



Healthcare expenditure and life expectancy in Cameroon

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Abstract

Background Healthcare is a serious issue confronting governments and households and calling for repeated deliberations in international forums. Ensuring good health for all was the predominant call of the millennium development goals (MDGs), re-echoed again in the sustainable development goals (SDGs). The first objective of this study is to evaluate and compare the impact of public and private health spending on life expectancy, and the second objective is to examine the causal link among public health expenditure, private health expenditure and life expectancy in Cameroon.

Methods We used annual time series data from 1980 to 2014. Ordinary least squares (OLS) regression was employed to evaluate the effect of public and private health expenditure on life expectancy while the Toda and Yamamoto causality test was used to examine the relationship among public health expenditure, private health expenditure and life expectancy in Cameroon.

Results The result shows that private health expenditure has a positive and significant impact on life expectancy while public health expenditure has no significant impact on life expectancy in Cameroon. The results of the causality test show a bidirectional causality between private health expenditure and life expectancy and a unidirectional causality running from life expectancy to public health expenditure.

Conclusions The findings of this study suggest that the Cameroonian government should continue to embark on its poverty reduction strategy elaborated in its Growth and Employment Strategy Paper (GESP) and in pursuing its vision of attaining the SDGs by 2030. In addition, establishing effective public-private partnerships in developing the health sector could go a long way to improve the health status of the population.

Keywords Public and private health spending · Life expectancy · Time series data · OLS regression · Toda and Yamamoto causality test

Background

Healthcare is one of the most important development issues facing our world today. The burden of infectious diseases and other preventable health threats greatly limits the ability of nations to focus their attention fully on other development

issues such as education and economic sustainability. Like all developing countries, Cameroon is facing a high burden of diseases (both communicable and non-communicable). The diseases plaguing the health of the people, coupled with the burden of injuries and disabilities, reduce, among others, their life expectancy.

Following the Bamako Initiative in 1987, the government of Cameroon adopted a new health policy in 1992 based on the decentralization of healthcare delivery, emphasizing primary healthcare (which refers to essential healthcare based on scientifically sound and acceptable methods and technology, whose ultimate goal is to make better health accessible to all) and the participation of beneficiary communities in the co-financing and co-management of healthcare facilities. African leaders pledged to allocate at least 15% of their national budgets to health at the Abuja Conference in 2001, given its enormous contribution to socioeconomic wellbeing.

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Healthcare financing in Cameroon is carried out by both the public and private sectors. The public financing mechanism involves social health insurance and taxes as well as external grants and loans. The private financing mechanism on the other hand involves mainly direct out-of-pocket payments but also includes community-based health insurance, private health insurance, mutual health organizations and medical savings accounts.

Economics deals with the distribution of scarce resources which have competing uses. Thus, if a country is spending huge sums of money on healthcare, it is allocating itself a resource. It is making an investment whose outcome must be worthwhile. This outcome can somehow be measured in terms of prolonged life or years of life gained.

Healthcare is a serious issue confronting governments and calling for repeated deliberations in international forums. Health, as measured by life expectancy, is one of the key components of the Human Development Index (HDI). Ensuring good health for all was the predominant call of the Millennium Development Goals (MDGs), re-echoed again in the Sustainable Development Goals (SDGs). Several health targets in the 2030 Sustainable Development Goals follow the unfinished agenda of the Millennium Development Goals, which ended in 2015.

According to the Human Development Report of 2015, life expectancy in Cameroon rose from 51.2 years in 1980 to 55.1 years in 2013.

The literature analyzed the effect of healthcare expenditure on life expectancy in developed and developing countries (Deshpande et al. 2011). The study was conducted using data from 181 countries and showed that while a significant correlation exists between healthcare expenditure and life expectancy in developed countries, no effect exists between the two variables in developing countries.

In this study, the central question we ask is: did healthcare expenditures have any effect on life expectancy in Cameroon during the period from 1980 to 2014?

This central question can be further broken down into the following sub-questions:

- What is the impact of public and private healthcare expenditures on life expectancy in Cameroon?
- What is the causal link between public and private healthcare expenditures and life expectancy in Cameroon?

In light of the questions posed above, this work proposes to evaluate and compare the impact of public and private healthcare expenditures on life expectancy in Cameroon from 1980 to 2014. More specifically, it will:

- Evaluate and compare the impact of public and private healthcare expenditures on life expectancy in Cameroon from 1980 to 2014.

- Examine the causal relationship among public healthcare expenditure, private healthcare expenditure and life expectancy in Cameroon from 1980 to 2014.

The rest of the article is divided into the following sections: evolution of healthcare expenditure and life expectancy at birth in Cameroon from 1980 to 2014, previous literature, methodology, results, discussion and conclusion.

Evolution of healthcare expenditures and life expectancy in Cameroon

For the past decades healthcare financing reforms have been common across the spectrum of high- to low-income countries. The post-independence health financing reform (after the Bamako Initiative) expects individuals to pay for health services out of pocket as a cost recovery strategy. This policy has however led to inequality in the access to healthcare between the rich and the poor, with the burden lying most heavily on underprivileged households.

In 2013, the Cameroon Economic Update (CEU) attested that Cameroon spends more money on health than any other sub-Saharan country (except South Africa): US\$61 per capita, as opposed to US\$51 on average. It is Cameroonians themselves, however, who shoulder the majority of this financial burden. Out of the \$61, the State finances only \$17; out of that sum, \$8 comes from international donors. This means there is a strong correlation between health statistics and revenue statistics, with well-off households and wealthy regions having better access to health services.

Figure 1 shows the evolution of public and private healthcare expenditures in Cameroon as a percentage of GDP.

Figure 1 shows that healthcare financing in Cameroon is dominated by private outlays; meanwhile, public expenditure accounts for a very small portion of total healthcare expenditures. The government for its part is faced with enormous constraints in that it is not able to meet the Abuja Agreement by allocating at least 15% of its budget to healthcare. With the very low enrollment in health insurance schemes, households suffer from catastrophic payments, which only aggravates the health situation.

Despite the huge healthcare expenditures in Cameroon, the country's health statistics are paradoxically behind the curve. Life expectancy for Cameroonians has decreased by about 2 years since 1990, while it has increased by an average of 5 years in the rest of sub-Saharan Africa. Worldwide, Cameroon is also among the countries where the mortality rate for children < 5 years of age (122 deaths per 1000 live births) has decreased the least (see Fig. 2). Figure 2 shows the evolution of life expectancy at birth and per capita health expenditures in Cameroon.

Fig. 1 Evolution of public and private health expenditures (HEX) in Cameroon from 1980 to 2004. Source: Authors from WDI 2016

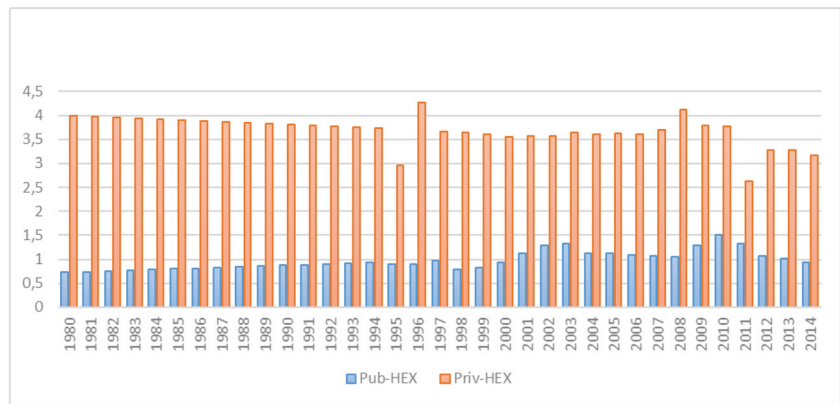


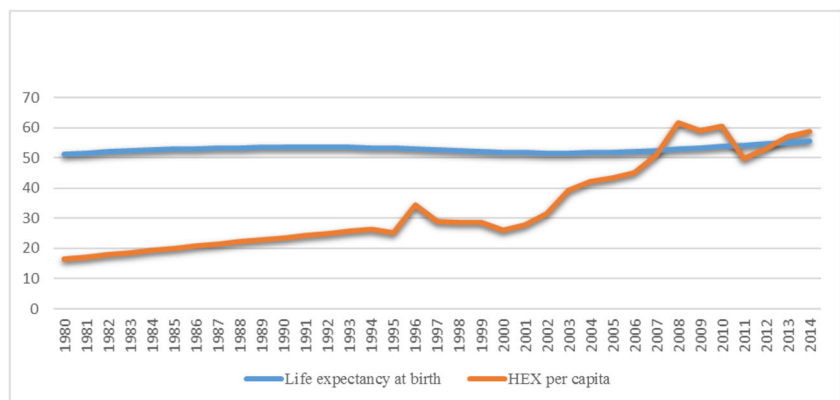
Figure 2 shows that as health expenditures increased progressively from 1980 to 1993, life expectancy followed suit, though mildly. But as health expenditures dropped from 1993 to 1996, life expectancy also decreased. This drop in per capita health expenditure could have been caused in part by the massive salary cuts, i.e., the 60% decrease in the salary of civil servants in 1993 and the devaluation of the CFA franc in 1994, accompanied by the decline in the state budget devoted to health (Owoundi 2013). From then on, it is quite surprising to note that health expenditures rose considerably after 1996, but the corresponding increase in life expectancy has been quite small.

Previous literature

The use of the OLS estimation technique to examine the relative roles of private incomes and public services using cross-country data for 22 countries shows that healthcare spending, particularly public spending on health, promotes health status (i.e., life expectancy at birth) (Anand and Ravallion 1993). The relationship between healthcare expenditure and outcomes across ten Canadian provinces over the 15-year period from 1978–1992 shows that lower healthcare spending was associated with a significant increase in infant mortality and a decrease in life expectancy (Crémieux et al. 1999).

The literature provides a detailed review of 16 studies that have examined the relationship between healthcare inputs and health outcomes using macro-level data and undertook their own studies using data from 15 EU countries in the 1980–1995 period (Nixon and Ulmann 2006). They employed three health outcomes measures—life expectancy at birth for males and females and infant mortality rate—and a dozen or more explanatory variables including: per capita health expenditure, number of physicians (per 10,000 population), number of hospital beds (per 1000 population), average length hospital of stay, in-patient admission rate, alcohol and tobacco consumption, nutritional characteristics and environmental pollution indicators. They conclude that although health expenditure and the number of physicians have made a significant contribution to improvements in infant mortality, the health care expenditure has made a relatively marginal contribution to the improvements in life expectancy in the EU countries over the period of the analysis. Time series analysis and the error correction model (ECM) were used to find that, in addition to public health care expenditure, the availability of physicians, female literacy and child immunization significantly influenced health outcomes in Lesotho (Akinkugbe and Mohanoe 2009). The literature studied the effects of public and private healthcare expenditure on health status in 44 sub-Saharan African countries with panel data from 1995 to 2010. Fixed and random effects panel data regression models

Fig. 2 Evolution of life expectancy at birth and health expenditure per capita (HEX) in Cameroon from 1980 to 2014. Source: Authors from WDI 2016



were fitted to determine the effects of healthcare expenditure on population health status and to examine the effect by public and private expenditure sources. The result that healthcare expenditure significantly influences health status by improving life expectancy and reducing death and infant mortality rates was found by Novignon and Olakojo (2012). Both public and private healthcare spending showed a strong positive association with health status even though public healthcare spending had a relatively higher impact. The effect of health expenditures on life expectancy in six regions of the world (the Americas, South-East Asia, Europe, Africa, Eastern Mediterranean and Western Pacific) was examined by Elisabeta et al. (2014). Using a fixed-effect model on data from 1995 to 2010, they found that health expenditures have a positive and significant effect on life expectancy at birth in all six country groups. The effect of public health spending on life expectancy at birth in Nigeria from 1981–2014 was estimated by Iori et al. (2017). The use of the ARDL method shows that public health spending has a positive and significant effect on life expectancy at birth in Nigeria. An error correction model was used by Richardson et al. (2017) to find the relationship between public health spending and life expectancy in Nigeria. They found in general that public health spending has a positive and significant effect on life expectancy in Nigeria. The effect of health expenditures on life expectancy in East African countries was analyzed by Bein et al. (2017). Using a fixed-effect model on a panel of eight East African countries (Burundi, Eritrea, Ethiopia, Kenya, Rwanda, Sudan, Tanzania and Uganda) from 2000–2014, they found a positive and significant association between the two variables.

Previous studies that investigated the relationship between healthcare expenditure and health outcomes are diverse concerning the analyzed indicators, model approach and countries studied. The majority of these studies analyzed panel data for developed countries, such as the OECD countries (Hitiris and Posnett 1992; Shaw et al. 2005) or the US (Lichtenberg 2000), though some recent papers are focused on developing and less developed countries (Bayati et al. 2013). Health expenditures have been found to have a positive and significant impact on life expectancy and a significant negative impact on mortality rate.

In contrast to this work, other studies have focused instead on the nature of the relationship between health expenditure and life expectancy (Ogungbenle et al. 2013; Akif and Mustafa 2017; Ogunsakin and Olonisakin 2017).

The relationship between health expenditure and life expectancy was studied in Nigeria by Ogungbenle et al. (2013) using the Granger causality test on data from 1977 to 2008; they found no causality between the two variables. The relationship between health expenditure and life expectancy in Turkey was examined by Akif and Mustafa (2017). Using the Granger causality test on data from 1975 to 2015, they found

that there is no causality between the two variables. In contrast to Ogungbenle et al. (2013) and Akif and Mustafa (2017), a two-way relationship between the two variables on data from 1980 to 2015 in Nigeria was found by Ogunsakin and Olonisakin (2017).

To our knowledge, the authors who examined the nature of the relationship between health expenditure and life expectancy used the Granger causality test. However, in the presence of cointegration, the causality analysis according to the usual Granger approach was no longer valid for Toda and Phillips (1994). In the current case, the analysis of causality frequently operates according to the alternative procedure proposed by Toda and Yamamoto (1995).

Methods

Variables

The relationship between life expectancy at birth (LE) and health expenditure (HEX), which comprises both public and private health expenditure, is expected to be positive. This is because health expenditure is supposed to curb the rate of mortality by ensuring a higher health status for the population. Preventive and curative health expenditures directly reduce the burden of disease by reducing the number of years of life lost (YLL) because of premature death and the years of life lived with disease (YLD). Granted, this should have the effect of prolonging life and increasing life expectancy.

Again, it is expected that life expectancy and per capita GDP will be positively related. Per capita GDP is a proxy for the standard of living of a population. The literature shows that a positive relationship exists between wealth and health. For instance, life expectancy in Brazil is about 12 years less for the lower than for the higher income group (Hugo 1981). Income and mortality differentials have also been found to be negatively correlated in many other studies (Duleep 1986; Araki and Murata 1986; Jain 2009). When incomes are below the poverty level, it is likely to exert an even more powerful negative influence on life expectancy. It has been found that although the per capita income of the developing countries have increased on average by 3% annually since 1990, so also did the number of people living in extreme poverty, by > 100 million people in some regions, and a rising income inequality is detrimental to life expectancy (Jafar 2013).

Undernourishment and HIV/AIDS have a negative effect on life expectancy. Undernutrition is one of the most important public health problems and is reported to affect > 900 million people worldwide. Its effects on health are enormous. Undernutrition is responsible for the highest mortality rates among children and has long-lasting physiological effects, including an increased susceptibility to fat accumulation

mostly in the central region of the body, lower fat oxidation, lower resting and postprandial energy expenditure, insulin resistance in adulthood, hypertension, dyslipidemia and a reduced capacity for manual work, among other impairments (Martins et al. 2009). HIV quickly breaks down immunity, hence opening the way for other infections. Undoubtedly, undernourishment and HIV are negatively related to life expectancy.

In addition, saving money can have a negative effect on health and thus on life expectancy depending on what school of thought we identify with. For instance, to the Keynesians, saving is a withdrawal from the circular flow of income. It has a negative multiplier effect on income or wealth creation and thus on standards of living. Hence, in an economy like in Cameroon where incomes are low, when households save, they reduce their current medical care consumption, which has a negative effect on their health and life expectancy. However, in the neoclassical conception, saving fuels investment, which stimulates growth and thus living standards. Hence, saving is seen as a requisite for long-term growth and welfare. Hence, saving today is preparing to have more tomorrow for better living and improved health. This generalization corroborates the life cycle hypothesis of Modigliani according to which people save at the start of their active life so they can spend when they get old. But if they get old and do not have enough to spend (especially on healthcare) because they did not save earlier on in life, then they will die quickly.

Lastly, population density can have either a positive or a negative impact on life expectancy in Cameroon. In fact, the literature on the impact of population density on health outcomes is inconclusive. There is much heterogeneity between studies, which makes it difficult to compare them or investigate pooled effects. Results from studies are often contradictory, so that what works in one place does not necessarily work in another. First and foremost, as the density of the population grows, there is also a corresponding increase in the competition for resources, which in the Malthusian conception leads to vice and misery. High densities are also accompanied by high levels of noise, crime and injury. In addition, studies have shown that a positive association exists between population density and mental illness, children's health, respiratory disease, heart attacks, cancer and unhappiness (Maas et al. 2009). However, studies have also shown a positive association between population density and the availability of health facilities as well as opportunities for wealth creation. For example, in China, people living in areas with the highest density (the coastal region) have much higher incomes than those living in the western region, which is the least densely populated area (Johnson 2001). It is possible that people can earn more by running businesses with less investment in areas with high density since the potential consumers usually outnumber those in the least densely populated areas.

Data source

The data used in our study are secondary data obtained almost exclusively from the World Bank database (2016) for the period from 1980 to 2014.

Model specification

The specification of the model in this study is consistent with the literature and allows for the identification of the channels through which healthcare expenditure affects life expectancy. To investigate the impact of public and private health expenditures on life expectancy in Cameroon, the specification of our life expectancy model is as follows:

$$LE_t = \alpha + \beta_1 PubHEX_t + \beta_2 PrivHEX_t + \beta_3 GDP_t + \beta_4 UNDER_t + \beta_5 HIVPRE_t + \beta_6 POPDEN_t + \beta_7 SAVING_t + \mu_t \quad (1)$$

where LE_t = life expectancy at birth in year t (measured by LE at birth per 1000 live births), $PubHEX_t$ = per capita public expenditure on health in year t (measured by public healthcare expenditures per capita % of GDP), $PrivHEX_t$ = per capita private expenditure on health in year t (measured by private healthcare expenditures per capita % of GDP), GDP_t = per capita GDP in year t (measured as GDP per capita (constant USD)), $UNDER_t$ = prevalence of undernourishment in year t (measured by the percentage of the total population), HIV_t = prevalence of HIV/AIDS in year t (measured by total prevalence of HIV), $POPDEN_t$ = population density in year t (measured by population density per square kilometer), $SAVING_t$ = saving rate in year t (measured by gross saving, % of GDP), and μ_t = the error term.

To investigate the causality among public health expenditures, private health expenditures and life expectancy in Cameroon, we used a VAR model. In the presence of cointegration of variables, the Granger causality test is limited (Toda and Phillips 1994). So, an interesting yet simple procedure requiring the estimation of an augmented VAR, which guarantees the asymptotic distribution of the Wald statistic (an asymptotic χ^2 distribution), was proposed by Toda and Yamamoto (1995), since the testing procedure is robust to the integration and cointegration properties of the process. The procedure of Toda and Yamamoto is carried out in two stages as follows. First, it is a question of determining the maximum integration order (dmax) of the series and the optimal number of lags (k) of the VAR process in the level. This step is performed using stationarity tests. Then, it is necessary to estimate a model VAR in increased level of the order $p = k + dmax$. If the series is stationary, only one additional lag is introduced into the VAR, and the test procedure follows the

standard approach. However, if the series is integrated on the order of one, then only one additional lag is introduced in the model. If LE_t , $PubHEX_t$ and $PrivHEX_t$ respectively denote the life expectancy, the public healthcare expenditure and the private healthcare expenditure variables, the model used as a basis for testing causality is specified as follows:

$$LE_t = \beta_0 + \sum_{i=1}^{k+dmax} \beta_{1i} LE_{t-i} + \sum_{i=1}^{k+dmax} \beta_{2i} PubHEX_{t-i} + \sum_{i=1}^{k+dmax} \beta_{3i} PrivHEX_{t-i} + \mu_{1t} \tag{2}$$

$$PubHEX_t = \alpha_0 + \sum_{i=1}^{k+dmax} \alpha_{1i} PubHEX_{t-i} + \sum_{i=1}^{k+dmax} \alpha_{2i} LE_{t-i} + \sum_{i=1}^{k+dmax} \alpha_{3i} PrivHEX_{t-i} + \mu_{2t} \tag{3}$$

$$PrivHEX_t = \zeta_0 + \sum_{i=1}^{k+dmax} \zeta_{1i} PrivHEX_{t-i} + \sum_{i=1}^{k+dmax} \zeta_{2i} PubHEX_{t-i} + \sum_{i=1}^{k+dmax} \zeta_{3i} LE_{t-i} + \mu_{3t} \tag{4}$$

where β_0 , α_0 and ζ_0 are the constants, k is the optimal lag number of the model, and $dmax$ is the maximum order of integration of the variables. μ_{1t} , μ_{2t} and μ_{3t} respectively represent the random perturbations of Eqs. (2), (3) and (4). In Eq. (2), the assumption that public health expenditure does not cause life expectancy is tantamount to testing the nullity of the β_{2i} coefficients. Likewise, the hypothesis that private health expenditure does not cause life expectancy amounts to testing the nullity of the β_{3i} coefficients. The analyses are identical for the other autoregressive Eqs. (3 and 4).

Results

The stationarity tests of Dickey and Fuller (1981) and Phillips and Perron (1988) were used to check if the series are

stationary or not. The results from the stationarity tests show that the variables GDP , HIV , $UNDER$, $PUBHEX$, $PRIVHEX$, $POPDEN$ and $SAVING$ are stationary at level (i.e., $I(0)$). LE on the other hand is stationary in the first difference (i.e., $I(1)$).

We notice from the Johansen (1988) test of cointegration that the variables of model (1) are cointegrated. Since there is an equilibrium relation between the variables of model 1, we can use the OLS method without being worried about the false regression. The existence of a cointegration relation permits us to move on directly to the estimation of the parameters of the life expectancy model.

Table 1 gives the results of regression model 1.

We notice that private healthcare expenditures have a positive and significant impact on life expectancy at birth. In fact, an increase in private healthcare expenditure by one unit will lead to an increase in life expectancy at birth in Cameroon of 0.146%. This result is consistent with the human capital model of the demand for health according to which an increase in the demand for ‘health goods and services’ will lead to an increase in health outcome. The positive and significant impact of healthcare expenditures on life expectancy is also compatible with the study conducted by Day et al. (2008), which revealed that life expectancy is highest in the developed world where health expenditures are highest.

Saving rate has a positive and statistically significant impact on life expectancy at birth in Cameroon. The results reveal to us that increasing the saving rate by one unit would lead to a 0.02% increase in life expectancy. This result is consistent with the Keynesian theory of the demand for money, specifically the precautionary demand for money according to which people save in order to be prepaid for various future risks, health risks or falling sick, for example. This result is also consistent with the famous life cycle model of Nobel laureate Franco Modigliani according to which people save (accumulate assets) to finance their retirement and dissave (spend their assets) during retirement.

Table 1 Regression result of the effect of healthcare expenditure on life expectancy

Variable	Coefficient	Standard error	t-Statistic	Probability
C	0.072816	0.013541	5.377494	0.0000
PUBHEX	0.001971	0.001343	1.468180	0.1545
PRIVHEX	0.001464**	0.000653	2.241642	0.0341
GDP	-1.28E-05	5.57E-05	-0.229830	0.8201
UNDER	-0.017358***	0.002733	-6.350069	0.0000
HIVPRE	-0.001786**	0.000755	-2.365098	0.0261
POPDEN	-0.000495**	0.000209	-2.366421	0.0260
SAVING	0.000199***	7.02E-05	2.841723	0.0088
R-squared = 0.968111		Durbin-Watson = 0.830619		
Adjusted R-squared = 0.959182		F-statistic = 108.4251		

Source: Authors from Eviews7

5% level of significance; *1% level of significance

Table 2 Choice of information criteria (optimal lag order of the model)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-274.9944	NA	439.5365	17.43715	17.62036	17.49788
1	-147.6807	214.8419	0.422679	10.48004	11.39613	10.78370
2	-141.9344	8.260227	0.845104	11.12090	12.76985	11.66748
3	-132.3678	11.36032	1.448278	11.52299	13.90481	12.31250

Source: Authors from Eviews7

*Lag order selected by the criterion

HIV prevalence has a negative and a significant impact on life expectancy at birth in Cameroon. In fact, an increase in the prevalence of HIV in Cameroon by one unit leads to a decline in life expectancy at birth of 0.179%. This finding is not surprising. In fact, according to the National AIDS Control Committee and the Central Technical Group (2010), there are 141 new HIV infections per day in Cameroon, 6 infections per hour, every day! The report also noted that, in 1995, 7900 people died from AIDS-related conditions in Cameroon; in just 5 years, the annual number rose to 25,000 in 2000; more than 34,000 deaths were projected in 2010. These statistics clearly reveal that HIV prevalence exerts a negative influence on life expectancy at birth in Cameroon.

The prevalence of undernourishment, like HIV, has a negative and significant impact on life expectancy at birth in Cameroon. We notice that a one unit increase in the prevalence of undernourishment will lead to a decline in life expectancy at birth by 1.74%. This result is consistent with the findings of Martins et al. (2011) according to whom child and maternal malnutrition is responsible for approximately 3.5 million deaths in children < 5 years of age and for 35% of the disease burden in this age group.

Population density has a negative and a significant impact on life expectancy at birth in Cameroon. The results show that an increase in population density by one unit in Cameroon will lead to a decline in life expectancy at birth by 0.05%. This result is consistent with the results of research on the association of high-density living and mental illness, children’s health, respiratory disease, heart attacks, cancer and human happiness. This result is consistent with the Maas et al. (2009) study.

Table 2 gives us the number of optimal lags that we must include inside the VAR model.

The optimal lag order of model k is estimated from the results provided by the FPE: final prediction error, AIC: Akaike information criterion, SC: Schwarz information criterion and HQ: Hannan-Quinn information criterion. The number of lags which minimizes the FPE, AIC, SC and HQ information criteria is k = 1. This is because k = 1 is the value for which these information criteria are minimized. The results of the causality test are summarize in the Table 3.

These results reveal that a bidirectional causality exists between private health expenditures and life expectancy at birth in Cameroon from 1980–2014. However, a unidirectional causality exists between public health expenditures and life expectancy at birth running from life expectancy at birth to public health expenditure. The results also show that a bidirectional causality exists between public and private healthcare expenditures.

Discussion

Private healthcare expenditures have a positive impact on life expectancy while other variables like HIV and undernourishment exert a negative impact on the dependent variable. It is recommended that households seek to avert the harmful effects of HIV and undernourishment on health (which can be measured by life expectancy) by adopting every measure to prevent the spread of HIV and its development into AIDS and also by engaging in appropriate feeding habits (e.g., by eating balanced diets). It is also recommended that the government

Table 3 Results of the causality test following the Toda and Yamamoto procedure

Null hypotheses	Wald tests χ^2 statistic	p value	Decision concerning no causality
LE does not cause PRIVHEX	6.117107	0.0470	No
PRIVHEX does not cause LE	5.266886	0.0718	NO
LE does not cause PUBHEX	33.90499	0.0000	No
PUBHEX does not cause LE	1.126316	0.5694	YES
PRIVHEX does not cause PUBHEX	12.25782	0.0022	No
PUBHEX does not cause PRIVHEX	4.993378	0.0824	NO

Source: Authors from Eviews7

adopt or promote a financial protection scheme to protect households from catastrophic health expenditures and their adverse effects. This could be done through various means of encouraging households to enroll in health insurance programs. The government should also continue with the HIV/AIDS sensitization campaign and nutrition sensitization campaign. Private healthcare spending is therefore indispensable in explaining life expectancy in Cameroon; hence, it is necessary to formulate policies that will boost access to care as well as the incomes of households in a country where 51% of the population lives on < 2 dollars a day and with $\leq 32\%$ of households spending less than half of their income on health alone according to Owoundi (2013). It is also recommended that the Cameroon government continue to embark on its poverty reduction strategy elaborated in its Growth and Employment Strategy Paper (GESP) and in pursuing its vision of attaining the SDGs by 2030. This would guarantee an improvement in the health status of the Cameroonian people. In addition, establishing effective public-private partnerships in developing the health sector could go a long way toward improving the health status of the population.

The relationship between public healthcare expenditure and life expectancy is positive, but statistically insignificant. This situation shows that increases in per capita income do not always imply an improvement in health outcomes. This concern can be traced to the widening gap in income distributions among all levels of households in Cameroon. This situation suggests that government should concentrate on its role in redistributing income in order to bridge this income inequality gap and enhance the significance of per capita income in improving life expectancy.

Conclusion

The results of this study indicate that private healthcare expenditures had a positive and significant impact on life expectancy at birth from 1980–2014; meanwhile, public healthcare expenditures had a positive but statistically insignificant impact on life expectancy in Cameroon during the same period. The study also reveals that a bidirectional causality exists between life expectancy at birth and private health expenditures in Cameroon from 1980–2014. A unidirectional causality also exists between life expectancy and public health expenditures (running from life expectancy at birth to public health expenditure).

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Authors' contributions Guivis Zeufack Nkemgha and Alim Belek carried out the data analyses and drafted the manuscript. They substantially contributed to the data analyses and interpretation of the data and provided comments on all the work. Tékam Oumbé Honoré carried out the

previous literature analysis of the study. All authors read and approved the final manuscript. We confirm that this manuscript describes original work and has neither been published elsewhere nor is under consideration by any other journal. All authors read and approved the final manuscript.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Consent for publication The authors give full consent for publication of this paper in Journal of Public Health.

Abbreviations *CEU*, Cameroon Economic Update; *GESP*, Growth and Employment Strategy Paper; *MDGs*, Millennium development goals; *OOP*, Out of pocket; *SDGs*, Sustainable development goals; *YLD*, Years lived with disease; *YLL*, Years of life lost; *WHO*, World Health Organization

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