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The effects of food affordability on life expectancy in emerging countries

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Abstract

The relationship between food prices and life expectancy in emerging countries has significant implications for public health and socioeconomic development in these regions. This study examines this relationship using a dataset of 120 emerging economies over the period 2000–2021, employing the dynamic panel threshold and system generalized method of moments (GMM) models. Our findings reveal a nonlinear inverted U-shaped relationship where beyond a specific threshold, higher food prices tend to shorten life expectancy. We also reveal the disproportionate burden placed on low-income countries when food prices rise, in comparison to middle-income countries and highlight the profound impact of economic disparities on public health. Moreover, we identify several channels through which food prices affect life expectancy. Specifically, we reveal that income, undernutrition, and mental health disorders represent potential mediating factors affecting food prices–life expectancy nexus. We also shed light on the severe implications of economic crises on public health, emphasizing the close connection between economic events and indicators of human health. These insights have direct implications for policymakers, offering valuable guidance in the context of fluctuating food prices.

KEYWORDS
economic growth, food prices, life expectancy, nonlinear

JEL CLASSIFICATION
I10, I15, Q18, C23

1 | INTRODUCTION

Understanding the relationship between food prices and life expectancy is crucial for designing effective public health policies and addressing socio-economic disparities among nations. While previous studies acknowledge the positive correlation between affordable food access and population health, uncertainties persist regarding the magnitude of this relationship and the moderating variables involved (Blazquez-Fernández et al., 2017; Shahbaz et al., 2019). This study aims to fill this gap by exploring the impact of food price variations on life expectancy, particularly in emerging economies, and identifying strategies to enhance health outcomes during economic turmoil.

This research differs from existing literature in several aspects that significantly enhance our understanding of the food price–life expectancy relationship. First, we test the existence of a nonlinear association between food prices and life expectancy by employing a dynamic threshold panel technique. This approach allows us to identify a critical price threshold beyond which rising food costs disproportionately impact health outcomes. The existence of such a relationship suggests that moderate food price increases might not adversely affect health, but excessive surges in food prices can have negative effects on health by hindering access to a balanced diet.

Second, our study advances the understanding of the complex relationship between food affordability and life expectancy in emerging economies as it employs a comprehensive approach that leverages both the global food price index (GFPI) and the domestic food consumer price index (DFPI). While the GFPI allows us to study the global trends in food commodity prices and their potential impact on life expectancy across a broad range of countries, it cannot fully capture the specific price variations of individual countries. To address this limitation, we incorporate the DFPI, which provides a specific analysis of food affordability challenges faced by households within each emerging economy under study. With the combined approach of examining both the global price trends and local price realities, we can better assess how food affordability influences life expectancy in these regions. This analysis offers a deeper understanding of the mechanisms at play and provides more targeted policy recommendations for policymakers aiming to improve public health outcomes in a fluctuating food prices landscape.

Third, we investigate the differential effects of food price fluctuations on life expectancy across income levels. Our research design allows us to analyze how rising food costs disproportionately impact low-income countries (LICs) compared to middle-income countries (MICs). This approach highlights the crucial need for specific policies that protect the most vulnerable populations from the negative health consequences of high food prices. The study also discusses the impact of economic recessions and pandemics on life expectancy. Specifically, it shows the severity of the challenges faced by LICs during the 2008 global financial crisis (GFC) and the 2020 COVID-19. These events had a substantial impact on the performance of the healthcare sector in LICs, while MICs have been better insulated from such crises due to their more diverse economic resources.

Finally, this study does not simply establish a correlation between food prices and life expectancy. Indeed, this study explores the potential pathways through which food price fluctuations affect health outcomes, by exploring factors such as undernutrition and mental health disorders and providing a deeper understanding of the underlying mechanisms that connect food affordability to life expectancy. To the best of the author's knowledge, such an analysis is novel and has not been documented in previous research. The findings of this study have, therefore, significant implications for policymakers and offer important insights for enhancing public health outcomes. Figure Supporting Information

The remainder of this article is structured as follows: Section 2 reviews the existing literature providing context for our study. Section 3 examines the evolution trends of food prices and life expectancy in emerging economies. Section 4 outlines the channels through which food prices affect life expectancy. Section 5 describes the data, research methodology, and analyzes the empirical findings. Section 6 presents the transmission mechanisms of food prices into life expectancy, while Section 7 thoroughly discusses the results, offering insights into the implications for public health policies. Finally, Section 8 concludes the study and provides policy recommendations based on the findings.

2 | LITERATURE REVIEW

Several studies in literature have attempted to identify the factors affecting life expectancy in various countries and regions. This section reviews this literature with a special focus on the various social and economic aspects (Bergh & Nilsson, 2010; Jafrin et al., 2021; Monsef & Mehrjardi, 2015; Obrizan & Wehby, 2018; Onwube et al., 2021; Rahman et al., 2022; Wirayuda et al., 2023).

The income level stands among the most popular factors affecting life expectancy (Barkat et al., 2019; Mackenbach, 2019; Monsef & Mehrjardi, 2015). Higher income is often associated with increased access to healthcare, education, and resources that promote better lifestyles. For instance, Ketenci and Murthy (2018) found that real per capita gross domestic product (GDP) positively affects life expectancy in the United States. In the same vein, Bayati et al. (2013) found a similar relation between income per capita and life expectancy in Eastern Mediterranean countries.

Moreover, better education affects health outcomes and life expectancy, as individuals with higher levels of education tend to take better health decisions and adopt healthier behaviors (Ketenci & Murthy, 2018). In this context, Şentürk et al. (2021), Rahman et al. (2022), and Jafrin et al. (2021) found a positive relationship between education attainment and life expectancy.

Access to healthcare services is another important determinant of life expectancy. A study conducted by Gilligan and Skrepnek (2015) spanning 21 countries in the Eastern Mediterranean Region from 1995 to 2010 highlighted the substantial impact of healthcare expenditure on longevity and emphasized the importance of sufficient healthcare expenditures in improving life expectancy.

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The empirical economic literature has also revealed that employment significantly affects life expectancy. In a study across 136 countries from 2002 to 2010, Monsef and Mehrjardi (2015) documented that unemployment adversely affects life expectancy due to the high level of stress and low access to healthy diets by unemployed people. In addition, many studies have shown the beneficial effects of international trade and trade liberalization on life expectancy, especially in nations with low levels of development (Herzer, 2017; Novignon et al., 2018).

Beyond individual income, education, employment, and trade openness, other social and political factors also play an important role in determining life expectancy. Shahbaz et al. (2016) examined the impact of economic misery on life expectancy in Pakistan from 1972 to 2012. They uncovered causal relationships indicating that life expectancy is positively related to health spending (HC), urbanization, and food supply, while being negatively related to economic misery and illiteracy. Similarly, Obrizan and Wehby (2018) used a dataset of 175 countries to reveal that HC exert a positive effect on longevity, especially in countries with low life expectancy. Lin et al. (2012) explored the effects of various social and political factors on life expectancy, focusing on less developed countries from 1970 to 2004. Their analysis revealed that political regimes have a slight impact on increasing life expectancy in the short run, but this influence gained prominence over time.

It is worth noting that the impacts of the socioeconomic factors on life expectancy are not consistent across the economic literature. Indeed, the findings by Kabir (2008) and Sede and Ohemeng (2015), revealed that commonly emphasized socioeconomic variables such as education, income, HC, safe water availability, and urbanization often proved to be insignificant predictors of life expectancy, particularly in emerging economies. However, these studies suggested that improving adult literacy accessibility, enhancing quality of government health expenditures, and addressing unemployment and undernourishment problems may enhance life expectancy in these countries.

Food prices are yet another fundamental component of a country's economic and social landscape that may indirectly affect life expectancy. Indeed, rising food prices can negatively impact household budgets. Faharuddin et al. (2022) examined the effects of increasing food prices on poverty in Indonesia. They found that higher food prices contribute to decreased welfare and increasing poverty rates, particularly in rural areas. This economic pressure can indirectly affect life expectancy by limiting access to healthcare and nutritious food. However, the net impact of food prices on poverty alleviation remains ambiguous. Several empirical studies have identified a negative correlation between food prices and poverty, indicating that an increase in food prices may, paradoxically, alleviate poverty by stimulating agricultural supply and augmenting wages in emerging economies (Fan et al., 2008; Headey, 2014; Headey & Martin, 2016; Ivanic & Martin, 2014; Jacoby, 2013; Van Campenhout et al., 2013).

While the literature has attempted to investigate the impact of various socioeconomic factors on life expectancy, the overall findings in the literature have often yielded mixed results. Furthermore, the effects of food prices on life expectancy and the exact patterns and implications of this relationship remain insufficiently explored, a gap that this study aims to address.

Table 1 summarizes the existing literature on the impact of socioeconomic, political, and environmental factors on life expectancy.

3 | EVOLUTION OF THE INTERNATIONAL AND DOMESTIC FOOD PRICE INDICES AND LIFE EXPECTANCY IN EMERGING ECONOMIES

Figure 1 illustrates the evolution of life expectancies by income group in emerging economies, alongside the trajectory of the food price index (global and domestic) obtained from the Food and Agriculture Organization (FAO) from 2000 to 2021. We divided our sample into two income groups, categorizing them as MICs and LICs according to the World Bank's classification of 2022.

The figure reveals a clear increase in life expectancy in LICs during the period from 2000 to 2021, rising from 53 to 62 years. This reflects a remarkable gain of 9 years on average. Similarly, in MICs over the same period, life expectancy increased from 66 to 70 years, illustrating a gain of 4 years on average.

Despite MICs showing higher life expectancies compared to their LICs counterparts, the growth rate of life expectancy in LICs has outpaced that of MICs. This period saw a remarkable 17% increase in life expectancy for LICs, as opposed to a 6% increase in MICs over the same period. This improvement can be explained by the fact that MICs have already achieved relatively higher levels of life expectancy so there is little margin for improvement compared to LICs.

Concurrently, the food price index showed a consistent upward trend since the early 2000s. After a minor dip in 2018, it resumed its upward trend, culminating in its highest recorded value in 2021 at 125 points. Additionally, the average food consumer price index for both MICs and LICs has witnessed a net increase since 2000s.

Examining the trends in life expectancy by gender in Figure 2 reveals two distinct observations. First, it is evident that females tend to have a higher life expectancy than males in both country groups. Second, the data shows a

TABLE 1 Summary of existing literature.

Variables	Impact	Authors
Real GDP per capita, income and investment	+	Mackenbach (2019)
		Ketenci and Murthy (2018)
		Monsef and Mehrjardi (2015)
		Gilligan and Skrepnek (2015)
		Bayati et al. (2013)
	Insignificant (Dev. countries)	Kabir (2008)
Inflation	–	Monsef and Mehrjardi (2015)
Unemployment	–	Monsef and Mehrjardi (2015)
		Onwube et al. (2021)
		Bayati et al. (2013)
Food availability	+	Bayati et al. (2013)
Education spending	+	Jafrin et al. (2021)
		Ketenci and Murthy (2018)
		Bayati et al. (2013)
	Insignificant (Dev. countries)	Kabir (2008)
Health spending	+	Wang et al. (2022)
	+ (countries with low life expectancy)	Obrizan and Wehby (2018)
		Gilligan and Skrepnek (2015)
	Insignificant (Dev. countries)	Kabir (2008)
Trade	+	Novignon et al. (2018)
		Herzer (2017).
		Owen and Wu (2007)
Urbanization	+	Shahbaz et al. (2016)
		Gilligan and Skrepnek (2015)
		Bayati et al. (2013)
	Insignificant (Dev. countries)	Kabir (2008)
Government expenditure	+	Onwube et al. (2021)
Political regimes (democracy)	+	Lin et al. (2012)
Demographic growth, and environmental degradation	–	Şentürk and Ali (2021)
Three aspects of globalization: economic, social, and political	+	Bergh and Nilsson (2010)
Globalization and financial development	+	Shahbaz et al. (2019)

significant disparity in the rate of increase in life expectancy between females and males during the period 2000–2021. Moreover, females in LICs experienced a substantial gain of 10 years in life expectancy, whereas this increase was 4.34 years only in MICs. In contrast, among males, the gain in life expectancy was 9 years in LICs compared to only 3.7 years in MICs. It is worth noting that the recent study by Schumacher et al. (2024), the COVID-19 pandemic killed over 16 million people worldwide over the 2020–2021 period. This high mortality led to a reduction in life expectancy by 1.6 years between 2019 and 2020 (Schumacher et al., 2024). At the regional level, life expectancy declined by 2.9 years in Latin America and the Caribbean, 1.7 years in Asia, and 1.2 years in Africa during 2019–2021 period (Cao et al., 2023).

The trends depicted in Figures 1 and 2 highlight distinct features in life expectancies. Hence, the remainder of this study aims to examine the determinants of these variations, with the goal of formulating tailored policy recommendations for each group of countries.

4 | CHANNELS ANALYSIS: HOW DO FOOD PRICES AFFECT LIFE EXPECTANCY IN EMERGING ECONOMIES?

In this section, we explore the various mechanisms through which food prices can affect life expectancy and identify four main channels through which this

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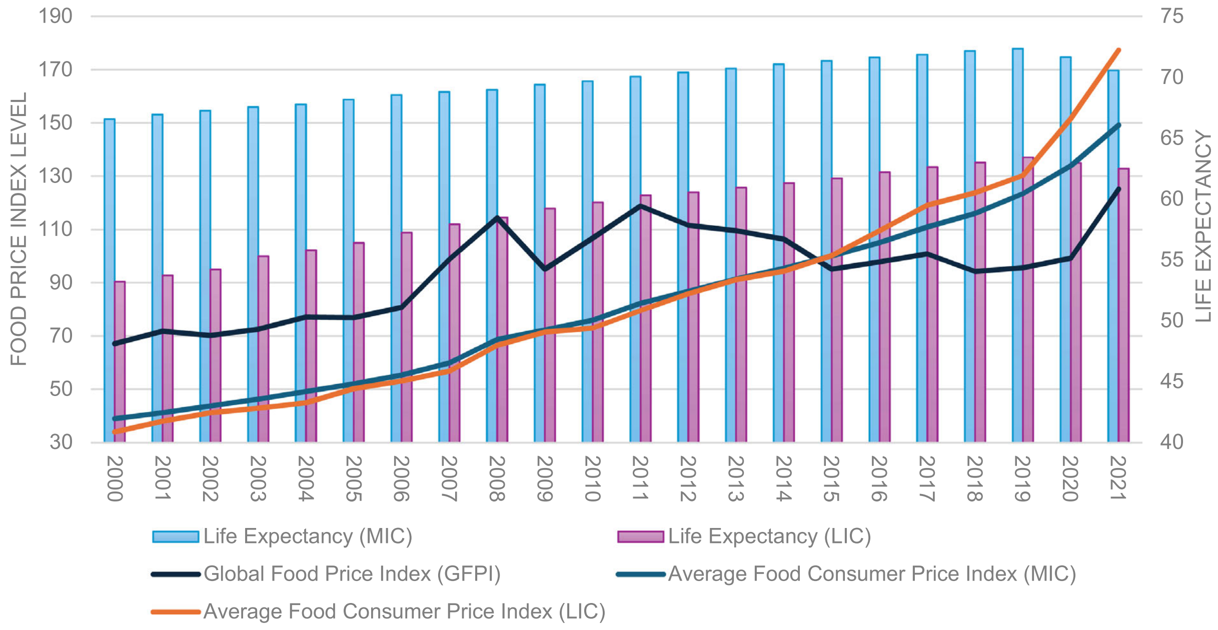

FIGURE 1 Global and domestic food price indices and life expectancy (by income groups). *Source:* Authors.

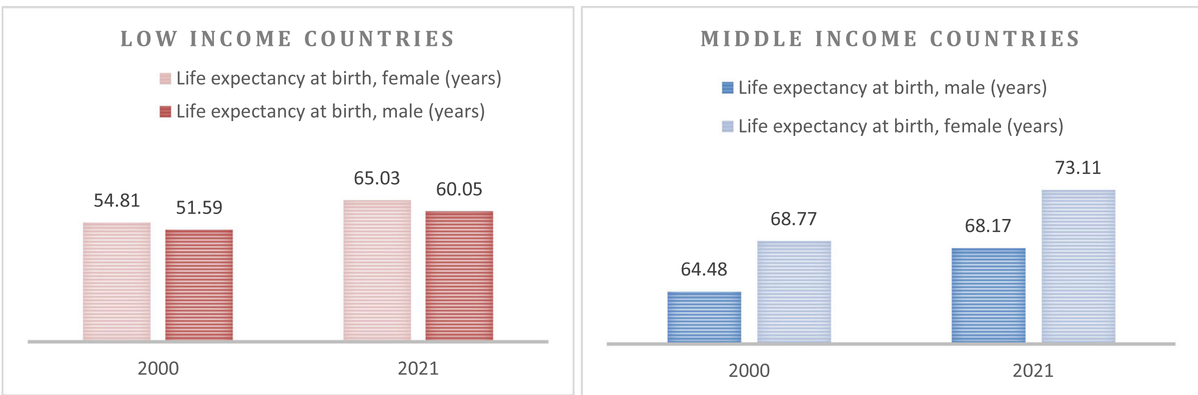

FIGURE 2 Life expectancy for females and males (by income groups).

transmission occurs: income, nutrition, mental health, and healthcare access and expenditure.

4.1 | Income poverty channel

Income in real terms plays a pivotal role in how food prices can impact life expectancy as it significantly affects an individual's or household's ability to afford food. This is particularly the case for lower-income populations who typically allocate a substantial portion of their revenue to essential foods (Cranfield et al., 2007). Accordingly, when food prices rise, it can further constrain their capacity to purchase nutritious foods, resulting in food insecurity and malnutrition, which can dramatically affect their life expectancy. Within this context, empirical studies have consistently shown that increases in food prices can lead to higher poverty rates, especially in the short term. This exacerbates the difficulties faced by low-income households in accessing healthy and nutritious food, thereby compromising their overall health and well-being (Barrett & Dorosh, 1996; Ivanic & Martin, 2008; Minot & Goletti, 2000; Ravallion, 1990).

Moreover, income levels in real terms can also affect the quality and diversity of foods that individuals consume. Higher-income households have greater purchasing power and can choose from a wider array of nutritious foods, such as fresh produce and lean meats. In contrast, lower-income households may be forced to rely solely on more affordable and less nutritious options, such as processed and fast foods. This significantly increases the risk of chronic diseases and may result in reduced life expectancy.

4.2 | Undernutrition channel

Undernutrition may be an important channel through which food prices can impact life expectancy. When food prices rise, individuals may limit the diversity of food they consume to the point where they are unable to meet their minimum nutritional requirements, leading to undernutrition. This undernutrition can manifest as stunting, wasting, or micronutrient deficiencies that can substantially increase the risk of morbidity and mortality, particularly among young children.

Research by Lee et al. (2016) has explored the effects of food prices on population health in emerging economies. The authors reveal that high and unpredictable food prices exert a substantial adverse effect on infant and child mortality, as well as the prevalence of malnutrition. This impact due to fluctuating food prices is significantly higher in LICs.

Undernutrition can result in long-term effects on health and life expectancy. It can alter cognitive development, subsequently affecting educational attainment and economic productivity (Lee et al., 2016; Victora et al., 2008). When it persists, undernutrition may increase the risk of chronic diseases such as cardiovascular disease, diabetes, and certain cancers, all of which can reduce life expectancy[1] (Portrait et al., 2011; Slawson et al., 2013).

Moreover, undernutrition can weaken the immune system making individuals more susceptible to infectious diseases, which further affect life expectancy (Calder & Jackson, 2000). In the poorest regions, undernutrition is often compounded with other factors such as poor sanitation, lack of access to clean water, and inadequate healthcare. All these factors may significantly increase the risk of morbidity and mortality.

4.3 | Mental health channels

Fluctuating food prices can affect mental health, potentially impacting life expectancy. Indeed, higher food prices can induce stress and anxiety, especially among those already facing financial challenges. This increased stress will usually result in adverse mental health outcomes (Dean et al., 2020; Murphy & Mercer, 2013; Victora et al., 2008), such as depression and anxiety disorders affecting the overall life quality. Moreover, increased food costs can contribute to social exclusion as individuals with low income may find it difficult to participate in social activities due to financial constraints. This social isolation can negatively impact mental health and, ultimately, affect life expectancy.

4.4 | Healthcare expenditure channel

Food prices can affect life expectancy through the healthcare access and health-related expenditure channel. As food prices rise, households may find themselves allocating a larger portion of their income toward purchasing food, which reduces significantly the financial resources dedicated to healthcare (Bouis et al., 2011; FAO, 1997). Hence, reduced healthcare access may be limited when individuals struggle to afford health insurance or out-of-pocket expenses, potentially causing delays in seeking medical care. These delays or inadequacies in healthcare treatments can result in health problems, ultimately diminishing life expectancy (Bein et al., 2017).

5 | EMPIRICAL RESULTS

5.1 | Data and estimation methodology

5.1.1 | Data

To investigate the impact of food prices and various socioeconomic factors on life expectancy, we compiled annual time-series data with total life expectancy at birth (LE) being the dependent variable. For the independent variables, we utilize the GFPI[2], domestic food consumer index[3] (DFPI), and general inflation (INF) to account for the effects of affordable food on life expectancy. We include the real GDP per capita and government HC as indicators of social development, while trade openness (TRA) is used to capture trade effects. Moreover, the access to clean fuels and technology is employed as a proxy of energy poverty (EP) (Barkat et al., 2023). These variables are extracted from the world development indicators (WDI),

[1] It is worth noting that Cutler et al. (2006, p.101) note that: "*Another concern with the nutritional story is that, from the sixteenth to the eighteenth centuries, English aristocrats had no life expectancy advantage over the rest of the population, despite presumably better nutrition. Moreover, mortality was not lower in well-fed populations of the same period, such as in the United States (Livi-Bacci, 1991)*".

[2] The GFPI, published by the Food and Agriculture Organization of the United Nations (FAO), tracks changes in international prices of five major food commodity groups: cereals, vegetable oils, dairy, meat, and sugar. This index provides a global perspective on food price trends and reflects average export quotation changes for these commodities.

[3] The DFPI, also provided by FAO, monitors changes in the average retail prices of a basket of food items commonly consumed by households within specific countries. While the specific food items included in the Food CPI can vary by country, they typically include a broader range of food products than the GFPI, offering a more localized view of food affordability challenges faced by individual nations.

TABLE 2 Descriptives statistics.

Panel						Middle-income countries					Low-income countries					t-test[a]
Variable	Obs	Mean	Std. dev.	Min	Max	Obs	Mean	Std. dev.	Min	Max	Obs	Mean	Std. dev.	Min	Max	P-value
LE	2640	65.65	8.10	41.96	79.73	2046	67.94	7.18	41.96	79.73	594	57.78	5.82	44.52	73.88	.00
GFPI	2640	94.79	16.45	67.06	125.08	2046	94.79	16.45	67.06	125.08	594	94.79	16.45	67.06	125.08	1.00
DFPI	2640	84.52	67.72	1.69	1630.00	2046	81.72	56.15	1.69	1630.74	594	90.74	97.42	5.33	1060.35	.01
GDP	2585	3275.70	2805.70	255.10	14,222.55	2030	3972.99	2773.84	318.01	14,222.55	555	725.27	490.26	255.10	2547.64	.00
INF	2382	8.40	24.63	−10.07	557.20	1892	7.37	19.02	−10.07	557.20	490	12.38	39.19	−8.97	513.91	.00
EP	2495	45.33	36.85	.00	99.90	1928	55.73	33.82	.40	99.90	567	9.94	21.66	.00	98.90	.00
HC	2442	5.42	2.24	1.26	20.41	1926	5.32	2.17	1.26	14.08	516	5.76	2.46	1.55	20.41	.00
TRA	2388	74.81	34.94	4.12	347.99	1902	79.93	36.27	15.68	348.00	486	54.76	18.71	4.13	126.35	.00

Abbreviations: DFPI, domestic food consumer price index; EP, energy poverty; GDP, gross domestic product; GFPI, global food price index; HC, health spending; INF, inflation; LE, life expectancy at birth; TRA, trade openness.
[a]The t-test is two sample t test (mean comparison test) in which H_0: The means of the two groups are equal.

the World Bank, and the FAO. The study covers 120 emerging economies during the period 2000–2021. Moreover, we divide the sample into two groups, namely, MICs and LICs to explore whether there are variations in the relationship between food prices and life expectancy based on the countries' income levels. The full list of these countries is provided in the appendix in Table A1. Finally, the description of the variables under investigation in this study and their sources are reported in Table A2 Table A3 of the appendix.

Table 2 provides summary statistics for the socio-economic indicators for all countries and the two subsamples (i.e., MICs and LICs), in addition to the t-test results for the two subsamples comparing the means of our variables. Table 2 highlights that LE, which is a fundamental health indicator, displays significant disparities. MICs have significantly higher life expectancies, averaging 67.94 years, compared to LICs with an average of 57.78 years, reflecting the impact of income on healthcare access and outcomes. Moreover, the economic performance, as measured by GDP per capita, varies widely in the subsamples. MICs exhibit a much higher average GDP per capita ($3972.99) compared to LICs ($725.27), emphasizing the economic challenges faced by LICs in achieving sustainable growth. For the trade openness variable, MICs display a high mean score compared to LICs, suggesting that MICs are more actively involved in international trade than LICs. Table 2 also reveals that inflation rates vary between the two groups suggesting the existence of diverse economic conditions. Our focal variable, the GFPI, remains consistent across MICs and LICs, suggesting similar food price trends and challenges, while the DFPI display higher values in LICs (90.74) compared to MICs (84.52), which may indicate that food is relatively more expensive and less accessible LICs. Finally, the variables access to clean fuels and technologies for cooking as a percentage of the population (EP) and government healthcare spendings (HC), while varying in specific data points, generally indicate areas for improvement across all countries. This highlights the need for investments in education and healthcare infrastructure in emerging economies to enhance socio-economic development.

Finally, the t test statistics in the two subsamples show that the P-value is relatively small ($P < .05$), indicating that the null hypothesis is rejected and suggests that the mean of the variables being compared are not equal between the two income groups except for the GFPI variable.

Overall, Table 2 shows the existence of significant differences between MICs and LICs. Hence, investigating the relationship between food prices and life expectancy using the pooled data may conceal important disparities among these groups of countries. Therefore, it is imperative to conduct separate empirical analyses for each group and tailor the policy implications to the specific characteristics of each region.

Table 3 reports the correlations between the log of all variables employed in our models to examine the effects of global and domestic consumer food prices on life expectancy. The GFPI model uses GFPI as an independent variable whereas the DFPI model uses DFPI as an independent variable. Table 3 shows that there is a strong positive correlation of .638/.635 between life expectancy (LnLE) and GDP per capita (LnGDP) in the two specifications, respectively. This indicates that countries with higher per capita GDP tend to have longer life expectancies. Similarly, life expectancy shows a positive correlation of .166/.158 with the percentage of the population with access to clean fuels and technologies for cooking, suggesting that nations with greater access to clean cooking technologies tend to live longer. Moreover, the correlation of (.470/.484) between LnGDP and LnEP reflects the link between economic prosperity and access to clean cooking technologies. Additionally, LnLE exhibits a positive correlation of (.136/.027) with the government healthcare

TABLE 3 Correlation matrix.

	GFPI model (Spe.1)							
	LnLE	**LnGFPI**	**LnGFPC2**	**LnGDP**	**LnTRA**	**LnEP**	**INF**	**LnHC**
LnLE	1							
LnGFPI	.184	1						
LnGFPI2	.183	.999	1					
LnGDP	.638	.126	.122	1				
LnTRA	.162	.045	.03	.114	1			
LnEP	.166	.073	.073	.470	.009	1		
INF	−.087	−.043	−.051	−.068	−.109	−.110	1	
LnHC	.136	.173	.141	.032	.311	.080	−.090	1
	DFPI model (Spe.2)							
	LnLE	**LnDFPI**	**LnDFPC2**	**LnGDP**	**LnTRA**	**LnEP**	**LnHC**	
LnLE	1							
LnDFPI	.184	1						
LnDFPI2	.174	.981	1					
LnGDP	.635	.106	.099	1				
LnTRA	.112	−.022	−.042	.242	1			
LnEP	.158	.063	.069	.484	.259	1		
LnHC	.027	.089	.078	.062	−.0003	.014	1	

TABLE 4 Variance inflation factor (VIF) test.

	GFPI		DFPI		
Variable	**VIF**	**1/VIF**	**Variable**	**VIF**	**1/VIF**
LnEP	2.93	.340728	LnEP	2.64	.378292
LnGDP	2.92	.341938	LnGDP	2.63	.378078
LnTRA	1.13	.885919	LnTRA	1.08	.922087
LnHC	1.04	.962098	LnHC	1.02	.984732
LnGFPI	1.04	.962757	LnDFPI	1.02	.976291
INF	1.03	.969386			
Mean VIF	1.68		Mean VIF	1.67	

spending variable (LnHC) implying that countries with better healthcare infrastructure tend to have longer life expectancies. However, inflation does not exhibit strong correlations with other variables.

Overall, the correlations in Table 3 suggest potential relationships among the socio-economic indicators, which can improve policymaking efforts in these countries.

To mitigate potential problems of multicollinearity among explanatory variables, which could result in unreliable estimates, we employ the variance inflation factor (VIF) test. A commonly accepted guideline for this test suggests that the highest VIF value should not surpass 10. As displayed in Table 4, the VIF values for the explanatory variables across each model fell within the range of 1.67–1.68 (below 10), indicating that multicollinearity concerns within our dataset are not significant.

5.1.2 | Estimation methodology

We examine, in this section, how different levels of international and domestic consumer food prices would affect life expectancy. To this end, we employ the dynamic panel threshold model developed by Seo and Shin (2016). This method extends the original static model by Hansen (1999), which requires all the explanatory variables to be strongly exogenous. To relax this assumption and extend the application of the model to a dynamic context, Seo and Shin (2016), introduced the dynamic panel threshold model based on the FD-GMM (first-differenced generalized method of moments) estimator to address potential endogeneity issues. Accordingly, the panel threshold model that we estimate in this study takes the following from:

$$\begin{aligned} \mathrm{LnLE_{it}} = {} & \alpha_0 + \alpha_1 \mathrm{LnLE_{it-1}} + \alpha_2 \mathrm{LnGFPI_{it}} + \alpha_3 \mathrm{lnGDP_{it}} \\ & + \alpha_4 \mathrm{LnEP_{it}} + \alpha_5 \mathrm{LnHC_{it}} + \alpha_6 \mathrm{INF_{it}} + \alpha_7 \mathrm{LnTRA_{it}} \\ & + (\beta_1 + \beta_2 \mathrm{LnLE_{it-1}} + \beta_3 \mathrm{LnFPI_{it}} + \beta_4 \mathrm{lnGDP_{it}} \\ & + \beta_5 \mathrm{LnEP_{it}} + \beta_6 \mathrm{LnHC_{it}} + \beta_7 \mathrm{INF_{it}} \\ & + \beta_8 \mathrm{LnTRA_{it}})\, \mathrm{I} * (\mathrm{lnGFPI_{it}} > \theta) + \mu_{it} \end{aligned} \quad (1.1)$$

$$\begin{aligned} \mathrm{LnLE_{it}} = {} & \alpha_0 + \alpha_1 \mathrm{LnLE_{it-1}} + \alpha_2 \mathrm{LnDFPI_{it}} + \alpha_3 \mathrm{lnGDP_{it}} \\ & + \alpha_4 \mathrm{LnEP_{it}} + \alpha_5 \mathrm{LnHC_{it}} + \alpha_6 \mathrm{INF_{it}} + \alpha_7 \mathrm{LnTRA_{it}} \end{aligned}$$

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$$+ (\beta_1 + \beta_2 \mathrm{LnLE}_{it-1} + \beta_3 \mathrm{LnFPI}_{it} + \beta_4 \mathrm{lnGDP}_{it} + \beta_5 \mathrm{LnEP}_{it} + \beta_6 \mathrm{LnHC}_{it} + \beta_7 \mathrm{LnTRA}_{it}) \; I * (\mathrm{lnDFPI}_{it} > \theta) + \mu_{it} \quad (1.2)$$

$$i = 1, 2, 3, \ldots N; t = 1, 2, 3, \ldots, T$$

where *Ln* refers to the log of the variable. LnE_{it} *and* $LnE_{i,t-1}$ represent life expectancies at time t and $t-1$, respectively. The inclusion of $LE_{i,t-1}$ is crucial to capture the convergence to the equilibrium and the dynamic nature of the model. *LnGFPI* and *LnDFPI,* our variable of interest, are the GFPI and domestic food consumer index. LnGDP_{it} is the real GDP per capita used as a proxy for the level of income. The variable LnEP, represents access to clean fuels and technologies for cooking, used to proxy EP. Moreover, LnHC_{it}, INF_{it}, LnTRA_{it}, represent domestic general government health expenditure, inflation, and trade openness, respectively. *I (.)* is an indicator function, taking a value of one when the condition in parentheses is met and zero otherwise. θ is the threshold parameter. The variables α_m and β_m ($m = 1, 2\ldots8, 9$) are the estimated parameters of the regressors and μ_{it} represent the stochastic error term.

5.2 | Threshold estimation results

Equations (1.1) and (1.2) allow the examination of the threshold relationship between the global and domestic food price indices and life expectancy in emerging economies. The results are presented in Table 5.

Table 5 shows the existence of a nonlinear relationship between life expectancy and the two food price indices, supporting the presence of a threshold effect as confirmed by the highly significant bootstrapped *P*-values of the Wald test (linearity test) reported at the lower section of Table 5. Specifically, the estimated threshold value for the GFPI variable is 4.345 (77 points), while being 4.46 (103.5 points) for the DFPI variable. Beyond these thresholds, food becomes less affordable resulting in a negative effect on life expectancy.

Our results in Table 5 also indicate that GFPI and DFPI both exert a positive and significant effect on life expectancy in the lower GFPI/DFPI regimes, but a negative and significant effect on life expectancy in the upper GFPI/DFPI regimes confirming the existence of an inverted U-shaped relationship between GFPI/DFPI and life expectancy.

The reason for an increase in food prices in emerging economies can yield an inverted U-shaped impact on life expectancy may be explained by the complex connection between various factors. Indeed, when food prices rise moderately, it can encourage local farmers to produce more and invest in agricultural projects. This can lead to increased food production, better nutrition, and improved access to a variety of foods, including fruits and vegetables. As a result, malnutrition rates may decrease and several health indicators will improve, potentially leading to an increase in life expectancy. Moreover, moderate increases in food prices will generally stimulate economic growth in emerging economies (Oluwatoyin & Balcilar, 2012), particularly in the agricultural sector (Solaymani, 2017). This economic growth will potentially lead to a higher income in rural communities, which may then translate into improved access to households' healthcare spending, better education, and enhanced sanitation. These factors combined can positively impact life expectancy. As food prices continue to rise, governments and communities may implement social welfare programs to mitigate any negative effects. For example, they may provide subsidies and food assistance to vulnerable populations. These interventions can help maintain or improve nutrition and healthcare access, thereby supporting life expectancy. However, as food prices rise further beyond a certain threshold, several negative factors can occur. Indeed, as food prices become excessively high, many people may not be able to afford an adequate diet. If this situation persists, it can lead to food insecurity, where individuals and families have insufficient access to nutritious food. Prolonged food insecurity will usually result in malnutrition and health problems, which ultimately may reduce life expectancy. Moreover, excessive food prices can lead to financial pressures on households where families may prioritize spending on food over other essential services like healthcare and education. This can result in delayed medical treatment, reduced access to healthcare services, and potentially lower life expectancy due to untreated illnesses. Additionally, with extreme food price increases, people may migrate from rural to urban areas to look for better opportunities. The rapid urbanization can put enormous burden on healthcare systems and access to clean water, eventually leading to health challenges and reducing life expectancy. Our results indicate therefore the need to take drastic measures to maintain food prices under control, ideally close to the GFPI/DFPI threshold, to extract the full benefits of affordable food on life expectancy.

To investigate whether the life expectancy – food prices relationship is different by income group, we re-estimate Equations (1.1) and (1.2) for two income groups, namely, MICs and LICs. The results reported in Table 6, validate the inverted U-shaped relationship between both food price indices and life expectancy in both income groups. These findings indicate that the estimated turning point

TABLE 5 Dynamic threshold estimation.

Threshold variables	Global food price (LnGFPI)		Domestic food price index(LnDFPI)	
D. variables	LnLE		LnLE	
Variables	Lower regime	Higher regime	Lower regime	Higher regime
LnLE	.848***	.048***	.847***	.111***
	(.010)	(.008)	(.009)	(.007)
LnGFPI	.005***	−.007***		
	(.003)	(.003)		
LnDFPI			.006***	−.024***
			(.002)	(.002)
LnGDP	.007***	.025***	.004***	.013***
	(.003)	(.003)	(.002)	(.001)
LnHC	−.010***	.017***	.0013***	.053***
	(.002)	(.003)	(.001)	(.001)
LnEP	.023***	.011***	.009*	.013***
	(.003)	(.002)	(.002)	(.001)
INF	−.0001***	−.0001***		
	(.000)	(.000)		
LnTRA	.010***	.010***	.004***	.012***
	(.004)	(.004)	(.008)	(0019)
Constant	−.194***		−.229	
	(.042)		(.027)	
Threshold value	4.451***		4.640***	
	(.010)		(.016)	
Threshold value (points)	85.71		103.54	
Observations	2310		2376	
Wald test	(.000)		(.000)	

Standard errors in parentheses, ***$P < .01$, **$P < .05$, *$P < .1$.

for the GFPI variable in LICs is approximately 81 points, which is lower than that observed in MICs, around 100 points. Similarly, the estimated turning point for the DFPI variable is lower in LICs compared to MICs, standing at 95 points versus 105 points, respectively.

Hence, Table 6 shows that, overall MICs can endure higher levels of food prices, compared to LICs, before experiencing the adverse effects of price rises. Accordingly, the inverted U-shaped relationship between food prices and life expectancy for the full sample documented in Table 5 can differ significantly between MICs and LICs due to variations in their economic conditions, infrastructure, and healthcare systems. Several factors may explain this intriguing result. First, MICs have generally stronger economies and more diversified sources of income in comparison to LICs. Hence, they usually have more resources to mitigate the impact of moderate food price increases without immediate severe consequences. Second, people in MICs tend to have access to a more diverse diet due to overall higher incomes. This diversity in food choices provides some resilience against food price hikes where individuals can substitute several foods following price rises. Third, MICs usually have more developed healthcare systems compared to LICs. Accordingly, MICs can manage more efficiently any health issues that may arise due to food price increases. Fourth, some MICs have better social welfare programs that can help assist vulnerable populations during times of economic turmoil.

For all these reasons, the inverted U-shaped relationship between food prices and life expectancy in MICs may be less severe, and the negative impact on life expectancy may be delayed. However, if food prices rise to extremely high levels, the negative effects can still manifest in these countries and negatively affect life expectancy.

On the other hand, LICs ability to manage food price increases is relatively limited. Indeed, LICs have weaker economies with a larger proportion of their population suffering extreme poverty. Even small food price increases can move a significant portion of the population into more poverty making them vulnerable to food insecurity and malnutrition. Moreover, people in LICs have access to limited nutritious food options with more reliance on essential

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TABLE 6 Dynamic threshold estimation by income groups.

Income group	Middle-income countries (MICs)				Low-income countries (LICs)			
Food prices index	Global food price index		Domestic food price index		Global food price index		Domestic food price index	
Threshold variable	LnGFPI		LnDFPI		LnGFPI		LnDFPI	
Variables	Lower regime	Upper regime	Lower regime	Upper regime	Lower regime	Upper regime	Lower regime	Upper regime
LnLE	.785***	.048***	.906***	.066***	.534***	1.019***	.987	−.280
	(.010)	(.008)	(.009)	(.010)	(.146)	(.245)	(.003)	(.028)
LnGFPI	.008***	−.009***			.017***	−.022**		
	(.003)	(.003)			(.009)	(.010)		
LnDFPI			.001***	−.007**			.023**	−.046***
			(.001)	(.014)			(.013)	(.014)
LnGDP	.029***	.025***	.009***	.014***	.019**	.026***	.0001	.016***
	(.003)	(.003)	(.002)	(.003)	(.003)	(.003)	(.002)	(.002)
LnHC	.010***	.017***	−.013**	.022**	.012***	.017***	−.011	.005***
	(.002)	(.003)	(.001)	(.002)	(.002)	(.003)	(.001)	(.001)
LnEP	.023***	.011**	−.001	.025**	.207***	.322*	−.051***	.006***
	(.003)	(.002)	(.001)	(.003)	(.207)	(.062)	(.005)	(.001)
INF	−.0001**	−.0001*			−.0001**	−.0001*		
	(.000)	(.000)			(.000)	(.000)		
LnTRA	.037***	.010***	.005**	.006***	.023***	.029***	.046***	.001
	(.004)	(.004)	(.001)	(.002)	(.003)	(.002)	(.003)	(.002)
Constant	.199***		−.245***		1.882**		.906***	
	(.025)		(.038)		(.423)		(.089)	
Threshold value	**4.607*** **		**4.662*** **		**4.401*** **		**4.554*** **	
	(.007)		(.058)		(.002)		(.453)	
Threshold value (points)	100.18		105.63		81.53		95.01	
Observations	1848		1914		462		462	
Wald test	(.000)		(.000)		(.000)		(.000)	

Standard errors in parentheses, ***$P < .01$, **$P < .05$, *$P < .1$.

foods. Accordingly, when their prices rise, the negative impact on nutrition and health can be dramatic. Additionally, LICs have usually underdeveloped healthcare systems with limited access to healthcare services making it difficult to address health issues related to malnutrition or food insecurity.

Accordingly, the inverted U-shaped relationship between global and domestic food prices and life expectancy in LICs is more noticeable and severe, where even moderate increases in food prices can quickly lead to food insecurity, malnutrition, and a decline in life expectancy.

Our results in Tables 5 and 6 clearly indicate the importance of affordable food prices to increase life expectancy. Moreover, the findings presented in these tables reveal clear disparities between MICs and LICs which require tailored policies to mitigate and ultimately overcome the adverse impacts of excessively high food prices.

Furthermore, the results in Table 6 also demonstrate that GDP per capita has a significant and positive impact on life expectancy in both income groups, regardless of the regime. These findings confirm the important role of economic growth in enhancing life expectancy in emerging economies. Indeed, higher GDP per capita in these regions can help alleviate high food prices' challenges by increasing access to healthcare, diversifying diets, and improving the overall quality of everyday life.

Table 6 also highlights the negative effect of inflation on life expectancy in both the upper and lower regimes for the two income groups. This outcome shows the decisive impact of inflation on public health. High inflation can reduce an individuals' purchasing power, making it more difficult for them to access healthcare and proper nutrition. It can also disrupt economic stability, indirectly affecting the healthcare sector (Grossman, 2017).

Finally, the results in Table 6 indicate that an increase in trade openness in both the upper and lower regimes will have a positive impact on life expectancy in both MICs and LICs. This finding can be explained by the fact that as a country becomes more open to international trade, its ability to import diverse food and effective medicines from foreign countries improves resulting in better health outcomes (Owen & Wu, 2007).

It is worth noting that the results for the government health expenditure and EP variables are mixed, while being mostly positive, as expected.

5.3 | Robustness checks

To assess the robustness of our findings, we conduct two further analyses. First, we employ the system GMM estimator[4] to re-estimate the relationship between global/domestic food prices and life expectancy, ensuring that our results do not depend on the estimation methodology. To this end, we use different specifications to account for the heterogeneity among countries in terms of income (low vs. middle-income), net food exports (food importing countries vs. food exporting countries), and the effect of external shocks such as the recent COVID-19 pandemic.

Our first specification (Spec.1) is a benchmark model that tests the existence of a nonlinear relationship between food price indices and life expectancy. In specifications 2–7 (i.e., Spec.2 to Spec.7), we introduce several interactive terms to evaluate the interaction effects of each selected variable with both food price indices and their impact on life expectancy. Specifically, Spec.2 includes the food prices–COVID-19 pandemic interactive term. Spec.3–5 examine the food prices and trade related interactive terms, while Spec.6 and 7 investigate the food price indices–income groups' interactive terms.

Second, we incorporate the effects of the 2008 GFC to explore whether there are any specific impacts of food prices on life expectancy associated with such major economic events.

5.3.1 | The GMM estimation of the impact of food prices on life expectancy

We use Equation (2.1) below, which we will refer to as Spec.1, to re-estimate the nonlinear relationship between life expectancy and food prices:

$$\mathrm{LnLE_{it}} = \alpha_0 + \alpha_1\mathrm{LnLE_{it-1}} + \alpha_2\mathrm{LnGFPI_{it}} + \alpha_3\mathrm{Ln}\mathit{GFPI}^2{}_{\mathrm{it}} + \alpha_4\mathrm{LnGDP_{it}} + \alpha_5\mathrm{LnTRA_{it}} + \alpha_6\mathrm{LnEP_{it}} + \alpha_7\mathrm{INF_{it}} + \alpha_8\mathrm{LnHC_{it}} + \omega_{\mathrm{it}} \tag{2.1}$$

All the variables in Spec.1 are as defined in Equation (1). We use the two steps system GMM (Blundell &, Bond, 1998) to estimate Equation (2.1) and determine the threshold level of food prices.

We also employ six alternative specifications (Spec.2—7). As mentioned earlier, Spec.1 serves as a benchmark specification that tests the nonlinear impact of food prices on life expectancy without any interactive term, while the other specifications (Spec.2–7) examine how this relationship changes when we introduce different interactive terms in the model, one at a time. Overall, we include four interactive terms in our estimations. The first explores the interaction between food prices and the COVID-19 pandemic to determine the effects of the food prices during the pandemic crisis on life expectancy. The second represents the interaction between food prices and trade openness to capture the effect of trade. To further investigate the effects of trade, we introduce the interplay between food prices and a dummy variable that takes the value of 1 if the country is a net food exporter[5] to determine whether being a net food exporter interacts with food price variations in explaining life expectancy. Finally, we employ the interaction between food prices and income groups to assess the effects of food prices on life expectancy depending on the development level. Thus, Equation (2.1), with its alternative specifications, is defined as follows:

$$\mathrm{LnLE_{it}} = \alpha_0 + \alpha_1\mathrm{LnLE_{it-1}} + \alpha_2\mathrm{LnGFPI_{it}} + \alpha_3\mathrm{Ln}\mathit{GFPI}^2{}_{\mathrm{it}} + \alpha_4\mathrm{LnGDP_{it}} + \alpha_5\mathrm{LnTRA_{it}} + \alpha_6\mathrm{LnEP_{it}} + \alpha_7\mathrm{INF_{it}} + \alpha_8\mathrm{LnHC_{it}} + \alpha_9 \mathit{DM}2020_{\mathrm{it}} + \alpha_{10}\mathit{CS}_{\mathrm{it}} + \alpha_{11}\mathit{LnGFPI{*}Indicators_{it}} + \alpha_{12}\mathrm{Ln}\mathit{GFPI}^2{*}\mathit{Indicators_{it}} + \omega_{\mathrm{it}} \tag{2.2}$$

$$i = 1, 2, 3, \dots N;\ t = 1, 2, 3, \dots, T$$

where, $DM2020_{it}$ is a dummy variable that takes the value of 1 from 2020 onwards. CS_{it} represents the country specific variable (LIC, MIC, Net food export dummies). $LnGFPI * Indicators_{it}$ are the interactive terms between food prices and the different variables defined earlier. We

[4] In order to choose between the difference and system GMM estimators, we conducted several estimations: OLS, Fixed Effects, and Diff-GMM. The results show that the coefficient of the lagged dependent variable (life expectancy) in the Diff-GMM estimation is lower than the coefficient obtained in the fixed effects estimation implying that system GMM is more suitable for our study. The results are available upon request.

[5] The variable "Net Food Exporter Country" (Netfexport) is a binary indicator, taking the value of 1 if the country is a net food exporter and 0 if it is a net food importer. This characterisation is made by calculating the ratio of food exports to food imports. A ratio greater than 1 indicates that the country is a net food exporter, while a ratio less than 1 indicates that it is a net food importer.

also estimate Equations (2.1) and (2.2) using DFPI instead of GFPI variable.

The results of the estimation of Equations (2.1) and (2.2) are reported in Table 7.

The first column of Table 7 displays the estimation of the first specification (Spec.1). Our findings reveal that the coefficient of the GFPI variable is positive and highly significant while the squared term of GFPI variable is negative and statistically significant. This result suggests an inverted U-shaped relationship between our variables of interest corroborating the findings in Table 5 where the dynamic threshold estimation is employed. However, as Lind and Mehlum (2010) caution, relying solely on the sign and significance of the coefficients (food prices and its squared term) can yield misleading results. Therefore, we conduct Lind and Mehlum's (2010) U-test to assess the robustness of our findings where the results are presented in the lower section of Table 7.

The test result is highly significant indicating the rejection of the null hypothesis of a U-shaped or monotone relationship. In other words, the results in Table 7 confirm the nonlinear inverted U-shaped relationship between global food prices and life expectancy, with an estimated turning point of 95.60 points for the full sample. This result aligns with, although slightly surpassing, the dynamic threshold model's turning point, which hovered around 85.71 points for the full sample. The estimated turning point falls within the dataset range used in this study but is higher than the sample mean of the GFPI variable, which is approximately 94 points. Accordingly, the adverse impact of high food prices on life expectancy will occur at higher global food price levels for the average emerging country in our sample.

In Spec.2, where we introduce an interaction term between GFPI and the COVID-19 pandemic dummy variable, the results show that both the coefficient of the COVID-19 dummy variable and the interactive term with global food prices are negative and highly significant, suggesting that the pandemic exacerbates the negative effects of higher food prices on life expectancy in emerging economies. Furthermore, it is worth noting that the GFPI turning point becomes lower compared to Spec.1, suggesting that food insecurity during pandemics may accelerate the reduction in life expectancy through the larger adverse effects on the health system, nutrition, and overall well-being.

In Spec.3, where we include the interactive term between GFPI and TRA to examine the effects of trade on life expectancy, the results indicate that the interactive term between these two variables is positive and statistically significant. This suggests that trade openness positively moderates the impact of food prices on life expectancy. One possible explanation for this result is that trade openness facilitates access to diverse and affordable food options, even during periods of surges in global food prices. Additionally, it may promote economic growth and improve healthcare access, all of which can positively influence life expectancy. Accordingly, our findings suggest that, in the context of emerging economies, trade openness plays a beneficial role in mitigating the negative effects of food price fluctuations on life expectancy.

Spec.4 using the interactive term between GFPI and a dummy variable indicating whether a country is a net food exporter, reveals that the interactive term loads positive and statistically significant. Hence, being a net food exporter positively moderates the relationship between food prices and life expectancy. This result can be attributed to the circumstance wherein countries with a surplus of food production (i.e., a net food exporter), may benefit from increased revenues and economic stability during periods of high global food prices. These revenues lead to larger investments in healthcare, infrastructure, and social programs, ultimately improving life expectancy. Additionally, being a net food exporter may provide these countries with a buffer against food shortages and price spikes, reducing the negative impacts on nutrition and health outcomes.

At this point, it would be interesting to study if net food exporting countries have a different turning point compared to the turning point in Spec.1 where such variable is not considered. This would allow us to examine if net food exporting countries are able to better mitigate increasing food prices on life expectancy. This is particularly straightforward to implement since the net food exporter variable is a dummy variable. To this end, we consider Spec.5, where we add the interactive term between the squared GFPI and the net food exporter variable to assess how the GFPI turning point would change.[6] The results indicate that the new turning point is significantly higher, at around 142 points compared to Spec.1. This result suggests that being a net food exporter country may alleviate the adverse effects of global food price increases on life expectancy.

Finally, in specification 6 and 7, we include interactive terms between GFPI and income groups (MICs and LICs). The result reveals that the turning point in LICs, around 85 points, is smaller than that in MICs (116 points). This finding confirms our previous results using the dynamic threshold estimation method in Table 6 and indicates that poorer countries are more susceptible to the adverse effects of rising food prices.

Turning our attention to the control variables, Table 7 shows a positive and statistically significant relationship between GDPs per capita and life expectancy, consistent

[6] The new turning point is calculated as: $exp(\frac{-(\alpha_2+\alpha_{11})}{2(\alpha_3+\alpha_{12})})$.

TABLE 7 Effect of global food price on life expectancy (GMM estimator).

	Global food price index						
	(ALL)	(COVID-19)	(Trade)	(NFE)	(NFE)	(LICs)	(MICs)
Variables	**Spec.1**	**Spec.2**	**Spec.3**	**Spec.4**	**Spec.5**	**Spec.6**	**Spec.7**
LnLE (−1)	.949***	.946***	.939***	.881***	.883***	.977***	.878***
	(.002)	(.003)	(.002)	(.003)	(.003)	(.002)	(.002)
LnGFPI	.341***	.306***	.715***	.613***	.3.66***	.070**	.140***
	(.030)	(.033)	(.031)	(.026)	(.045)	(.028)	(.027)
$LnGFPI^2$	−.037***	−.034***	−.076***	−.068***	−.025***	−.007**	−.016***
	(.003)	(.004)	(.003)	(.003)	(.005)	(.003)	(.003)
LnGDP	.004***	.004***	.008***	.005***	.003***	.004***	.006***
	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)
LnEP	.004***	.004***	.007***	.004***	.006***	.002***	.001***
	(.001)	(.001)	(.001)	(.000)	(.000)	(.000)	(.000)
INF	−.0001***	−.0001***	−.0001***	−.0001***	−.0001***	.0002***	−.0001***
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
LnHC	.003***	.005***	.004***	.004***	.008***	.003***	.006***
	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)	(.000)
LnTRA	.010***	.010***	.050***			.009***	.004***
	(.001)	(.001)	(.006)			(.001)	(.001)
DM2020	−.013***	−.080***	−.014***	−.070***	−.024***	−.015***	−.010***
	(.001)	(.030)	(.000)	(.030)	(.000)	(.000)	(.000)
LnGFPI*DM2020		−.014**					
		(.006)					
LnGFPI*LnTRA			.012***				
			(.001)				
Netfexport				.033***	2.832***		
				(.010)	(.227)		
LnGFPI*Netfexport				.009***	1.253***		
				(.002)	(.100)		
$LnGFPI^2$*Netfexport					−.138***		
					(.011)		
LIC						−.384*	
						(.230)	
LnGFPI*LIC						.180*	
						(.101)	
$LnGFPI^2$*LIC						−.021*	
						(.011)	
MIC							−1.194***
							(.072)
LnGFPI*MIC							.567***
							(.032)
$LnGFPI^2$*MIC							−.058***
							(.003)
Constant	−.592***	−.498***	−1.082***	−.925***	−.041	−.082	.146**
	(.064)	(.075)	(.072)	(.057)	(.102)	(.063)	(.062)
Observations	2044	2044	2044	2257	2257	2044	2044
Number of id	104	104	104	113	113	104	104

(Continues)

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TABLE 7 (Continued)

	Global food price index						
	(ALL)	(COVID-19)	(Trade)	(NFE)	(NFE)	(LICs)	(MICs)
Variables	**Spec.1**	**Spec.2**	**Spec.3**	**Spec.4**	**Spec.5**	**Spec.6**	**Spec.7**
Instruments	83	77	92	99	97	91	103
Hansen *P*-value	.209	.136	.179	.183	.108	.284	.237
AR (2)	.253	.255	.252	.169	.175	.255	.244
Lind and Mehlum test							
Turning point	4.56	4.50	4.70	4.50	4.96	4.45	4.76
Turning point (points)	95.58	90.01	109	90.01	142	85.62	106
P-value	10.23***	8.30***	11.34***	17.45***			

Standard errors in parentheses, ***$P < .01$, **$P < .05$, *$P < .1$. Netfexport is a dummy that takes 1 if the country is a net exporter. NFE refers to net food exporter specification.

with economic theory. As countries experience higher GDP per capita, they often invest more in healthcare infrastructure, improve nutrition, and raise overall living standards. Combined these effects will lead to longer life expectancies (Bayati et al., 2013; Gulis, 2000; Miladinov, 2020; Radmehr & Adebayo, 2022). For the trade openness variable, the coefficients are positive and statistically significant for all specifications suggesting that more trade openness may boost life expectancy in emerging countries by facilitating the access to advanced medical resources and expertise. Moreover, active international trade fosters economic growth enabling larger investments in public health infrastructure, improves access to healthcare and essential goods, and facilitates the transfer of technology and knowledge in the medical field (Barkat et al., 2024a, 2024b; Owen & Wu, 2007).

Interestingly, access to clean fuels and technologies for cooking shows a positive and highly significant effect on life expectancy. This result reveals the importance of initiatives aimed at reducing indoor air pollution and its associated health risks and suggests that EP mitigation matters for public health policies in these countries. Additionally, the positive relationship between government health expenditure and life expectancy unveils the critical role of public healthcare investment in improving healthcare accessibility. This result is in line with the findings of Gulis (2000). Finally, the negative effect of inflation on life expectancy suggests that economic instability and reduced purchasing power can adversely affect access to healthcare and essential goods and services reducing life expectancy.

Table 8 re-estimates Equations (2.1) and (2.2) using the variable DFPI instead of GFPI. The results in Table 8 are mostly similar to those reported in Table 7. Specifically, DFPI and its squared term are highly significant with a positive and negative sign, respectively, implying the existence of an inverted U-shaped relationship between DFPI and life expectancy. However, it is worth noting that the turning point obtained when using DFPI (103 points) is higher than that obtained with the GFPI variable (95.60). One possible explanation of this result may be related to government intervention. Governments in many countries often implement policies to stabilize domestic food prices, such as subsidies, price controls, or strategic reserves. These interventions may be more effective in mitigating the negative impacts of high food prices on health outcomes within their domestic markets compared to the global market. The results for the control variables in Spec.2 to Spec.7 in Table 8 are similar to those obtained in Table 7.

Overall, the results using the system GMM technique (Tables 7 and 8) are consistent with those obtained using the dynamic threshold estimation (Tables 5 and 6) confirming the robustness of our findings according to which the relationship between food prices and life expectancy is inverted U-shaped.

5.3.2 | The effects of the GFC

The 2008 GFC was a major economic event that left a clear mark on the world economy. It originated in the United States but quickly spread globally showing the interconnection between financial markets. The GFC was characterized by a credit crisis, housing market collapse, and bank failures, leading to massive job losses as many businesses were forced to suspend their operations. Governments and central banks intervened with unprecedented bailouts to save the economy from a major collapse. The housing market suffered large losses with severely reduced property values and widespread foreclosures. Global trade also declined sharply, which disrupted supply chains and affected export-dependent economies.

The GFC had a dramatic impact on households' purchasing power, primarily due to the substantial loss of jobs throughout this major event. Many families were obliged to closely monitor their spending on essential foods, particularly in LICs. Therefore, it is legitimate to explore

TABLE 8 Effect of domestic food price on life expectancy (GMM estimator).

	Domestic food price index						
	(ALL)	(Covid-19)	(Trade)	(NFE)	(NFE)	(LICs)	(MICs)
Variables	**Spec.1**	**Spec.2**	**Spec.3**	**Spec.4**	**Spec.5**	**Spec.6**	**Spec.7**
LnLE (−1)	.924***	.959***	.938***	.805***	.841***	.960***	.963***
	(.003)	(.003)	(.001)	(.006)	(.002)	(.003)	(.002)
LnDFPI	.022***	.023***	.017***	.018***	.008***	.009***	.010***
	(.001)	(.001)	(.001)	(.002)	(.001)	(.001)	(.001)
$LnDFPI^2$	−.002***	−.003***	−.002***	−.002***	−.001***	−.001***	−.001***
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
LnGDP	.003***	.003***	.006***	.008***	.002***	.008***	.008***
	(.001)	(.001)	(.000)	(.001)	(.001)	(.001)	(.000)
LnEP	.002***	.003***	.000	.002**	.005***	.002***	.002***
	(.000)	(.000)	(.000)	(.001)	(.000)	(.000)	(.000)
LnHC	.016***	.001***	.004***	.003***	.008***	.012***	.011***
	(.001)	(.000)	(.000)	(.001)	(.001)	(.001)	(.000)
LnTRA	.011***	.005***	.003***	.008***		.005***	.001***
	(.001)	(.001)	(.001)	(.001)		(.001)	(.000)
DM2020	−.015***	−.011***	−.011***	−.015***	−.015***	−.021***	−.010***
	(.000)	(.003)	(.003)	(.001)	(.003)	(.002)	(.003)
LnDFPI*DM2020		−.009***					
		(.001)					
LnDFPI*LnTRA			.001**				
			(.000)				
Netfexport				.035***	.038***		
				(.004)	(.005)		
LnDFPI*Netfexport				.006***	.020***		
				(.001)	(.002)		
LnDFPI2*Netfexport					−.002***		
					(.000)		
LIC						−.019	
						(.012)	
LnDFPI*LIC						.019***	
						(.005)	
$LnDFPI^2$*LIC						−.002***	
						(.000)	
MIC							−.021***
							(.001)
LnDFPI*MIC							.009***
							(.000)
$LnDFPI^2$*MIC							−.001***
							(.000)
Constant	.225***	.120***	.218***	.672***	.619***	.105***	.121***
	(.012)	(.012)	(.006)	(.019)	(.009)	(.010)	(.006)
Observations	2202	2202	2202	2433	2433	2202	2202
Number of ids	109	109	109	117	117	109	109
Instruments	95	93	101	93	109	97	108
AR (2)	.213	.224	.212	.219	.139	.209	.209

(Continues)

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TABLE 8 (Continued)

	Domestic food price index						
	(ALL)	(Covid-19)	(Trade)	(NFE)	(NFE)	(LICs)	(MICs)
Variables	**Spec.1**	**Spec.2**	**Spec.3**	**Spec.4**	**Spec.5**	**Spec.6**	**Spec.7**
Lind and Mehlum test							
Turning point	4.64	4.44	4.26	4.50	4.66	4.50	4.78
Turning point (points)	103.18	84.77	70.80	91.01	105.63	90	119
P-value	31.51***	15.74***	11.45***	14.45***			

Standard errors in parentheses, ****P* < .01, ***P* < .05, **P* < .1. Netfexport is a dummy that takes 1 if the country is a net exporter. NFE refers to net food exporter specification.

how such events affect the relationship between food prices and life expectancy. We hypothesize that the food price threshold will decrease to reflect that even slight increases in food prices can trigger a decline in life expectancy in periods of crises.

To investigate the GFC's impact, we have included a dummy variable that takes the value of 1 from 2008 onwards and 0 otherwise. Additionally, we have incorporated an interactive term, which is equal to the GFPI variable multiplied by the crisis dummy variable to capture any variations in the impact of food prices on life expectancy attributable to the crisis. Therefore, we estimate the following model using the system GMM:

$$\begin{aligned} \mathrm{LnLE}_{it} = {} & \alpha_0 + \alpha_1 \mathrm{LnLE}_{it-1} + \alpha_2 \mathrm{LnGFPI}_{it} + \alpha_3 \ln GFPI^2{}_{it} \\ & + \alpha_4 \mathrm{LnGDP}_{it} + \alpha_5 \mathrm{LnTRA}_{it} + \alpha_6 \mathrm{LnEP}_{it} \\ & + \alpha_7 \mathrm{INF}_{it} + \alpha_8 \mathrm{LnHC}_{it} + \alpha_9 \mathrm{DUM2008}_{it} \\ & + \alpha_{10} \mathrm{LnGFPI}_{it} * \mathrm{DUM2008} + \alpha_{11} \mathrm{Ln} GFPI^2{}_{it} \\ & * \mathrm{DUM2008} + \omega_{it} \end{aligned} \tag{3}$$

Additionally, the turning point without accounting for the GFC is calculated as:

$$GFPI = \exp\left(\frac{-\alpha_2}{2\alpha_3}\right)$$

While the new turning point considering the effects of the GFC is obtained as follows:

$$GFPI = \exp\left(\frac{-(\alpha_2 + \alpha_{10})}{2(\alpha_3 + \alpha_{11})}\right)$$

Equation (3) is also estimated using DFPI instead of GFPI. The findings of this analysis are presented in Table 9. The results show that, without accounting for the GFC, the turning points of the nonlinear relationship between food prices indices (i.e., GFPI/DFPI) and life expectancy were 90.92/120 points for the full sample, 90.01/123 points for MICs, and 89.12/93.69 points for LICs, respectively. These figures represent the thresholds at which the two indices of food prices begin to exert a negative effect on life expectancy. However, when the GFC is considered by including the crisis dummy and interactive term, a considerable shift in these turning points occurs. Indeed, when we account for the GFC, the new turning points become 81.45/96.54 points for the full sample, 85.62/84.77 points for MICs, and 77.48/75.94 points for LICs. These findings offer strong evidence that the GFC had a noticeable impact on the food price threshold. The decline in the threshold suggests that even relatively modest increases in food prices can trigger a decline in life expectancy in these economically vulnerable regions.

Additionally, the mean of the GFPI prior to the GFC[7] (64.87 points) falls below the turning points for MICs and LICs, (90.01 and 81.12 points, respectively). This suggests that, before the crisis, an increase in global food prices will positively impact life expectancy, as the mean global food price has not yet reached the turning point. The same conclusion can be drawn regarding the domestic food price index. However, following the 2008 GFC (2008–2019), the mean GFPI increased to 106 points, exceeding the turning points for both income groups (85.62 and 77.48 points, respectively). This indicates that, after the GFC, an increase in global food prices negatively affects life expectancy. Furthermore, there is a larger gap between the turning point (77.48 points) and the average global price index (106 points) for LICs compared to MICs, where the gap is smaller. Turning to the domestic food price indices, the results are more nuanced. The mean domestic price (93 points) is lower than the turning points for MICs (123 points), while the mean domestic price index (100 points) is higher than the turning points for LICs (93.69 points). The latter result reveals interesting differences between MICs and LICs. Indeed, it appears that MICs exhibits greater resilience to domestic food price increases compared to MICs. This resilience may be attributed to several factors inherent to MICs. Usually, MICs have more diversi-

[7] Please refer to Table A3 in the appendix for the descriptive statistics of our variables prior and after the GFC and COVID-19 pandemic.

TABLE 9 Effects of the global financial crisis on food prices – Life expectancy nexus.

Variables	ALL GFPI	MICs	LICs	ALL DFPI	MICs	LICs
LnLE(−1)	.908***	.967***	.928***	.429***	.849***	.923***
	(.003)	(.002)	(.016)	(.008)	(.002)	(.032)
LnGFPI	.131***	.135***	1.560***			
	(.088)	(.054)	(.370)			
$LnGFPI^2$	−.014***	−.015***	−.176***			
	(.010)	(.006)	(.042)			
LnDFPI				.163***	.029***	.201***
				(.002)	(.002)	(.081)
$LnDFPI^2$				−.017***	−.003***	−.022***
				(.003)	(.009)	(.011)
LnGDP	.003***	.003***	.009***	.007***	.008***	.009***
	(.002)	(.003)	(.003)	(.001)	(.001)	(.005)
LnTRA	.023***	.009***	.005**	.049***	.002***	.004***
	(.001)	(.000)	(.001)	(.001)	(.005)	(.010)
LnEP	.013***	.016***	.0001*	.028***	.0134***	.001***
	(.001)	(.001)	(.001)	(.009)	(.007)	(.003)
INF	−.0004***	−.0003***	−.00001*			
	(.000)	(.000)	(.000)			
LnHC	.016	.011***	.005***	.011**	.015**	.008**
	(.002)	(.001)	(.003)	(.009)	(.009)	(.005)
DM2008	−1.150**	−4.535***	−2.315**	−.065***	−.023***	−.150
	(.377)	(.242)	(.959)	(.008)	(.004)	(0141)
LnGFPI*DM2008	.500**	1.943***	1.187***			
	(.165)	(.106)	(.388)			
$LnGFPI^2$*DM2008	−.057**	−.218***	−.223***			
	(.018)	(.136)	(.066)			
LnDFPI*DM2008				.020***	.003**	.030***
				(.004)	(.002)	(.081)
$LnDFPI^2$*DM2008				−.002***	−.0015**	−.001***
				(.004)	(.003)	(.075)
Constant	−.003**	−.206***	−2.134***	1.873***	.619***	.211**
	(.212)	(.116)	(.711)	(.031)	(.003)	(.222)
Observations	2257	1800	457	2257	1800	457
Instruments	90	88	35	103	82	34
AR (2)	.139	.370	.356	.347	.353	.876
Turing point (TP)						
TPB	4.51	4.50	4.43	4.79	4.82	4.56
TPB (points)	90.92	90.01	89.12	120.30	123	93.69
TPA	4.40	4.45	4.35	4.57	4.44	4.33
TPA (points)	81.45	85.62	77.48	96.54	84.77	75.94

Standard errors in parentheses, ***$P < .01$, **$P < .05$, *$P < .1$. TPB is the turning point before the crisis, whereas TPA is the turning point after the crisis.

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fied economies and stronger infrastructure, which enables them to absorb economic shocks more effectively. Additionally, these countries may benefit from higher levels of human capital and better healthcare systems, which contribute to their ability to mitigate the negative impacts of food price volatility on life expectancy. Moreover, MICs may have greater access to financial resources (Barkat et al., 2016), allowing them to implement intervention policies to alleviate the negative effects of food price increases on their populations.

Overall, the results confirm our hypothesis according to which the GFC placed additional burdens on households leading to unsatisfactory diets and potentially lower life expectancy. This significant and previously undocumented finding reflects the severe consequences of economic downturns on public health and well-being. Indeed, while the GFC is often analyzed from a financial markets and macroeconomic perspective, our study shows the strong link between economic events, household budgets, and human health.

6 | ANALYSIS OF THE TRANSMISSION CHANNELS

This section empirically examines the channels (discussed in Section 4) through which food prices may impact life expectancy in emerging economies. These channels include four potential mediating variables, namely, income poverty (measured by per capita GDP), undernutrition (measured by prevalence of undernourishment in % of population), mental health (measured by the share of population with mental health disorder), and household healthcare expenditure (measured by out-pocket healthcare expenditure).

To uncover the role of these transmission mechanisms, we employ the two-staged estimation widely used to study potential mediators between two variables (Barkat et al., 2023; Churchill & Smyth, 2022; Dogan et al., 2022; Munyanyi & Churchill, 2022). This estimation comprises two sequential steps. In the first step, we assess the correlation between the food price variables (GFPI and DFPI) and the candidate mediating variables (the four channels mentioned earlier). The existence of a significant correlation is a prerequisite for the variable to be considered in the second step as a potential mediating factor. Once the correlation is established in the initial step, we move on to the second step, which involves estimating the impact of food prices on life expectancy by adding each of the mediators as additional covariate in the model. If the mediator's inclusion causes a reduction in the coefficient of the food prices index variable or makes it statistically insignificant, then we validate the corresponding channel as a potential link through which food prices affect life expectancy.

Table 10 reports the first step of the two-staged approach where we assess the existence of a relationship between the four channels and the food price indices (GFPI and DFPI). The results in Table 10 confirm that GFPI and DPFI have a negative and significant effect on income, while it exerts a positive and significant effect on undernutrition, mental health discords and healthcare expenditure. Despite, that the result indicating that higher food prices lead to an increase in households' healthcare spending is unexpected, it aligns with the findings of Dean et al. (2020) who documented that individuals experiencing food insecurity are more prone to incurring substantial healthcare expenses caused by chronic diseases resulting from malnutrition, stress, and anxiety. Such chronic illnesses can impose significant financial pressures on households' food budgets.

Overall, the results in Table 10 suggest that an increase in food prices will significantly affect income, mental health disorders, and households' healthcare spending. Our results confirm therefore that the four mediators can be considered as potential channels of influence and carried out in the second step of the two-staged estimation.

In the second step of the two-staged approach, we add the four covariates to our model one at a time. The results are reported in Table 11. Column 1 of Table 11 includes the global and domestic food price indices as the only explanatory variables. The coefficient on these variables represents a benchmark used to unveil any effect when a mediator is added to the regression. The results in Table 11 show that income and households healthcare spending (column 2 and 3) have a positive and highly significant effect on life expectancy, while undernutrition and mental health disorders (column 4 and 5) coefficients are negative and statistically significant. Interestingly, the inclusion of these mediators as additional covariates reduces the magnitude and level of statistical significance of the food prices coefficients (GFPI and DFPI) in column 1 (i.e., the benchmark). These results confirm that income, undernutrition, and mental health disorders are important channels through which food prices transmit to life expectancy. However, the household's healthcare expenditure is not considered as a potential channel as higher food prices tend to increase healthcare expenditure (see Table 10).

7 | FURTHER DISCUSSION OF THE RESULTS

In this section, we thoroughly examine two major aspects of our findings. First, we further explore the impact of food price increases on life expectancy from a micro and

TABLE 10 Effect of food prices on income, health spending, undernutrition, and metal health.

	Global food prices index				Domestic food prices index			
	Income (GDP)	Healthcare spending (OUT)	Mental health disorders (PMH)	Undernutrition (PUN)	Income (GDP)	Healthcare spending (OUT)	Mental health disorders (PMH)	Undernutrition (PUN)
Variables	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Ln.DV	1.095***	1.114***	1.004***	1.007***	.866***	1.046***	1.015***	.916***
	(.006)	(.018)	(.001)	(.007)	(.002)	(.021)	(.002)	(.007)
LnGFPI	−.040***	.031***	.0007***	.013**				
	(.002)	(.010)	(.000)	(.005)				
LnDFPI					−.068***	.044***	.001***	.074***
					(.005)	(.008)	(.001)	(.005)
Constant	−1.776***	.173***	.070***	.829**	−3.908***	.576***	.0422**	4.553***
	(.047)	(.174)	(.008)	(.141)	(.068)	(.037)	(.007)	(.287)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2182	2061	2025	1931	2283	2061	2025	1931
Number of id	115	115	111	102	115	115	111	102
AR (2)	.956	.785	.362	.482	.098	.333	.310	.454
Hansen test	.106	.078	.089	.104	.266	.123	.090	.183

Standard errors in parentheses, $^{***}P < .01$, $^{**}P < .05$, $^{*}P < .1$.

macroeconomic perspectives. Second, we elaborate on the ramifications of the impact of the GFC and COVID-19 crises on life expectancy amidst the backdrop of rising food prices.

7.1 | Assessing the effects of increasing food prices: Who experiences the costs or benefits?

Our empirical findings in Sections 5 and 6 meticulously depict the relationship between domestic and global food prices and life expectancy in emerging economies. We identified an inverted U-shaped relationship between food prices and life expectancy, with varying effects across countries based on their unique economic characteristics.

At the macroeconomic level, fluctuations in food prices have significant consequences for a country's economic well-being. While high prices benefit nations that export food products due to increased revenue, they impede the economies of importing countries due to higher import costs (Headey & Hirvonen, 2023). In the long run, high food prices might incentivize importers to invest in domestic agriculture, potentially transitioning them into becoming exporting countries (FAO, 2011). These investments are pivotal for poverty alleviation and food security. The impact on a country's balance of payments also confirms its role in the food trade. Food exporters enjoy a surplus when prices are high, while importers face a deficit. However, a country heavily reliant on exporting other commodities might see a mitigating effect if the prices of those exports rise alongside food prices (FAO, 2011). Moreover, in term of fiscal impact, food subsidies can be a burden for importers facing high prices, particularly in nations where food subsidies constitute a significant portion of the budget, affecting investment in other critical public goods such as healthcare and education (FAO, 2011).

Moreover, trade liberalization policies implemented since the 1990s aimed to address concerns that government interventions kept food prices artificially low, adversely affecting farmers' income. While trade liberalization can potentially serve farmers by allowing them to benefit from higher market prices and incentivize production, it is crucial to acknowledge potential drawbacks, such as increased competition from cheaper imports that might hurt small-scale farmers in emerging countries (Schneider & Kernohan, 2006).

At the microeconomic level, food price fluctuations have a significant impact on the well-being of different groups within a country. Since a large portion of a poor household's income is spent in food purchases, rising prices disproportionately harm them, forcing them to reduce spending on essential items such as healthcare and education (Obayelu, 2011). This can lead to negative effects on their overall health and life expectancy. The concept of "net food buyer" versus "net food seller" is crucial in understanding the varying effects. Urban areas, with limited food production, are home to many vulnerable net food buyers who are negatively impacted by price hikes. Rural areas have some net food buyers facing similar chal-

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TABLE 11 Effects of mechanisms.

DV: Life expectancy	Sys-GMM (1)	(2)	(3)	(4)	(5)
Global food price index					
Food prices (GFPI)	.0042***	−.017**	−.001***	.0032**	.0035**
	(.009)	(.000)	(.0006)	(.0006)	(.0006)
Income (GDP)		.0042***			
		(.0001)			
Healthcare spending (OUT)			.0003***		
			(.0009)		
Undernutrition (PUN)				−.0048***	
				(.0007)	
Mental stress (PMH)					−.013***
					(.0024)
AR 2	.432	.138	.162	.182	.155
Hansen test	.683	.727	.805	.080	.06
Domestic food price index					
Food prices (DFPI)	.0078***	−.003**	−.004**	−.0001**	−.0027*
	(.0001)	(.0002)	(.0001)	(.0002)	(.007)
Income (GDP)		.0030***			
		(.0006)			
Healthcare spending (OUT)			.0003***		
			(.0004)		
Undernutrition (PUN)				−.0065***	
				(.0007)	
Mental stress (PMH)					−.047***
					(.001)
AR 2	.311	.147	.163	.179	.154
Hansen test	.454	.637	.801	.105	.149

Standard errors in parentheses, ***$P < .01$, **$P < .05$, *$P < .1$.

lenges and some net food sellers (farmers with a surplus to sell) potentially benefiting from higher income (Aksoy & Isik-Dikmelik, 2008). To cope with rising food costs, net food buyers might resort to various strategies like taking on extra work, selling assets, or borrowing money, which can have long-term negative consequences.

While higher food prices can improve the income of net-selling farmers, particularly those with larger surpluses, the benefits might not be evenly distributed. Poorer farmers with minimal surplus to sell might see a smaller increase in income. A more equitable land distribution could lead to a stronger positive impact on poverty reduction in rural areas (FAO, 2011). The impact on the labor market is another consideration. Higher food prices might create a demand for more farm labor, potentially raising wages in the long run and benefiting poor, wage-dependent households (FAO, 2011; Headey & Martin, 2016). However, according to FAO (2011) the evidence on this relationship is mixed and depends on the role of agricultural sector in the economy and the time frame of wages adjustment.

Government interventions in the form of subsidies are a common response to protect the poor from high food prices[8]. However, these subsidies are often criticized for

[8] Several central banks in emerging and developed countries use monetary policy instruments to deal with soaring food prices. According to a recent study by the IMF in 2003, 13 emerging economies were identified as having implemented general inflation targeting, including South Africa (2000), Thailand (2000), Mexico (2001), Philippines (2002), Guatemala (2005) Indonesia (2005), Turkey (2006), Ghana (2007), Gorgia (2009), Russia (2014), Kazakhstan (2015), Argentina (2016), and India, (Bhalla et al., 2023). Only five countries adopted food inflation targeting: Turkey, Mexico, India, Brazil, and Russia (Bhattacharya & Jain, 2020). Furthermore, as highlighted by Bhattacharya and Jain (2020), implementing a one-time monetary tightening to counter food sector inflation may destabilize both food and general inflation in the economy. They argue that sustained monetary contraction is necessary to effectively lower food prices, outweighing the positive effects from the production cost channel with negative effects from the aggregate demand channel.

being expensive, inefficient, and ultimately benefiting the wealthy more than the intended population (FAO, 2011). A more sustainable solution lies in long-term investments in agriculture, which can be achieved by increasing yields, reducing input costs, and improving overall productivity. These investments can lead to lower food prices for consumers and higher profits for farmers in the long run. This approach offers a win-win situation for both parties and represents an opportunity for long-term economic growth and poverty reduction. While high food prices create short-term challenges for vulnerable populations, they can also serve as a catalyst for investments that address food insecurity and poverty in the long run (Headey & Hirvonen, 2023). For instance, Fan et al. (2008) highlighted the role of public investments in education, agricultural research and rural infrastructure in promoting agricultural growth and poverty reduction.

7.2 | Impact of financial and health crises amidst rising food price on life expectancy

In normal market conditions, moderate increases in food prices can initially stimulate agricultural production and economic activity (FAO, 2011; Oluwatoyin & Balcilar, 2012). However, the prolonged and significant rises in food prices following the GFC had deviated from the "normal" typical pattern. The severity and relatively long duration of the crisis resulted in unprecedented economic turmoil, particularly in emerging economies, and had triggered a cascade of effects that significantly impacted households' purchasing power and access to essential goods, including food.

During 2008, a notable surge in the price of nearly every agricultural commodity led to the emergence of a global food price bubble, posing a threat to vulnerable populations limiting their purchasing ability. The GFC resulted in uncertainties where households' food budgets were squeezed, exacerbating challenges related to food insecurity, malnutrition, and access to healthcare. These conditions ultimately influenced life expectancy (Brinkman et al., 2010).

The COVID-19 pandemic is another instance where high food prices affected life expectancy. Our analysis revealed that the occurrence of such crises amplifies the pressure on the health system, nutrition, and overall well-being. The COVID-19 crisis highlighted the critical importance of a robust healthcare infrastructure in mitigating the spread of infectious diseases.

The COVID-19 pandemic has disproportionately affected LICs, which amplified existing disparities in healthcare infrastructure and economic resilience compared to higher-income countries (Boro & Stoll, 2022). LICs, already facing challenges in healthcare delivery and resource allocation, experienced larger challenges on their fragile healthcare systems as they struggled to cope with the surge in COVID-19 cases. Limited access to testing, medical supplies, and critical care facilities further prolonged the duration of the crisis and delayed the attainment of herd immunity. Moreover, the economic impacts of the pandemic were particularly severe in LICs, where vulnerable populations faced job losses and income reductions. Weak social welfare programs and financial resources constrained governments' ability to provide adequate support to affected individuals and communities, this exacerbated the socio-economic inequalities, and widened the gap between rich and poor countries. As a result, the differential impact of COVID-19 on LICs reflects the urgent need for targeted interventions and global solidarity to address the underlying structural vulnerabilities and mitigate the adverse health and socio-economic consequences of future economic and health crises in emerging economies.

8 | CONCLUSION AND POLICY IMPLICATIONS

Our study sheds light on the complex relationship between global and domestic food prices and life expectancy in emerging economies and highlights the differences between MICs and LICs. Our analysis reveals several key findings that have important policy implications, especially when considering the unique circumstances of these two income groups. First and foremost, our research highlights the existence of an inverted U-shaped relationship between global and domestic food prices and life expectancy according to which affordable food prices are crucial for enhancing life expectancy. However, the impact of food prices on life expectancy varies significantly depending on the economic status of the country. For MICs, our results indicate that these countries are able to bear higher levels of food prices before experiencing any adverse effects on life expectancy. This resilience can be attributed to their stronger economies, diversified income sources, access to diverse diets, developed healthcare systems, and social welfare programs. Accordingly, policymakers in MICs should remain vigilant regarding the potential negative effects of extremely high food prices but can relatively afford to allow for reasonable fluctuations in food prices. In contrast, LICs are more vulnerable to food price increases because of their weaker economies, higher poverty rates, limited access to diverse and nutritious foods, and underdeveloped healthcare systems. For these countries, small food price increases can quickly lead to malnutrition and eventually a decline in life expectancy.

Therefore, it is imperative for LICs to implement corrective policies that mitigate the negative effects of rising food prices. Moreover, we find that the GFC substantially affected the food price thresholds, particularly in LICs, where even small food price increases can lead to declining life expectancy. This finding stresses the severe consequences of economic crises on public health and highlights the close connections between economic events and human health.

While the inverted U-shaped relationship between food prices and life expectancy is a common stylized fact across emerging economies, the extent of vulnerability and the policy responses required differ significantly between MICs and LICs. Tailored policy measures that consider these income-based disparities are essential to promote food security and improve life expectancy in emerging economies. Within this context, the findings of our research are of utmost importance with several policy implications. First, policymakers in LICs should focus on the protection of vulnerable populations from rising food prices. This may involve implementing food subsidy initiatives, expanding social welfare programs, and ensuring access to affordable and nutritious food for the most vulnerable communities. Second, both MICs and LICs can benefit from larger investments in agriculture, which can help stabilize food prices. Third, LICs need to strengthen their healthcare systems to better handle health issues related to pandemics, malnutrition, or food insecurity. This includes improving access to healthcare services and enhancing the quality of care. Moreover, efforts to promote diet diversity, especially in LICs, can help populations cope with food price fluctuations. Fourth, the development of continuous monitoring and early warning systems for global and domestic food price fluctuations can enable effective policy interventions to prevent severe negative consequences on life expectancy. Finally, the international community can play a key role by providing assistance to LICs during periods of extreme food price increases and ensure that vulnerable populations receive the required support.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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APPENDIX

TABLE A1 List of countries.

Low-income countries	Middle-income countries			
Afghanistan	Albania	Dominica	Lesotho	Tajikistan
Burkina Faso	Algeria	Dominican Republic	Malaysia	Tanzania
Burundi	Angola	Ecuador	Mauritania	Thailand
Central African Republic	Argentina	Egypt	Mauritius	Timor-Leste
Chad	Armenia	El Salvador	Mexico	Tunisia
Congo, Dem. Rep.	Azerbaijan	Equatorial Guinea	Mongolia	Türkiye
Eritrea	Bangladesh	Eswatini	Montenegro	Turkmenistan
Ethiopia	Belarus	Fiji	Morocco	Ukraine
Gambia	Belize	Gabon	Myanmar	Uzbekistan
Guinea	Benin	Georgia	Namibia	Vanuatu
Guinea-Bissau	Bhutan	Ghana	Nepal	Vietnam
Liberia	Bolivia	Guatemala	Nicaragua	Zimbabwe
Madagascar	Bosnia and Herzegovina	Guyana	Nigeria	
Malawi	Botswana	Haiti	Pakistan	
Mali	Brazil	Honduras	Papua New Guinea	
Mozambique	Bulgaria	India	Paraguay	
Niger	Cabo Verde	Indonesia	Peru	
Rwanda	Cambodia	Iran	Philippines	
Sierra Leone	Cameroon	Iraq	Russian Federation	
Somalia	China	Jamaica	Samoa	
South Sudan	Colombia	Jordan	Sao Tome and Principe	
Sudan	Comoros	Kazakhstan	Senegal	
Syrian Arab Republic	Congo, Rep.	Kenya	Serbia	
Togo	Costa Rica	Kiribati	South Africa	
Uganda	Cot' d'Ivoire	Kyrgyz Republic	Sri Lanka	
Yemen	Cuba	Lao PDR	St. Vincent and the Grenadines	
Zambia	Djibouti	Lebanon	Suriname	

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TABLE A2 **List of** variables **and sources.**

Variables	Code	Source
GDP per capita (constant 2015 US$)	GDP	WDI
Life expectancy at birth, female (years)	FLE	WDI
Life expectancy at birth, male (years)	MLE	WDI
Life expectancy at birth, total (years)	LE	WDI
Trade openness (% of GDP)	TRA	WDI
Inflation, consumer prices (annual %)	INF	WDI
Access to clean fuels and technologies for cooking (% of population)	EP	WDI
Domestic general government health expenditure (% of GDP)	HC	WDI
Global food price index	GFPI	FAO
Domestic Food CPI	DFPI	FAO
Prevalence of undernourishment in (%) of population	PUN	WDI
Share of population with mental health disorder (% of population)	PMH	WHO
Out-pocket health care expenditure (% of health care expenditure)	OUT	WDI

TABLE A3 Descriptives **statistics for the pre-GFC, post-GFC, and post COVID-19 pandemic periods.**

	Pre-GFC (2000–2007)					Post-GFC (2008–2019)					Post COVID-19 (2020–2021)				
Variable	Obs	Mean	Std. dev.	Min	Max	Obs	Mean	Std. dev.	Min	Max	Obs	Mean	Std. dev.	Min	Max
LE	960	63.13	8.91	41.96	78.51	1440	66.99	7.36	43.57	79.73	240	67.66	6.19	52.53	79.28
GFPI	960	64.87	12.99	53.12	94.25	1440	106.65	13.60	91.66	131.88	240	111.93	13.83	98.13	125.73
DFPI	960	47.42	19.28	1.69	102.19	1440	95.21	36.90	11.46	602.57	240	168.84	166.14	26.67	1630.74
GDP	936	2723.26	2339.91	255.10	12857	1418	3561.0	2979.8	270.14	14222.5	231	3762.44	3081.86	261.02	13341.6
INF	837	9.76	27.21	−10.07	513.91	1345	6.89	15.23	−6.81	380.00	200	12.85	50.39	−2.60	557.20
EP	952	40.96	36.07	.00	99.90	1425	47.75	37.08	.00	99.90	118	51.34	37.17	.00	99.90
HC	921	5.11	2.06	1.50	12.62	1402	5.56	2.29	1.26	20.41	119	6.19	2.71	2.01	16.83
TRA	856	75.70	35.90	20.29	323.23	1317	75.20	34.40	15.28	348.00	215	68.83	34.04	4.13	264.02
Middle-income countries (MICs)															
LE	744	65.77	7.85	41.96	78.51	1116	69.12	6.60	43.57	79.73	186	69.48	5.45	52.68	79.28
GFPI	744	64.87	12.99	53.12	94.25	1116	106.65	13.60	91.66	131.88	186	111.93	13.84	98.13	125.73
DFPI	744	48.51	19.16	1.69	102.19	1116	93.69	26.73	11.46	519.88	186	153.78	136.26	26.67	1630.74
GDP	735	3281.75	2333.42	318.01	12857	1111	4335	2915.6	669.56	14222.5	184	4548.20	2976.61	972.42	13341.6
INF	668	9.00	18.64	−10.07	325.00	1062	5.81	9.70	−4.29	255.31	162	10.86	46.35	−2.60	557.20
EP	736	50.50	33.96	.40	99.90	1101	58.63	33.41	.90	99.90	91	62.96	32.32	3.30	99.90
HC	722	5.01	2.04	1.50	12.62	1110	5.46	2.20	1.26	14.08	94	6.09	2.47	2.01	12.49
TRA	685	81.44	36.78	21.46	323.23	1047	80.16	35.92	22.11	348.00	170	72.48	35.61	15.68	264.02
Low-income countries (LICs)															
LE	216	54.03	5.83	44.52	73.71	324	59.67	4.66	48.02	73.88	54	61.39	4.14	52.53	72.14
GFPI	216	64.87	13.01	53.12	94.25	324	106.65	13.62	91.66	131.88	54	111.93	13.93	98.13	125.73
DFPI	216	43.63	19.26	5.33	82.18	324	100.47	59.71	18.71	602.57	54	220.72	236.92	92.77	1060.3
GDP	201	681.01	525.29	255.10	2401.2	307	760.23	486.44	270.14	2547.6	47	686.26	320.40	261.02	1828.1
INF	169	12.78	47.88	−8.97	513.91	283	10.93	27.04	−6.81	380.00	38	21.31	64.92	−.77	382.8
EP	216	8.45	20.95	.00	98.90	324	10.76	22.01	.00	98.80	27	12.16	23.09	.00	96.90
HC	199	5.45	2.09	1.55	11.52	292	5.91	2.57	2.53	20.41	25	6.56	3.50	2.61	16.83
TRA	171	52.73	19.36	20.29	126.35	270	55.99	17.47	15.28	111.84	45	55.06	22.76	4.13	115