Emigration and health outcomes in Africa

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Abstract

The aim of this article is to empirically analyze the effect of emigration on health outcomes using a sample of 31 African countries over the period 1985-2014. This article also attempts to ascertain whether this effect varies according to emigrants skill levels. In order to achieve these objectives, we focus on the Brücker et al. (2013) database, which provides data on migration flows to 20 OECD countries. In accordance with this database and the empirical literature, the overall emigration rate, the low skilled rate and the high skilled rate are retained as emigration indicators. The health indicator used is life expectancy at birth. Using a random effects model, the results show that emigration improves health in migrants' home countries. These results also show that migrants with a low skilled have a greater positive effect on health. Overall, our results are robust to a wide range of specifications and identifications methods.

Introduction

Health is a fundamental component of human capital that greatly influences labour productivity and economic prosperity (Odokonyero et al. 2017; Gallup and Sachs 2001). Evidence abounds in the empirical and theoretical literature about the benefits of health on labour productivity and economic prosperity. Health problems significantly reduce hourly wages, especially in developing countries where a higher proportion of the workforce is engaged in manual labour than in industrialised countries (Bloom et al. 2004). While it is true that health is an important pillar of development, very little is being done by political leaders to improve the health of their citizens. As a result of falling investment in maternal and newborn health, global progress in reducing the number of deaths of pregnant women, mothers and babies has stagnated over the past eight years. More than 4.5 million women and babies die every year (one death every seven seconds) during pregnancy, childbirth or the first weeks after birth from causes that are preventable or treatable if appropriate care is provided (WHO 2023). The statistics are even more alarming in Africa. Based on the year 2021, Africa has the highest neonatal mortality rates in the world (UNICEF 2023). Although under-five mortality has fallen considerably over the past three decades, from 177.5 per 1000 in 1990 to 73.7 in 2017, it is still high in Africa, where half of all child deaths in this age group are concentrated (UN IGME[1] 2018). These statistics are confirmed by Figure 1, which shows that Africa is, after South Asia, the region with the worst health results.

[1] United Nations Inter-Agency Group for Child Mortality Estimates

Several determinants are associated with health in the empirical literature, namely: energy poverty (Banerjee et al. 2021); the environment (Ajide et al. 2020; Mahalik et al. 2022; Shah et al. 2021); trade openness (Shah et al. 2021; Byaro et al. 2021; Bouchoucha 2023); conflict (Kotsadam and Østby 2019; Ghobarah 2004; Urdal and Che 2013); economic sanctions (Gutmann et al. 2021; Ha and Nam 2022; Kim 2019); financial development (Alam et al. 2021; Alam et al. 2015); urbanization (Gong et al. 2012; Li et al. 2012; Walter and Dewitte 2017), official development assistance (Odokonyero et al, 2017; Toseef et al. 2019), economic complexity (Vu 2020) and emigration (Immurana 2020; Uprety 2019; Chikanda 2006; Grignon et al. 2006).

In the light of this literature, research focusing on the link between international migration and health in countries of origin has been under-explored. This under-exploration is contradictory in the light of recent evidence. The COVID-19 pandemic, which has affected every region of the world and has had unprecedented human and economic consequences (Nguimkeu and Tadadjeu 2021; Nguimkeu and Okou 2021), has spread internationally due to the movement of people across national borders. Moreover, the theoretical literature is sufficiently documented on the existence of a link between the two concepts. Emigration in general can have direct and indirect effects on health in migrants' countries of origin. The direct effect can be summed up as the loss of skilled labour, in which the home countries have invested heavily, to the host countries, which have spent nothing on educating them. The migration of healthcare professionals leads to a reduction in the quality of healthcare supply in the home country (Uprety 2019). In addition, according to the new economics of labour migration, since migration is a decision taken at household level (Stark 1991), the costs of migration lead to a reduction in health spending by non-migrants.

The indirect effect can be explained on several levels. First, according to Hirshmann's voice and exit model (1970), emigration (exit) can help to reduce the pressure (voice) on the government to create or improve healthcare infrastructures. Second, given that skilled people are more entrepreneurial than unskilled people, and therefore contribute more to tax revenues than unskilled people, their migration leads to a considerable drop in healthcare spending (Uprety 2019). Third, the positive effect comes from the spillover effects of emigration. During their stay abroad, migrants acquire new skills in addition to accumulated savings (Hamdouch and Wahba 2015; Wassink 2020, Tamwo et al. 2022). These resources accumulated abroad enable them to open medical schools or hospitals equipped with cutting-edge technology once they return. Furthermore, once abroad, migrants can put pressure on international institutions to improve institutions (Shain and Barth 2003), particularly health institutions. Finally, the most important indirect effect is that associated with remittances. Remittances compensate for losses incurred in the country of origin. Remittances enable receiving families to increase their income and, consequently, their spending on healthcare. The effect of these resources on the host country depends on the skill levels of emigrants. The literature shows that high skilled emigrants have a low propensity to transfer financial resources to the home country because of the desire to integrate into the host society (Coulibaly and Gnimassoun 2023; Niimii et al. 2010). Ultimately, the overall impact of emigration on health depends on how the composition of migrants' skills affects remittances.

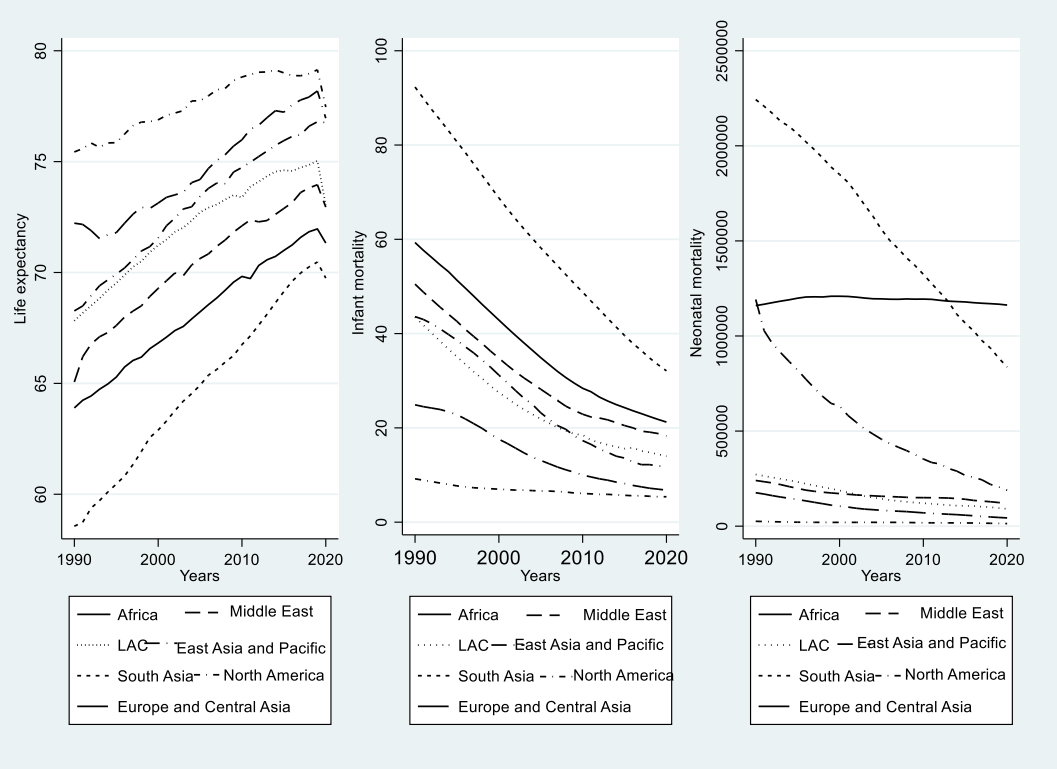

Fig. 1 Trends in global health indicators ; Source :Authors

The work that has addressed this relationship suffers from a number of shortcomings. While some studies focus exclusively on the migration of health professionals (Chikanda 2006; Grignon et al. 2006), others, such as those by Uprety (2019) and Immurana (2020), focus on a few health indicators and do not check whether the effect on health varies according to gender in the countries of origin. Furthermore, these authors use estimation techniques that do not take into account the correction of endogeneity problems, which could lead to biased estimators and therefore call into question the quality of the results obtained. Unlike Uprety (2019) and Immurana (2020), we focus on all the health indicators used in the literature, taking care to check whether the impact of emigration on health varies according to gender. Moreover, unlike previous authors, we use two-stage least squares with pseudo gravity models based on recent developments on international migration (Coulibaly and Gnimassoun 2023; Coulibaly and Omgba 2021; Docquier et al. 2016). Uprety (2019) uses fixed effects estimator while, Immurana (2020) uses the system generalised method of moments (GMM). While fixed effects do not correct for endogeneity, GMMs corrects for this problem, but suffers from the criticism linked to the proliferation of internal instruments (Roodman 2009).

The aim of this study is therefore to evaluate empirically the effect of emigration on health by focusing on a sample of 31 African countries. The choice of Africa is justified by the fact that the number of African migrants to the OECD (Organisation for Economic Co-operation and Development) has risen sharply in recent years. It rose from 7.2 million between 2000 and 2001 to 12.5 million between 2015 and 2016. This is the second biggest increase behind the Asian continent. Moreover, this migration is dominated by skilled migrants, creating perverse effects in the migrants home countries. To achieve our objectives, we therefore focus on the Brücker et al. (2013) database, which provides data on migratory stocks by education level for 20 OECD countries. This is the overall emigration rate and its sub-components by education level, in particular low skilled and high skilled. In line with the empirical literature, the health indicator chosen for this purpose is life expectancy at birth. Using a random-effects model validated on the basis of the Hausmann test, the results show that emigration improves health in Africa. However, the positive effect is greater for migrants with a low skilled. These results remain robust to the addition of control variables, the use of alternative health indicators, the use of alternative emigration indicators and the use of two-stage least squares with a pseudo gravity model.

The rest of the article is structured as follows. Section 2 presents the data and methodology. Section 3 focuses on the discussion of the results, while section 4 concludes.

Empirical methodology

Empirical model

This paper empirically analyses the effect of emigration on health in Africa (see Table A5 in the Appendix for the list of countries). It also tests whether this effect varies according to emigrants skills level. We construct a panel that contains 5-years non-overlapping averages data for each country (Gnimassoun 2019; Coulibaly and Gnimassoun 2023). Averages are constructed over the periods 1985-1989, 1990-1994, 1995-1999, 2000-2004, 2005-2009 and 2010-2014 (emigration data are for 1985, 1990, 1995, 2000, 2005 and 2010), giving us six periods for each cross-sectional unit. The specification used is consistent with the literature on health determinants (Uprety, 2019). The specification is :

$$LIEX_{it} = \alpha + \beta MIGR^{s}_{it-1} + \sum_{k} \phi_k X^{k}_{it-1} + \chi_{it} \quad (1)$$

where $LIEX_{it}$, represents life expectancy at birth ; $MIGR^{s}_{it-1}$, the emigration indicator with skill level s ; X^{k}_{it-1} , the control variables and χ_{it} the error term. The control variables used are all consistent with the empirical literature on health determinants (Uprety, 2019; Ajide and Alimi 2020; Banerjee et al. 2021; Immurana 2021; Alam et al. 2016; Uddin et al. 2023). The set of control variables includes:

- Trade openness (exports plus imports as a ratio of GDP). Trade openness has an ambivalent effect on health (Shah et al. 2021). Indeed, thanks to its positive effects on increasing economic activity, trade openness leads to an increase in income and consequently improves citizens' quality of life (Kohli 2004). While the positive effect of trade openness on health has been proven in the literature, the opposite effect has also been documented thanks to the rise in CO2 emissions. Increased trade openness leads to an intensification of economic activity, which in turn increases the quantity of CO2 emissions. This increase alters the quality of the environment, which is closely linked to life expectancy (Grossmann and Krueger 1991; Copeland and Taylor 2004).
- Financial development (IMF[2]'s composite financial development index). Financial development has an impact on health mainly through its positive effect on economic activity (Demetriades and Hook Law, 2006; Jalilian and Kirkpatrick 2002). An increase in economic activity leads to an increase in income, which in turn leads to an increase in healthcare expenditure (Alam et al. 2021).
- Urbanization (percentge of total population, refers to people living in urban area as defined by national statistical offices. The work of Kalėdienė and Petrauskienė (2000) shows that urbanization is a fundamental determinant of health in both developed and developing countries. People from urban areas find it easier to find a job. In addition to this ease of access to paid employment, urban populations have greater proximity in terms of medial, educational and socio-economic infrastructures (Uddin et al. 2023). This proximity facilitates access and, consequently has a favourable influence on people's health.
- Vaccination (percentage of children ages 12-23 months who received measles vaccination before 12 months or at any time before the survey). The recent COVID-19 pandemic has rekindled the debate on vaccine efficacy (Khubchandani et al. 2020; Kaur and Gupta 2020). Vaccines provide herd immunity in the fight against a pandemic. A high vaccination rate in a population limits the risk of developing severe forms of the disease (WHO 2020; Pezzotti et al. 2020; Doherty et al. 2016).
- Economic growth (GDP per capita, current US$). Economic growth has an impact on health mainly through its role in increasing income. The increase in income induced by economic growth improves nutrition through increased consumption of nutritious food (Lange and Vollmer 2017). Well-nourished individuals are less likely to fall ill. Similarly, higher incomes lead to increased spending on health and therefore to better health outcomes (Kim and Koh 2021; Acemoglu et al. 2013).

Variables such as urbanization, GDP per capita, trade openness, vaccination and the various health indicators are considered in logarithms. The use of the logarithm in the empirical literature is justified by the reduction of skewness in data (Saadi 2020). To choose between the fixed-effect estimator and the random-effect estimator, we perform the Hausman test. The null hypothesis validates the random effect while the alternative hypothesis

[2] International Monetary fund

validates the fixed effect. Regardless of the emigration indicator chosen, the results of the following Hausman test show that the random-effect estimator is more appropriate for our data.

when emigration is captured by low skilled:

$b =$ conistent under H_o and H_a ; obtained from xtreg

$B =$ inconsistent under, efficient under H_o ; obtained from xtreg

$$Chi^2(6) = (b-B)'\left[(V_b - V_B)^{-1}\right](b-B) = 10.13$$

$$\Pr ob. \succ Chi^2 = 0.11$$

when emigration is captured by high skilled

$$Chi^2(6) = (b-B)'\left[(V_b - V_B)^{-1}\right](b-B) = 8.65$$

$$\Pr ob. \succ Chi^2 = 0.19$$

When emigration is captured by the overall emigration rate

$$Chi^2(6) = (b-B)'\left[(V_b - V_B)^{-1}\right](b-B) = 11.2$$

$$\Pr ob. \succ Chi^2 = 0.12$$

As in the empirical literature, we lag explanatory variables to address endogeneity issues (Uprety 2019; Spilimbergo 2009; Docquier et al. 2016; Brinks and Coppedge 2006). Endogeneity in this case could result from reverse causality. Indeed, it is possible that life expectancy influences the variables on the right, like GDP per capita. According to Zhang and Lee (2003), individuals with a high life expectancy are likely to save more, which favours capital accumulation and therefore economic growth (Uprety 2019). In addition, these individuals invest more in education, which further stimulates economic growth (Uprety 2019). Before estimating our model, we ensure that there are no multicollinearity problems in our baseline specification. To do this, we use the Variance Inflation Factors (VIF). A VIF equal to 1 means that there is no correlation between the regressors. As a general rule, a VIF greater than 4 warrants further study, while a VIF greater than 10 is a sign of serious multicollinearity requiring correction (Uprety 2019). The results of the multicollinearity test are presented in Table A1 in the Appendix. For different emigration rates, we obtain a VIF of less than 2, proof that the multicollinearity problem does not arise.

Data

As in the empirical literature on international migration (Beine and Sekkat, 2013; Coulibaly and Gnimassoun, 2023; Uprety 2019), to capture emigration, we rely on the database of Brücker et al. (2023), which provides data on the total number of foreign individuals aged 25 and over living in each of the 20 OECD countries according to country of origin, educational level and gender from 1980 to 2010 at 5-year intervals. Thus, emigration is captured by three indicators: the overall emigration rate and its sub-components by level of education, in particular: low skilled (corresponding to no schooling, primary and lower secondary education) and high skilled (corresponding to any diploma higher than the high-school leaving certificate or equivalent). Due to data availability, we focus on the period from 1985 to 2010. The dependent variable, life expectancy at birth (total, year), indicates the number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life

The data on trade openness, GDP per capita, urbanization, vaccination and life expectancy at birth come from the World Bank database. As in previous studies, the health indicator used is life expectancy at birth (Uprety 2019; Immurana 2022; Banerje et al. 2021). As an indicator of financial development, we use the International Monetary Fund (IMF) composite indicator of financial development. According to Svirydzenka (2016), this indicator is more

interesting than traditional indicators of financial development because it takes into account financial institutions and financial markets. In the case of the gravity model, the data on the colonial link comes from the database of the Centre d'Etude Prospective et d'Information Internationale (CEPII).

The descriptive statistics contained in Table A2 in the Appendix show that emigration in Africa is dominated by high skilled migrants. The average is 0.152 for high skilled migrants compared with 0.0195 for low skilled migrants. Figure 2 shows the correlation between emigration and health outcomes in Africa, focusing on life expectancy at birth and the various emigration indicators. Figure 2 shows that emigration improves life expectancy at birth. This effect is greater for low skilled migrants. For high skilled migrants, although the relationship appears positive, the slope is flatter, indicating a weak impact.

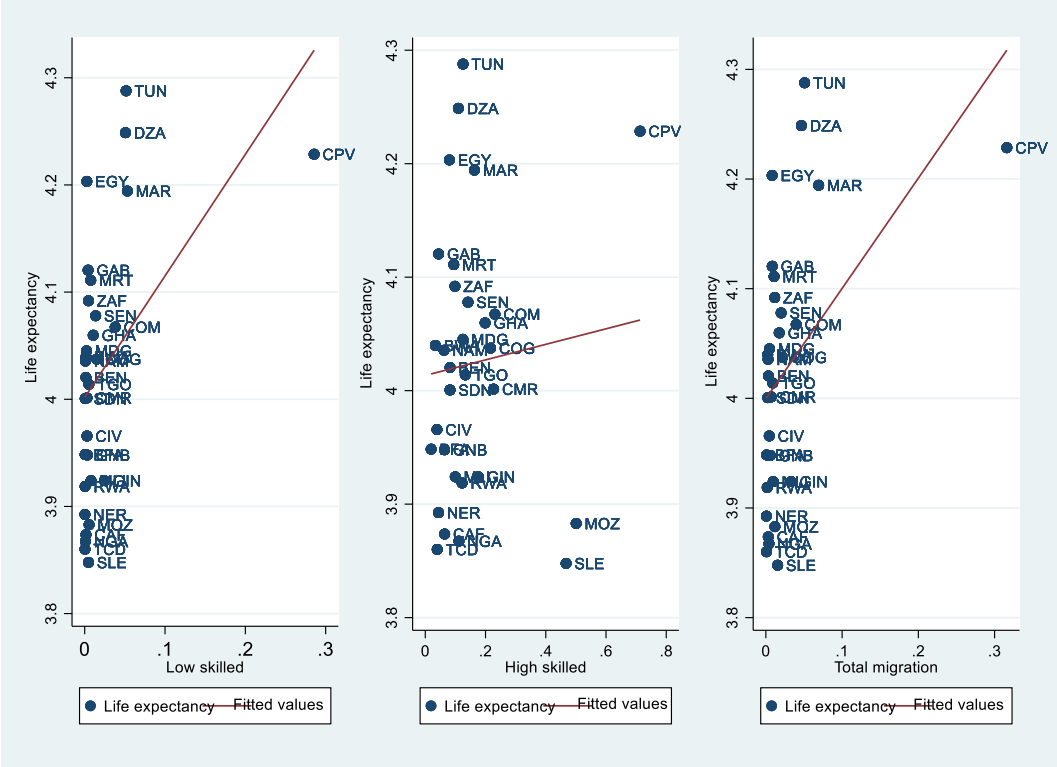

Fig. 2 Link between emigration and health in Africa ;Source: Authors, based on data from Brücker et al (2013) and the World Bank.

Results

Basic results

Table 1 presents the results of the effect of emigration on health outcomes in Africa. The three columns correspond to the three emigration indicators taken into account. In the first column, we focus on low skilled . In the second column, we consider the high skilled, while in the last column, we consider the overall emigration rate. The independent variable considered is life expectancy at birth. Irrespective of the emigration indicator chosen, the results show that the semi-elasticity of emigration in relation to life expectancy at birth is stable and always positive. Thus, the positive marginal effect indicates that an increase in emigration leads to an improvement in life expectancy at birth. Although the effect is positive for all emigration indicators, the magnitude is much greater for migrants with a low skilled. In fact, all other things being equal, the results suggest that a one standard deviation increase in low skilled (0.0514), high skilled (0.154) and total migration (0.0563) is associated with an increase

in life expectancy at birth of around 0.051, 0.033 and 0.036 years respectively. These results contradict the theoretical literature, which predicts a negative effect. More recently, Uprety (2019) shows independently of the skill levels of that emigration negatively influences life expectancy, with a greater effect for migrants with a high skilled. The negative effect can be explained in the literature by the brain drain of healthcare professionals (doctors, nurses, radiologists, etc…). Brain drain has an effect on reducing the quality of healthcare supply and consequently reduces life expectancy at birth. The pessimistic authors seem to neglect the effects of remittances. Indeed, it has been documented that migrants with a skilled migrants remit fewer than their counterparts with a low low skilled (Coulibaly and Gnimassoun 2023).

Table1 Effect of emigration on healh outcomes in Africa

	Life expectancy		
	(1)	(2)	(3)
Low skilled, t-1	0.604**		
	(0.273)		
High skilled, t-1		0.218**	
		(0.100)	
Total migration, t-1			0.651**
			(0.316)
ln Urbanization	0.223***	0.234***	0.224***
	(0.0542)	(0.0509)	(0.0550)
ln GDP per capita, t-1	0.0153	0.0141	0.0142
	(0.0134)	(0.0122)	(0.0131)
ln Immunization, t-1	0.0894***	0.0856***	0.0875***
	(0.0227)	(0.0237)	(0.0229)
ln Trade openness, t-1	0.0253	0.0268	0.0247
	(0.0201)	(0.0189)	(0.0202)
Financial development, t-1	-0.310**	-0.324**	-0.317***
	(0.122)	(0.127)	(0.121)
Constant	2.704***	2.662***	2.716***
	(0.109)	(0.107)	(0.111)
Observations	155	155	155
Country	31	31	31
R-squared	0.517	0.431	0.514

t statistics are in parentheses

*, **, ***Significance at the 10, 5, and 1% levels. Source : Authors

For migrants with a low skilled, their families back home receive a large amount of remittances. These monetary transfers lead to an increase in income and consequently in health expenditure. On the other hand, for high skilled migrants with, the amount of remittances to the home country are low, thus limiting the effectiveness of these funds on health. The results obtained from Table 1 also show that urbanization and vaccination improve health in Africa, while financial development worsens it. The positive effect of vaccination and urbanization on health corroborates the results obtained in the empirical literature (Banerje et al. 2021; Uprety 2019; Ajide and Alimi 2020). On the other hand, the negative effect of financial development is contrary to the empirical literature on migration (Uddin et al. 2023; Sehrawat and Agiri 2017). Several elements may justify this contradictory result. First, most previous work uses traditional indicators of financial development that are heavily criticised (Svirydzenka 2016). Second, in most African countries, access to finance remains a challenge. For example, in order to access finance, some people are sometimes forced to sell their fixed assets such as houses, cars and so on (Kindleberger et al. 2005). This situation is likely to cause extreme stress for these people, leading to a negative impact on their health (Kindleberger et al. 2005).

Robustness checks

Several sensitivity analyses are carried out as part of this work. First, we use alternative health indicators used in the literature. These are infant mortality (Infant mortality rate is the number of infants dying before reaching one year of age, per 1000 live births in a given year) (Banerje et al. 2021; Uprety 2019) and neonatal mortality

(Neonatal mortality rate is the number of neonates dying before reaching 28 days of age, per 1,000 live births in a given year) (Immurama, 2021; Vu , 2020; Toseef et al., 2019). In addition to using the aggregate indicator of these two variables (Table 2), we also consider the gender-disaggregated indicator to check whether the effect of emigration on health outcomes varies by gender (Table A3 in the Appendix). In addition to considering infant mortality by gender, we also consider life expectancy at birth by gender (Table 3).

Table 2 The effect of emigration on health outcomes in Africa, the use of alternative health indicators

	Infant mortality			Neonatal mortality		
	(1)	(2)	(3)	(4)	(5)	(6)
Low skilled, t-1	-1.628***			-8.996***		
	(0.476)			(2.796)		
High skilled, t-1		-0.130			0.461	
		(0.336)			(0.548)	
Total migration, t-1			-1.745***			-8.033***
			(0.649)			(2.455)
ln Urbanization, t-1	-0.269**	-0.454***	-0.406***	-0.244	-0.315*	-0.227
	(0.112)	(0.111)	(0.111)	(0.176)	(0.176)	(0.176)
GDP per capita, t-1	-0.278***	-0.180***	-0.177***	-0.0312	-0.0425	-0.0146
	(0.0421)	(0.0556)	(0.0553)	(0.0711)	(0.0715)	(0.0715)
ln Immunization, t-1	-0.300***	-0.335***	-0.337***	0.103	0.107	0.107
	(0.0537)	(0.0704)	(0.0677)	(0.110)	(0.110)	(0.110)
ln Trade openness, t-1	-0.0149	-0.190***	-0.177***	-0.189	-0.178	-0.177
	(0.0668)	(0.0640)	(0.0643)	(0.119)	(0.119)	(0.119)
Financial developement, t-1	0.386	0.299	0.260	0.424	0.372	0.439
	(0.296)	(0.372)	(0.356)	(0.547)	(0.546)	(0.547)
Constant	8.272***	9.061***	8.863***	10.72***	10.76***	10.50***
	(0.367)	(0.458)	(0.455)	(0.640)	(0.647)	(0.647)
Observations	155	155	155	155	155	155
Country	31	31	31	31	31	31
R-squared	0.6961	0.581	0.635	0.3614	0.114	0.346

t statistics are in parentheses

*, **, ***Significance at the 10, 5, and 1% levels. Source : Authors

Table 3 Effect of emigration on health outcomes by gender

	Life expectancy					
	Female			Male		
	(1)	(2)	(3)	(5)	(6)	(7)

Low skilled, t-1	0.662***			0.531*		
	(0.246)			(0.303)		
High skilled, t-1		0.196**			0.233**	
		(0.0947)			(0.107)	
Total migration, t-1			0.692**			0.593*
			(0.276)			(0.358)
ln Urbanization, t-1	0.203***	0.215***	0.204***	0.241***	0.251***	0.242***
	(0.0515)	(0.0488)	(0.0523)	(0.0562)	(0.0525)	(0.0570)
ln GDP per capita, t-1	0.0208	0.0198*	0.0196	0.0106	0.00917	0.00947
	(0.0130)	(0.0119)	(0.0126)	(0.0141)	(0.0127)	(0.0136)
ln Immunization, t-1	0.0888***	0.0847***	0.0868***	0.0897***	0.0866***	0.0880***
	(0.0234)	(0.0245)	(0.0236)	(0.0228)	(0.0236)	(0.0230)
ln Trade openness, t-1	0.0203	0.0228	0.0198	0.0295	0.0300	0.0288
	(0.0172)	(0.0165)	(0.0171)	(0.0243)	(0.0225)	(0.0244)
Financial developement, t-1	-0.295**	-0.312**	-0.303**	-0.325***	-0.335***	-0.331***
	(0.121)	(0.125)	(0.120)	(0.124)	(0.129)	(0.123)
Constant	2.787***	2.742***	2.800***	2.627***	2.590***	2.638***
	(0.104)	(0.104)	(0.106)	(0.121)	(0.117)	(0.123)
Observations	155	155	155	155	155	155
Country	31	31	31	31	31	31
R-squared	0.538	0.448	0.534	0.488	0.41	0.487

t statistics are in parentheses

*, **, ***Significance at the 10, 5, and 1% levels. Source : Authors

Despite the use of alternative health indicators or the taking into account of gender, the results contained in Tables 2, 3 and A3 (in Appendix) confirm those obtained previously in Table 1, in particular the improvement of health through emigration. Tables 2 and 3 show that low skilled migrants remain fundamental to improving health in Africa. Their effect remains greater than that of skilled migrants. This situation is even more relevant in the case of Table A3 (in Appendix), which shows that skilled migrants have no effect on infant mortality. Overall, the results obtained for the control variables also support those obtained in Table 1, in particular a positive and significant effect of urbanization and vaccination on health outcomes in Africa.

Second, we control for the effect of some variables considered relevant in the empirical literature on health determinants (Immurama, 2021, Ajide and Alimi 2020 ; Odokonyero et al. 2017 ; Toseef et al. 2019). These are fertility, inflation and official development assistance. The mechanisms by which these variables affect health are described as follows. In the case of fertility (total, births per woman), the literature has recognised that having children, or a certain number of children, can affect an individual's quality of life. Young age at first pregnancy is associated with a reduction in breast cancer (Erlandsson et al. 2002; Kvale 1992). In particular, in women with a family history, having children reduces the risk of ovarian cancer (Vachon et al. 2002; Negri et al. 1992). Conversely, a later age at first pregnancy reduces the likelihood of contracting Achilles tendon cancer (Hinkula et al. 2002). As far as inflation (GDP defaltor, annual percentage) is concerned, the rise in food prices has an effect on the health of households with limited budgets because it reduces spending on food and health. Reduced spending on nutrition leads to the consumption of poorer quality food, which is detrimental to the health of people who are unable to use the health system because of their precarious situation. The empirical literature supports these theoretical predictions. Black et al (2008) show that around 11% of the total global burden of disease and 35% of deaths in children under five are attributed to nutrition-related factors. Finally, the relationship between official development assistance (current US$) and health is ambiguous. Some authors defend a positive effect while others defend a negative effect. Proponents of the positive effect argue that it occurs if two conditions are met, namely the orientation of aid towards public spending that improves welfare indicators and countries with lower welfare at the outset (Toseef et al. 2019). On the other hand, authors who maintain a negative effect do so for several reasons. First, they argue that aid does not target the intended population. Second, they denounce the leakage of resources and the crowding out of government spending by aid. Finally, they point to poorly designed projects (Odokonyero et al. 2017; Thiele et al. 2007). It follows from Table 4 that the introduction of these additional control variables does not alter the results obtained previously.

Table 4 Adding control variables

	Life expectancy								
	Fertility			Official development assistance			Inflation		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Low skilled, t-1	0.589**			0.600**			0.564**		
	(0.261)			(0.284)			(0.272)		
High skilled, t-1		0.201**			0.220**			0.207**	
		(0.0976)			(0.101)			(0.0993)	
Total migration, t-1			0.621**			0.650**			0.609**
			(0.296)			(0.326)			(0.307)
ln Urbanization, t-1	0.206***	0.217***	0.208***	0.225***	0.236***	0.226***	0.224***	0.232***	0.224***
	(0.0571)	(0.0546)	(0.0575)	(0.0546)	(0.0510)	(0.0555)	(0.0549)	(0.0517)	(0.0557)
ln Gdp per capita, t-1	0.0124	0.0122	0.0118	0.0150	0.0137	0.0139	0.0148	0.0138	0.0137
	(0.0146)	(0.0134)	(0.0142)	(0.0133)	(0.0121)	(0.0130)	(0.0134)	(0.0124)	(0.0131)
ln Immunization, t-1	0.0900***	0.0871***	0.0886***	0.0883***	0.0848***	0.0865***	0.0918***	0.0889***	0.0900***
	(0.0228)	(0.0238)	(0.0229)	(0.0231)	(0.0239)	(0.0233)	(0.0220)	(0.0227)	(0.0221)
ln Ouverture commerciale, t-1	0.0211	0.0230	0.0209	0.0248	0.0264	0.0243	0.0240	0.0249	0.0235
	(0.0202)	(0.0189)	(0.0202)	(0.0216)	(0.0198)	(0.0216)	(0.0203)	(0.0189)	(0.0203)
Développement financier, t-1	-0.310**	-0.318**	-0.314**	-0.317**	-0.330**	-0.324***	-0.328***	-0.339***	-0.334***
	(0.125)	(0.129)	(0.124)	(0.125)	(0.129)	(0.124)	(0.122)	(0.125)	(0.121)
ln fertility, t-1	-0.0299	-0.0249	-0.0252						
	(0.0296)	(0.0280)	(0.0295)						
ln Official developement assistance, t-1				0.00243	0.00173	0.00225			
				(0.00936)	(0.00839)	(0.00926)			
ln Inflation, t-1							-0.00523	-0.00556	-0.00494
							(0.00501)	(0.00474)	(0.00489)
Constant	2.849***	2.788***	2.840***	2.696***	2.656***	2.708***	2.717***	2.683***	2.728***
	(0.167)	(0.165)	(0.167)	(0.113)	(0.110)	(0.115)	(0.104)	(0.101)	(0.107)
Observations	155	155	155	155	155	155	155	155	155
Country		31	31	31	31	31	31	31	31
R-squared	0.539	0.455	0.533	0.513	0.428	0.51	0.517	0.439	0.515

t statistics are in parentheses *, **, ***Significance at the 10, 5, and 1% levels. Source : Authors

Third, we use alternative indicators of emigration, namely the medium skilled migrants (high-school leaving certificate or equivalent) taken from Brücker et al. (2013). In addition, similar to Uprety et al. (2019), we consider a new variable called skills which is the sum between the high skilled and the medium skilled migrants. Finally, a last robustness analysis is based on the elimination of outliers. Figure 2 shows that Cabo Verde has very high values in terms of the emigration indicator. We therefore removed this country from the sample and repeated the estimates. The results obtained show that by using an alternative emigration indicator (Table 5) or removing Cabo Verde from our sample (Table A4 in the Appendix), we obtain the same results as in Table 1.

Table 5 Use of an alternative emigration indicator

	Life expectancy	
	(1)	(2)
Low skilled, t-1	0.440**	
	(0.211)	
Skills, t-1		0.171**
		(0.0785)
ln Urbanization, t-1	0.230***	0.234***
	(0.0531)	(0.0515)
ln GDP per capita, t-1	0.0161	0.0145
	(0.0129)	(0.0121)
ln Immunization, t-1	0.0842***	0.0843***
	(0.0241)	(0.0241)
ln Trade openness, t-1	0.0255	0.0262
	(0.0205)	(0.0192)
ln Financial development, t-1	-0.325***	-0.327***
	(0.122)	(0.126)
Constant	2.693***	2.671***
	(0.111)	(0.108)
Observations	155	155
Country	31	31
R-squared	0.481	0.443

t statistics are in parentheses

*, **, ***Significance at the 10, 5, and 1% levels. Source : Authors

Endogeneity: pseudo gravity model

Although part of the literature agrees with the use of the lag of explanatory variables to correct endogeneity problems (Uprety 2019; Spilimbergo 2009; Docquier et al. 20016; Brinks and Coppedge 2006), the other part develops appropriate methods based on the use of instrumental variables or the GMM. Due to the proliferation of internal instruments, the GMMs have been strongly criticised (Roodman 2009) in favour of the use of instrumental variable methods. Thus, we correct endogeneity problems by using an alternative method, namely two-stage least squares (2SLS) based on recent developments in the literature on international migration (Ortega and Peri 2014; Docquier et al. 2016; Coulibaly and Omgba 2021; Coulibaly and Gnimassoun 2023). The 2SLS considered rely on a pseudo gravity model to build a prediction based on the geography of bilateral migratory stocks. Thus, we consider the following pseudo gravity model that allows bilateral relations to vary over time within the framework of a panel:

$$\ln Emi_{ij}^{s} = \tau_1 \ln Emi_{ij,1980} + \tau_2 (Landlocked_i + Landlocked_j) + \tau_3 Coloni_{ij} + \varsigma_t + \chi_{jt} + \omega_{ijt} \quad (2)$$

where Emi_{ij}^{s} is the stock of migrants with the skill level s, born in the country i and living in the country j at date t. $Emi_{ij,1980}$, is the stock of migrants in 1980. $Landlocked$, is a binary variable that captures countries with access to the sea. This variable takes the value 1 when the country has access to the sea and otherwise.

$Colony$, is also a binary variable which captures the colonial link between the migrants' host country and country of origin. It takes the value 1 when there is a colonial link between the host country and the country of origin and 0 otherwise. Given the importance of migration policies in host countries, multilateral resistance in destination countries is the most important aspect of multilateral resistance in the context of international migration (Beine and Parsons 2015). Thus, to account for this multilateral resistance, equation 2 incorporates destination fixed effects (ς_t) and destination-time fixed effects (χ_{jt}), reflecting the reaction of bilateral migration in a given origin-destination pair to any time-varying shock occurring in another pair (Coulibaly and Gnimassoun 2023). Finally, ω_{ijt} , is the error term. After estimating equation 2 for each skill level, we calculate the predicted emigration for each country of origin by summing the predicted variable over the countries of destination (20 OECD countries) j ($Emi_{ij} = \sum_{j} Emi_{itj}$). The gravity model is estimated using the non-linear Possion pseudo Maximum likelihood (PPML) approach. Similar to Silva and Tenreyro (2010), we address the problem of identifying PPML estimates with a large number of zero regressors and non-negative values of the dependent variable. In addition to taking into account the problems of heteroskedasticity, this approach has the advantage of taking into account the problems of the dependent variable linked to zero observations (Silva and Tenreyro 2010). Table 6 reports the results of the pseudo gravity model. The results show that migration stocks in 1980, the colonial link and access to the sea explain bilateral migration flows.

Table 6 Results of the gravity model

	Low skilled	High skilled	Total migration
	(1)	(2)	(3)
ln Emigration rate in 1980	0.0698***	0.0702***	0.0623***
	(0.0231)	(0.0130)	(0.0162)
Sum landlocked	3.523***	4.080***	3.678***
	(0.289)	(0.238)	(0.244)
Colonial ties	2.861***	1.338***	2.116***
	(0.241)	(0.213)	(0.202)
Constant	3.933***	2.098***	4.085***
	(0.391)	(0.316)	(0.322)
Time fixed effects	Yes	Yes	Yes
Destination-time fixed effects	Yes	Yes	Yes
Observations	3 720	3 720	3 720
R-quared	0.146	0.045	0.096

t statistics are in parentheses

*, **, ***Significance at the 10, 5, and 1% levels. Source : Authors

Table 7 presents the results of the random effect estimator with pseudo gravity model. Before commenting on these results, it is worth checking whether the instruments used in the pseudo gravity model are valid. Therefore, we consider the rk Wald F-stat test of Kleibergen and Paap (2006) which tests the null hypothesis of weak instruments. For each regression in Table 7, the Kleibergen and Paap (2006) test statistic for weak identification is above the demanding Stock and Yogo (2005) critical value at the 10% and 25% thresholds. In all cases, we individually reject the null hypothesis of weak individual identification. Overall, the results confirm those obtained in Table 1, namely that emigration improves health in Africa. As in Table 1, the effect of migrants with a low skilled remains significant. The results obtained for the control variables are also consistent with those obtained in Table 1. Although the results obtained in Table 7 confirm those obtained in Table 1, it appears that Table 7 underestimates or overestimates the estimated coefficients, depending on the case. In the case of emigration indicators, the estimated coefficients obtained are lower than those obtained in Table 1. On the other hand, for the control variables, the estimated coefficients are larger than those obtained in Table 1. In conclusion, the endogeneity problem overestimates the estimated coefficients in the case of emigration indicators and underestimates in the case of control variables.

Table 7 Effect of emigration on health outcomes in africa, 2SLS results

	Life expectancy		
	(1)	(2)	(3)
Low skilled, t-1	0.355**		
	(0.177)		
High skilled, t-1		1.760***	
		(0.352)	
Total migration, t-1			-0.505
			(2.173)
ln Urbanization, t-1	0.230***	0.210	0.238***
	(0.0468)	(0.138)	(0.0394)
ln GDP per capita, t-1	0.0155	-0.0132	0.0172
	(0.0127)	(0.0572)	(0.0139)
ln Immunization, t-1	0.0884***	0.0938*	0.0912***
	(0.0204)	(0.0522)	(0.0210)
ln Trade openness, t-1	0.0271	0.0132	0.0308
	(0.0242)	(0.0540)	(0.0239)
Financial development, t-1	-0.318***	-0.352**	-0.312***
	(0.0918)	(0.174)	(0.0966)
Constant	2.682***	2.725***	2.632***
	(0.203)	(0.356)	(0.189)
Observations	155	155	155
Nombre de pays	31	31	31
R-squared	0.497	0.612	0.532
K-P F-stat	88.6	104.7	37.7
SY 10% max IV size	16.38	16.38	16.38
SY 25 % max IV size	5.53	5.53	5.53

t statistics are in parentheses

*, **, ***Significance at the 10, 5, and 1% levels. Souce : Authors

Conclusion and policy implications

In this paper, we examine how emigration, especially of skilled workers, affects health in a sample of 31 African countries. The underlying idea is that emigration of skilled workers reduces the quality of health supply. On the other hand, emigration of low-skilled workers improves health. Theoretical literature indicates that low-skilled emigrants transfer more financial resources to the home country than skilled emigrants, mainly due to the desire of skilled migrants to settle in the host country.

Focusing on the Brücker et al. (2013) database, three emigration indicators are selected in accordance with the literature, namely: the overall education rate and its components by skill levels, in particular low and high skilled rate On the basis of a random model chosen using the Hausman test, the results show that emigration improves health in Africa. However, the effect on health is greater for migrants with a low skilled. The results remain robust to the addition of control variables, the use of alternative indicators of health and emigration and the use of two-stage least squares with a pseudo gravity model.

This study has a particular implication. It is important for policy-makers in the home countries to pursue policies that reduce the migration of skilled workers, as they have only a marginal influence on the home countries. This category of migrants would be more important for the development of the home country. On the other hand, policymakers should pursue policies that encourage the migration of low-skilled workers, as they are seen as agents of development.

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Appendix

Table A1 Multicollinearity test

Variable	VIF	1/VIF	VIF	1/VIF	VIF	1/VIF
Low skilled, t-1	1.14	0.874				
High skilled, t-1			1.2	0.835		
Total migration, t-1					1.15	0.866
ln GDP per capita, t-1	2.66	0.357	2.85	0.351	2.67	0.375
ln Urbanization, t-1	2.28	0.439	2.33	0.428	2.28	0.437
ln Trade openness, t-1	1.45	0.691	1.43	0.718	1.45	0.69
ln Immunization, t-1	1.39	0.717	1.45	0.688	1.4	0.715
Financial developement, t-1	1.4	0.714	1.42	0.706	1.4	0.715
Total	1.72		1.78		1.72	

Source : Authors

Table A2 Descriptive statistics

Variable	Observations	Mean	Std deviation	Min	Max
Low skilled	186	0.0195	0.0514	0.000100	0.298
High skilled	186	0.152	0.154	0.0167	0.769
Total migration	186	0.0240	0.0563	0.000384	0.336
Medium skilled	186	0.0315	0.0686	0.000487	0.381
Skills	186	0.183	0.214	0.0172	1.133
ln Life expectancy	186	4.024	0.139	3.666	4.325
ln Neonatal mortality	186	4.053	0.140	3.702	4.367
ln Life expectancy_Male	186	3.994	0.139	3.617	4.293
ln Life expectancy_Female	186	4.117	0.489	2.628	5.085
ln Infant mortality_Male	186	4.288	0.475	2.812	5.178

ln Infant mortality	186	4.2097	0.482	2.726	5.177
ln Infant mortality_Female	186	4.210	0.482	2.727	5.178
ln GDP per capita	186	6.750	0.947	5.204	9.047
ln trade openness	186	4.014	0.414	2.666	4.910
ln Immunization	186	4.122	0.353	2.821	4.593
ln Urbanization	186	3.587	0.438	1.648	4.461
ln Fertility	186	1.621	0.307	0.690	2.063
ln Inflation	186	2.549	1.175	-1.942	5.228
ln Official development assistance	186	3.761	0.836	0.313	6.191
		Pseudo gravity model			
Low skilled	3720	1.307	12.094	0	297.16
High skilled	3720	957.0	4.696	0	92.377
Total migration	3720	2,715	16.565	0	341.88
ln Emigration rate in 1980	3720	1,952	20.030	1.00e-04	461.77
Sum landlocked	3720	0.961	0.193	0	1
Colonial ties	3720	0.0495	0.217	0	1

Source : Authors

Table A3 Effect of migration on health outcome in Africa, taking into account gender

	Infant mortality					
	Female			Male		
	(1)	(2)	(3)	(4)	(5)	(6)
Low skilled, t-1	-1.521***			-1.565***		
	(0.517)			(0.530)		
High skilled, t-1		-0.120			-0.130	
		(0.333)			(0.336)	
Total migration, t-1			-1.701***			-1.745***
			(0.634)			(0.649)
ln Urbanization, t-1	-0.406***	-0.458***	-0.411***	-0.401***	-0.454***	-0.406***
	(0.114)	(0.114)	(0.115)	(0.110)	(0.111)	(0.111)
ln GDP per capita, t-1	-0.185***	-0.184***	-0.182***	-0.180***	-0.180***	-0.177***
	(0.0564)	(0.0568)	(0.0564)	(0.0552)	(0.0556)	(0.0553)
ln Immunization, t-1	-0.360***	-0.352***	-0.354***	-0.344***	-0.335***	-0.337***
	(0.0704)	(0.0728)	(0.0701)	(0.0681)	(0.0704)	(0.0677)
ln Trade openness, t-1	-0.184***	-0.194***	-0.181***	-0.180***	-0.190***	-0.177***
	(0.0668)	(0.0661)	(0.0665)	(0.0645)	(0.0640)	(0.0643)
Financial developement, t-1	0.281	0.340	0.305	0.235	0.299	0.260
	(0.364)	(0.380)	(0.365)	(0.356)	(0.372)	(0.356)
Constant	8.922***	9.092***	8.894***	8.893***	9.061***	8.863***
	(0.459)	(0.467)	(0.463)	(0.451)	(0.458)	(0.455)
Observations	155	155	155	155	155	155
Country	31	31	31	31	31	31
R-squared	0.643	0.595	0.64	0.634	0.581	0.63

t statistics are in parentheses

*, **, ***Significance at the 10, 5, and 1% levels. Source : Authors

Table A4 The effect of emigration on health outcome in Africa, the case of the removal of Cape Verde from the sample

	Life expectancy		
	(1)	(2)	(3)
Low skilled, t-1	1.858***		
	(0.561)		
High skilled, t-1		0.221*	

		(0.128)	
Total migration, t-1			1.972***
			(0.591)
	(0.0585)	(0.0525)	(0.0601)
ln GDP per capita, t-1	0.0139	0.0139	0.0115
	(0.0142)	(0.0130)	(0.0135)
ln Immunization, t-1	0.0930***	0.0888***	0.0884***
	(0.0220)	(0.0233)	(0.0225)
ln Trade openness, t-1	0.0256	0.0253	0.0249
	(0.0200)	(0.0189)	(0.0198)
Financial developement, t-1	-0.287**	-0.310**	-0.301**
	(0.122)	(0.129)	(0.121)
Constant	2.755***	2.686***	2.780***
	(0.114)	(0.111)	(0.119)
Observations	150	150	150
Nombre de pays	30	30	30
R-squared	0.528	0.383	0.517

t statistics are in parentheses

*, **, ***Significance at the 10, 5, and 1% levels. Source : Authors

Table A5 List of countries

Algeria	Cabo Verde	Comores	Gabon	Madagascar	Mozambique	Rwanda	Sudan
Benin	Cameroun	Congo Republic	Ghana	Mali	Namibie	Sénégal	Togo
Botswana	Central Africa Republic	Côte d'Ivoire	Guinea	Mauritania	Niger	Sierra Leone	Tunisia
Burkina Faso	Chad	Egypt	Guinea-Bissau	Morocco	Nigeria	South Africa	

Source : Authors