC per capita health expenditure. Not surprisingly, the higher the share of population aged 60 and over, the higher the non-PHC health expenditure. The figure also shows that richer countries spent more on non-PHC in general.

Table 2 presents the results of fixed-effects regression models. Models 1–4 provide different model specifications, with model 1 as the base model and model 4 as the fully specified model. Model 2 adjusts for the interaction term of population aged 60 and over with a PHC expenditure share; model 3 adjusts for the NCD burden as a share of total disease burden (in population aged 60

and over). Model 4 is a fully specified model adjusting for the interaction between the NCD burden and PHC expenditure share.

The results show that PHC spending as a share of total healthcare expenditures was negatively associated with non-PHC healthcare spending, indicating that spending more on PHC can reduce non-PHC spending. The magnitude of the effect of PHC spending was slightly greater when adjusting for the control variables and remained significant in models 1–4.

The proportion of the total population aged 60 and over was a significant predictor of non-PHC expenditures. As expected, the greater the population aged 60 and over, the greater the non-PHC healthcare expenditure. The interaction terms for PHC and the proportion of the population aged 60 and over, however, are not significant across the models. The NCD burden and its interaction terms with PHC are also not significant in this final data and specification.
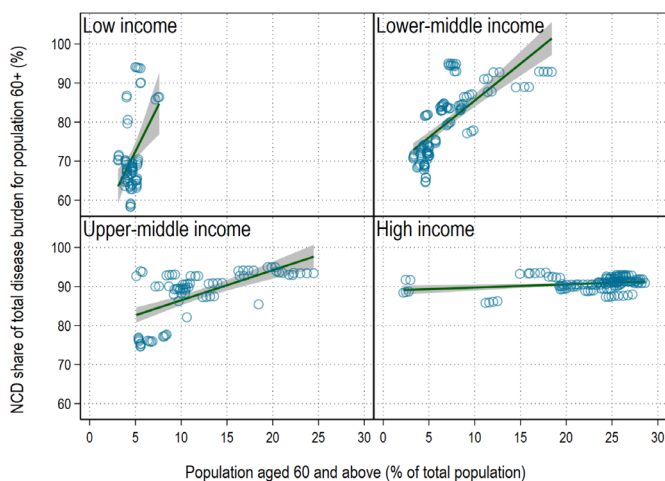

Figure 1 NCD share of total disease burden for population aged 60 and above across income country groups. Each circle represents one country; the line is the fitted line between population aged 60 and above with NCD share of total disease burden for population 60+ (%). The grey shade covers the 95% CIs. The study sample included 404 country-years, which covered 108 countries from year 2016 to 2019. NCD, non-communicable disease.
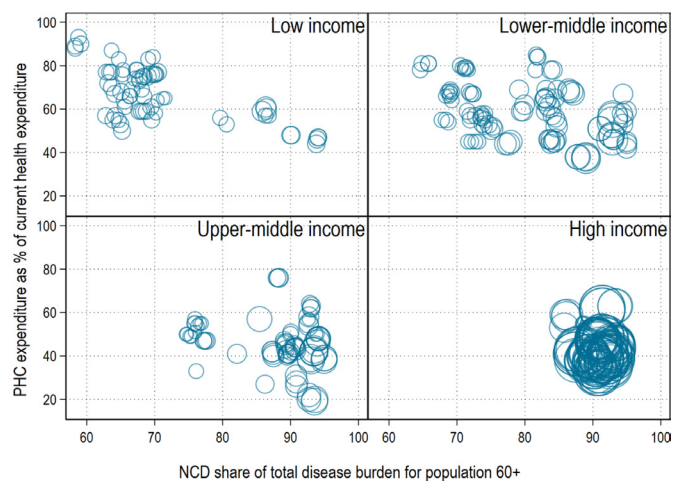

Figure 2 Primary healthcare expenditure as a share of total health expenditure (%) versus NCD share of total disease burden for population aged 60 and above. Each circle represents one country. The size of the circle represents the percentage of population aged 60 and over for that country in increasing scale. The study sample included 404 country-years, which covered 108 countries from year 2016 to 2019. NCD, non-communicable disease; PHC, primary healthcare.
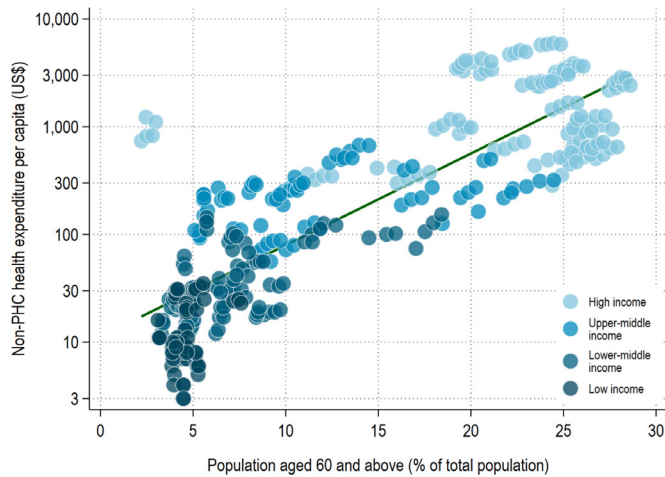
Figure 3 Non-primary healthcare expenditure and population aged 60 and Above. Each circle represents a country. The line is the fitted line of population aged 60 and above (% of total population) with non-PHC health expenditure per capita (US$). The study sample included 404 country-years, which covered 108 countries from year 2016 to 2019. NCD, non-communicable disease; PHC, primary healthcare.

Discussion and policy implications

This study used regression with the interaction terms to explore whether spending on PHC can mitigate the growing fiscal pressure from population ageing and the NCD burden. The regressions, including the one presented in this paper and an earlier analysis with 2016–2018 data, show strongly that a higher PHC share is correlated with lower non-PHC health expenditure. However, the interaction terms of PHC and population aged 60 and over, PHC and NCD are contingent on the data set and model specifications. They were significant in earlier models, but not in the ones with the latest 2019 data.

While the coefficient estimations of interaction terms do not support the hypothesis that high PHC spending could not mitigate the fiscal pressure caused by an ageing population and higher NCD burden, the empirical model presented in the paper supports the importance of investing in PHC.

The healthcare systems need to be prepared to address the complex needs and preferences of an ageing population, not only to provide better care for older adults but also to strengthen the system, so that it can more effectively and efficiently address current and future challenges. The PHC system is particularly well positioned to address the diverse physical health, behavioural health and social needs of the population across the life course, although major care gaps and structural barriers inhibit the PHC system in its current form from meeting the needs of elderly adults.

However, the measurement of PHC investment and the roles of PHC in the health system present a real challenge. Although this study used PHC spending as a share of total healthcare spending as the proxy for investment in PHC, this is far from ideal. Investing in PHC is not just about financial resources allocated but also about allocation of human

Outcome variable: log of non-PHC expenditures (composition of THC by non-primary health care, per capita in US$)	Model (1)	Model (2)	Model (3)	Model (4)
PHC as a share of THC expenditure (%), PHC	−0.0246*** [0.00349]	−0.0270*** [0.00625]	−0.0268*** [0.00612]	−0.0327* [0.0195]
Population aged 60 and above (% of total population), pop_60	0.103*** [0.0184]	0.0911*** [0.0307]	0.0906*** [0.0306]	0.0961*** [0.0302]
PHC (as a share of THC expenditure, %) * (Pop_60)		0.000316 [0.000573]	0.000300 [0.000567]	0.000177 [0.000623]
Noncommunicable disease (NCD) burden as a share of total disease burden (%) among population aged 60 and above (NCD60)			0.0112 [0.0161]	0.00586 [0.0219]
PHC * NCD60				8.67E-05 [0.000252]
GDP per capita	1.25e-05*** [3.46e-06]	1.27e-05*** [3.47e-06]	1.27e-05*** [3.48e-06]	1.26e-05*** [3.41e-06]
Constant	4.715*** [0.277]	4.798*** [0.363]	3.866*** [1.355]	4.255** [1.804]
Number of observations	370	370	370	370
R^2	0.537	0.538	0.54	0.54
Number of countries	107	107	107	107

Table 2 Country fixed effects regression models

Robust standard errors in brackets.
*** p<0.01, ** p<0.05, * p<0.1.
GDP, gross domestic product; PHC, primary healthcare; THC, total healthcare.

resources and, more importantly, how PHC is delivered. For example, using data from a group of OECD countries, Ke and colleagues[30] and Barros[31] found that the existence and use of primary care physicians and general practitioners as system gatekeepers can decrease healthcare spending.[28 31] Similarly, Delnoij and colleagues[22] demonstrated that healthcare systems with family physicians acting as gatekeepers to more specialised care had smaller increases in ambulatory care costs and outpatient health service use, although not in total healthcare costs. Gatekeeping is one of the key characteristics of PHC-based health systems. The use of primary care physicians as gatekeepers enhances continuity and coordination of care, which reduces the unnecessary, inappropriate use of specialty services[10 12 15 16 39] and will thereby improve population health outcomes and reduce healthcare costs.

Another important feature of PHC is its coordinating role, especially in the context of optimally serving elderly adults. The PHC system will have not only to be prepared to deliver care but also to integrate services with nursing homes, long-term care and secondary and tertiary care. To provide more empirical evidence of the role of PHC in serving an ageing population, data must be collected on more than just expenditures. Indicators that can better capture the role of PHC in the system will reveal how PHC should be delivered to contain escalating healthcare expenditures and improve the quality of care for elderly adults.

A few other studies have shown that enhancing PHC may stimulate the increase of healthcare utilisation.[40 41] If spending on PHC is increased to satisfy unmet needs, including referrals to specialists, a longer study time is needed to assess its effect on growth in total costs.[19] To slow total spending, it is important not only to increase a system's orientation towards PHC for selected single components (such as primary care physician supply) but also to include other interventions such as a value-based health financing design (eg, lower cost-sharing for preventive care), payment reform for physicians and healthcare institutes and market competition and price regulatory systems to strategically promote efficiency.[19 42–44]

Study limitations

The study had several limitations. First, dependent and independent variables both contain expenditure terms. To minimise endogeneity, we used PHC expenditures as a share of total healthcare expenditures as the independent variable and non-PHC expenditures as the dependent variable. Second, we explored other institutional variables that capture non-monetary aspects of how PHC functions in countries, such as the size of the PHC workforce as a share of the healthcare workforce, but such information is limited in many countries. Finally, as Hanson *et al*[44] discussed, there were numerous issues in measuring PHC expenditures. There is no universally agreed approach to estimate spending on PHC. Though WHO's System of Health Account compiles PHC-level and hospital-level expenditures, there is much room for improvement.

CONCLUSIONS

Population ageing, far from being just a burden, can be a crucial part of a country's economic development, as demonstrated through extensive work on the demographic dividend. As the world begins to think about healthcare beyond COVID-19, reimagining PHC creates an opportunity to rethink care for growing ageing populations while supporting and propelling the move toward universal health coverage. More spending on PHC, together with changes in PHC service delivery, highlighting its coordination and referring roles, will put nations on a pathway to sustainably achieving universal health coverage.

ORCID iDs
Xiaohui Hou http://orcid.org/0000-0002-8219-996X
Lingrui Liu http://orcid.org/0000-0003-4015-2589
Jewelwayne Cain http://orcid.org/0000-0001-6640-0929

REFERENCES

1 United Nations, Department of Economic and Social Affairs, Population Division. World population ageing – highlights, 2020. Available: https://www.un.org/development/desa/pd/sites/www.un.org.development.desa.pd/files/undesa_pd-2020_world_population_ageing_highlights.pdf

2 U.S. National Institutes of Health, World Health Organization. Global health and aging report, 2011. Available: https://www.nia.nih.gov/sites/default/files/2017-06/global_health_aging.pdf

3 World Health Organization. Ageing and health, 2021. Available: https://www.who.int/news-room/fact-sheets/detail/ageing-and-health

4 Kämpfen F, Wijemunige N, Evangelista B. Aging, non-communicable diseases, and old-age disability in low- and middle-income countries: a challenge for global health. *Int J Public Health* 2018;63:1011–2.

5 de Meijer C, Wouterse B, Polder J, *et al*. The effect of population aging on health expenditure growth: a critical review. *Eur J Ageing* 2013;10:353–61.

6 Wouterse B, Huisman M, Meijboom BR, *et al*. The effect of trends in health and longevity on health services use by older adults. *BMC Health Serv Res* 2015;15:1–14.

7 International Monetary Fund. *World economic outlook: Countering the Cost-of-Living crisis*. Washington, DC, 2022.

8 Kurowski C, Evans DB, Tandon A. *From double shock to double recovery – implications and options for health financing in the time of COVID-19 (discussion paper)*. Washington, DC: Health, Nutrition, and Population (HNP) Global Practice, World Bank, 2021.

9 Kurowski C, Evans DB, Tandon A. *From double shock to double recovery – implications and options for health financing in the time of COVID-19 (technical update 2: old scars, new wounds)*. Washington, DC: Health, Nutrition, and Population (HNP) Global Practice, World Bank, 2022.

10 Kruk ME, Porignon D, Rockers PC, *et al*. The contribution of primary care to health and health systems in low- and middle-income countries: a critical review of major primary care initiatives. *Soc Sci Med* 2010;70:904–11.

11 Haque M, Islam T, Rahman NAA, *et al*. Strengthening primary Health-Care services to help prevent and control long-term (chronic) non-communicable diseases in low- and middle-income countries. *Risk Manag Healthc Policy* 2020;13:409–26.

12 Starfield B, Shi L, Macinko J. Contribution of primary care to health systems and health. *Milbank Q* 2005;83:457–502.

13 World Health Organization. *A vision for primary health care in the 21st century: towards universal health coverage and the sustainable development goals*. World Health Organization, 2018.

14 World Health Organization. *Declaration of Alma-Ata*, 2000.

15 Macinko J, Starfield B, Shi L. The contribution of primary care systems to health outcomes within organization for economic cooperation and development (OECD) countries, 1970-1998. *Health Serv Res* 2003;38:831–65.

16 Shi L. *The impact of primary care: a focused review*. Scientifica, 2012.

17 Macinko J, Starfield B, Erinosho T. The impact of primary healthcare on population health in low- and middle-income countries. *J Ambul Care Manage* 2009;32:150–71.

18 Kringos DS, Boerma W, van der Zee J, *et al*. Europe's strong primary care systems are linked to better population health but also to higher health spending. *Health Aff* 2013;32:686–94.

19 Song Z, Gondi S. Will increasing primary care spending alone save money? *JAMA* 2019;322:1349–50.

20 Chernew ME, Sabik L, Chandra A, *et al*. Would having more primary care doctors cut health spending growth? *Health Aff* 2009;28:1327–35.

21 Baicker K, Chandra A. Medicare spending, the physician workforce, and beneficiaries' quality of care: areas with a high concentration of specialists also show higher spending and less use of high-quality, effective care. *Health Affairs* 2004;23:W4-184–W4-97.

22 Delnoij D, Van Merode G, Paulus A, *et al*. Does general practitioner gatekeeping curb health care expenditure? *J Health Serv Res Policy* 2000;5:22–6.

23 Friedberg MW, Hussey PS, Schneider EC. Primary care: a critical review of the evidence on quality and costs of health care. *Health Aff* 2010;29:766–72.

24 Baum A, Song Z, Landon BE, *et al*. Health care spending slowed after Rhode Island applied affordability standards to commercial insurers. *Health Aff* 2019;38:237–45.

25 Koller CF, Khullar D. Primary care spending rate; A lever for encouraging investment in primary care. *N Engl J Med* 2017;377:1709–11.

26 Velasco Garrido M, Zentner A, Busse R. The effects of gatekeeping: a systematic review of the literature. *Scand J Prim Health Care* 2011;29:28–38.

27 Newhouse JP. Medical-care expenditure: a cross-national survey. *J Hum Resour* 1977;12:115–25.

28 Gerdtham U-G, Jönsson B, MacFarlan M. *The determinants of health expenditure in the OECD countries: a pooled data analysis. health, the medical profession, and regulation*. Springer, 1998: 113–34.

29 Gerdtham U-G, Jönsson B. *International comparisons of health expenditure: theory, data and econometric analysis*. Handbook of Health Economics: Elsevier, 2000: 11–53.

30 Ke X, Saksena P, Holly A. *The determinants of health expenditure: a country-level panel data analysis*. 26. Geneva: World Health Organization, 20111–28.

31 Barros PP. The black box of health care expenditure growth determinants. *Health Econ* 1998;7:533–44.

32 Greenfield G, Foley K, Majeed A. Rethinking primary care's gatekeeper role. *BMJ* 2016;354:i4803.

33 World Health Organization. *Data from: global health expenditure database (GHED)*, 2021. https://apps.who.int/nha/database

34 World Health Organization. Global expenditure on health: public spending on the rise? 2021. Available: https://apps.who.int/iris/bitstream/handle/10665/350560/9789240041219-eng.pdf

35 World Health Organization. The decade of healthy ageing, 2020. Available: https://cdn.who.int/media/docs/default-source/decade-of-healthy-ageing/final-decade-proposal/decade-proposal-final-apr2020-en.pdf?sfvrsn=b4b75ebc_25&download=true

36 World Health Organization,. United Nations Children's Fund (UNICEF). A vision for primary health care in the 21st century: Towards universal health coverage and the sustainable development goals. Available: https://www.who.int/docs/default-source/primary-health/vision.pdf

37 dataset] World Bank. Data from: world development data indicators, 2022. Available: https://databank.worldbank.org/source/world-development-indicators

38 [dataset] Institute for Health Metrics and Evaluation (IHME). *Data from: global burden of diseases (GBD) 2019 database*. https://vizhub.healthdata.org/gbd-results/

39 Gerdtham U, Jonsson B. *Factors affecting health spending: a cross-country econometric analysis. new directions in health care policy: health policy series No. 7: OECD*. Paris: OECD, 1995.

40 Bradley CJ, Neumark D, Walker LS. *The effect of primary care visits on health care utilization: findings from a randomized controlled trial*. National Bureau of Economic Research, 2017.

41 Walsh B, Nolan A, Brick A, *et al*. Did the expansion of free GP care impact demand for emergency department attendances? A difference-in-differences analysis. *Soc Sci Med* 2019;222:101–11.

42 Goodyear-Smith F, Bazemore A, Coffman M, *et al*. Primary care financing: a systematic assessment of research priorities in low- and middle-income countries. *BMJ Glob Health* 2019;4:e001483.

43 Kruk ME, Nigenda G, Knaul FM. Redesigning primary care to tackle the global epidemic of noncommunicable disease. *Am J Public Health* 2015;105:431–7.

44 Hanson K, Brikci N, Erlangga D. The Lancet global health Commission on financing primary health care: putting people at the centre. *The Lancet Global Health* 2022.