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EVALUATION OF PRICE VARIATION OF BASIC GOODS DURING THE PANDEMIC AND POST-PANDEMIC PERIOD (2020–2024) CAUSED BY COVID-19 IN TWO FOOD MARKETS IN TWO DISTRICTS OF PERU

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ABSTRACT

This study evaluated the price variations of basic goods across the pandemic and post-pandemic periods (2020–2024) in two food markets located in two districts of Peru. The research follows a descriptive-exploratory approach, assessing price variations across the entire health crisis. Data collection included fruits, vegetables, cereals, legumes, tubers, eggs, meats, dairy products, processed foods, pharmaceuticals, cleaning supplies, basic services, and the exchange rate (USD/PEN). Prices were recorded monthly at one traditional market (Ayacucho) and one supermarket (Lima) from March 2020 to March 2024.

Both districts exhibited sustained price increases throughout the pandemic. While fruits and vegetables fluctuated, cereals, legumes, meats, processed foods, cleaning supplies, and basic services showed persistent upward trends. The cost of most essential goods was higher in Lima than in Ayacucho. Additionally, shrinkflation was identified in products such as pasta, evaporated milk, cooking oil, rolled oats, bottled water, canned tuna, and dishwashing detergent. This is the first study to assess price variation across the entire course of the pandemic in Peru.

Keywords: food access, shrinkflation, food security, medication costs, water price, inflation.

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Pages: 1- 61

1. Introduction

The Peruvian population projected for 2024 is 34,039,000 inhabitants (INEI, 2024c), an increase of five million compared to 2017 (INEI, 2021). The National Institute of Statistics and Informatics (INEI) periodically assesses poverty at the national level: households whose per capita expenditure is insufficient to acquire a basic basket of food and non-food items (housing, clothing, education, health, transportation, among others) are classified as poor. Extreme poverty is defined for households whose per capita expenditures fall below the cost of the basic food basket (INEI, 2024b). In 2023, monetary poverty affected 29.0% of the national population, compared with 20.2% in 2019. Extreme poverty rose from 2.9% in 2019 to 5.7% in 2023. In metropolitan Lima the total poverty rate was 28.1% in 2023, while in Ayacucho it was 39.4% (INEI, 2024b). The national minimum living wage in Peru is 1,130.00 soles as of 1 January 2025 (MTPE, 2024); previously it was 1,025.00 soles from 1 May 2022 and 930.00 soles in 2020 (MTPE, 2022). Despite this modest increase in the basic wage, an increasing number of people report that household income is insufficient to cover monthly expenses, a situation driven by the sustained increase in prices for many products, as documented in the present study.

Peru is a country with a wide variety of ecosystems, including the coast, the highlands, and the rainforest (Chaca and Fernández, 2016). In the coastal region, foods such as grapes, sugarcane, corn, rice, and beans, among others, are produced. In the highlands, crops such as avocado, carrot, pea, and potato are cultivated, while in the rainforest, products such as plantain, rice, and cassava are grown (INEI, 1998). Moreover, Peru is an importing country, mainly of wheat (AgroForum.pe, 2021), and an exporter primarily of quinoa (Huacani *et al*., 2024) and grapes (CIEN, 2024b).These findings reflect a situation that affects household food security. However, the internal distribution of these resources faces structural challenges related to logistics and connectivity, which exacerbate the vulnerability of food security to external shocks (Bento & Ramos, 2025).

Despite the wide diversity of foods available, access to them is often limited, which negatively affects the nutritional status of the Peruvian population. In 2022, 33.6% of children aged 6 to 59 months were diagnosed with anemia, compared to 29.5% in 2019 (INEI, 2023b). The prevalence of arterial hypertension was 22.1% among individuals aged 15 years and older.

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Pages: 1- 61

Additionally, 37.5% of individuals in this age group were overweight, and 25.6% were obese (INEI, 2023c). These figures reflect a concerning nutritional and health situation among the Peruvian population.

In December 2019, an outbreak of atypical pneumonia was reported in China, causing illness and death in the city of Wuhan. By January 2020, it was identified as a highly contagious coronavirus, prompting the Chinese government to impose a strict quarantine in Hubei province (Lossio, 2021). On March 6, 2020, the first case of coronavirus in Peru was officially confirmed (MINSA, 2020b). Following the declaration by the World Health Organization on March 11, 2020, that the outbreak had become a global pandemic, the Peruvian government issued a Supreme Decree declaring a national health emergency for 90 calendar days (MINSA, 2020a). On March 15, 2020, a national state of emergency was declared, including mandatory social isolation (quarantine) for 15 days (PCM, 2020a). From March 16 onward, transportation services were suspended, and access to markets, grocery stores, restaurants, and other establishments was restricted. After the initial 15-day period, the government issued several additional decrees extending the quarantine. On June 26, 2020, the mandatory nationwide quarantine was lifted and replaced by a targeted or localized quarantine (PCM, 2020b). Later, on October 27, 2022, the state of health emergency officially ended, and authorities encouraged voluntary mask use, vaccination against COVID-19, and other preventive measures (PCM, 2022). Finally, on May 5, 2023, after more than three years, the World Health Organization declared the end of the COVID-19 pandemic (WHO, 2023), marking the conclusion of a crisis that left profound consequences, including an increase in extreme poverty.

According to the World Health Organization (WHO), the pandemic had affected 4.5 million people in Peru (Infobae, 2024). Currently, there continue to be controlled cases (MINSA, 2024). As cited by the WHO, COVID-19 is here to stay, and we will continue to coexist with it. Moreover, the WHO notes that other pandemics are expected to emerge due to factors such as globalization, climate change, and human–animal interaction (WHO, 2024). Therefore, it is essential to maintain a balanced diet, which will depend on how we choose foods and our access to them.

There are relatively few studies worldwide that evaluate price variation during the pandemic. For instance, Mesa and Esparcia (2023), using monthly secondary data from the food consumption panel in Spanish households, reported price increases in April, particularly in

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Pages: 1- 61

vegetables (7.5%) and fruits (20.7%) compared to 2019. In Peru, Riofrio (2020) assessed price variation in fish between April and August of 2019 and 2020 using secondary data from the Ministry of Production, concluding that the pandemic did not have a significant effect on the prices of the most consumed hydrobiological products at the national level. Similarly, Pu and Zhong (2020), in China, evaluated food price variation using secondary data from the Ministry of Agriculture and Rural Affairs between February 20 and March 31, 2020, reporting a decrease in fruit and vegetable prices. In Peru, the government agency responsible for recording price variations of selected representative products across several markets is the National Institute of Statistics and Informatics (INEI), which reports this information monthly as the National Consumer Price Index (IPCN). The base period for the new national consumer price index has been established as December 2021 = 100 (INEI, 2024a). The present study differs by adopting a descriptive-exploratory market surveillance approach through a four-year longitudinal follow-up in territorially asymmetric regions: El Agustino (Lima) and Ayacucho (Huamanga). This comparison allows for documenting the differential impact between modern retail and traditional markets in a country with marked logistical disparities.

An innovative component of the study is the analysis of *shrinkflation*, a business strategy that involves reducing the quantity or size of a product without altering its nominal price, thereby generating a hidden increase in the price per unit of measurement (OECD, 2022). According to Gupta et al. (2023), this represents a form of hidden inflation that erodes real purchasing power. To capture this phenomenon, the present study implements the calculation of standardized unit prices (Pu), enabling precise technical monitoring of the real cost per unit of measurement.

The COVID-19 pandemic and the lockdown measures implemented worldwide have caused significant disruptions in supply chains as well as in the demand for goods and services, resulting in price fluctuations, particularly for essential products. Under a descriptive-exploratory approach, this research proposes the following objectives: (i) to evaluate the variation in prices of basic goods in two food markets in Peru during the pre-quarantine period, the mandatory quarantine phase, the state of emergency period, the late pandemic phase, and the post-pandemic period caused by COVID-19 from 2020 to 2024; (ii) to analyze price differences of basic goods between the two food markets in the districts of Ayacucho and El Agustino; and (iii) to identify mass-consumption basic products in which firms have applied shrinkflation through the monitoring of costs per unit of measurement.

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The results of this study contribute to academic knowledge on price fluctuations of food, medicines, and basic services, which are highly relevant due to their implications for food availability, household vulnerability, territorial inequality, and overall food security. Additionally, these findings are useful for decision-makers in the design and implementation of public policies aimed at mitigating the negative impacts of future crises.

The analysis of price variation provides a more accurate understanding of how much food prices have increased throughout the pandemic period, which directly influences access to food and, consequently, household food security.

2. Methodology

2.1 Research Design

This study is descriptive and exploratory in nature. The exploratory approach allows for documenting price variation across two departments with distinct market structures: Lima and Ayacucho.

Additionally, the study follows a quantitative and longitudinal approach, as it measures and quantifies price variations of basic goods over the period from 2020 to 2024, enabling the observation of price changes across the different phases of the health crisis.

2.2 Sampling Procedure

Two food markets were selected in two distinct geoeconomic districts of Peru: one in the highlands (Ayacucho department) and another on the coast (Lima department, El Agustino district). The selection of food markets followed a cluster-based approach, as they represent a large proportion of the population. In Ayacucho, the Nery García Zárate Market was selected, as it is the only large wholesale market with high attendance in the district. In El Agustino, where two supermarkets are available, one of them was selected.

Additionally, the selection was based on convenience sampling, given that, during the mandatory quarantine phase, mobility was highly restricted and the duration of the restrictions was uncertain. In Ayacucho, the selected market was chosen due to its high attendance and the coexistence of both wholesale and retail sales; furthermore, given the small size of the city, it was accessible on foot. In El Agustino, a supermarket was selected because it is among the most frequented and was also accessible on foot for price data collection.

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In both districts, only one type of supply center was selected due to personnel limitations. Data collection was carried out by the researchers themselves, one in each district, who assumed this responsibility despite the risks associated with the pandemic.

Furthermore, the selection of these supply points does not aim to establish a direct equivalence comparison, but rather to document the differential impact of the crisis across settings with divergent supply structures. The district of El Agustino represents a high-density urban environment integrated into the logistical infrastructure of the capital, where access to modern retail (supermarkets) and digitized supply chains predominates. In contrast, the district of Ayacucho functions as a regional consumption center dependent on interprovincial land connectivity, where traditional markets constitute the primary supply axis.

2.3 Data Collection Techniques

Price data were collected from March 2020 to March 2024. Data were recorded on a monthly basis. The periods considered were: pre-quarantine (March 2020), pandemic with mandatory quarantine (until June 26, 2020), pandemic under a state of health emergency (until October 27, 2022), late pandemic phase (May 5, 2023), and post-pandemic period (until March 2024).

Supply centers were visited once per month: the Nery García Zárate Market in the district of Ayacucho and a supermarket in the district of El Agustino.

For price data collection, essential basic goods were included in the study, such as fruits, vegetables, cereals, legumes, eggs, meats, dairy products, processed foods, medicines, cleaning supplies, basic services, and the exchange rate of the U.S. dollar.

It should be noted that neither Food markets includes pharmaceutical points of sale; therefore, medication prices were collected from pharmacies located near both Food markets.

Regarding the costs of basic services, water and electricity, data were obtained from the monthly bills issued by the service providers to households in each district.

Finally, the exchange rate of the U.S. dollar was obtained from currency exchange offices located within each district.

2.4 Inclusion and Exclusion Criteria

The present study included essential basic goods considered part of the household consumption basket, such as fruits, vegetables, cereals, legumes, eggs, meats, dairy products, processed

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foods, medicines, cleaning supplies, basic services, and the exchange rate of the U.S. dollar. Additionally, only products available in both Food markets were considered.

For processed foods and cleaning supplies, products with the same brand and presentation were selected to maintain consistency in the tracking of shrinkflation across different phases. In the case of bulk products, such as fruits, vegetables, tubers, legumes, and cereals, the highest-quality available options were selected.

Products with non-mass consumption or highly specific characteristics (e.g., organic or luxury items) were excluded. Likewise, products that were unavailable or that differed significantly in brand and presentation between the two locations were excluded.

It should be noted that, in the case of gas, the type of supply differs between districts. However, these data were not excluded, as gas is a commonly consumed good and its inclusion is relevant for the analysis. This consideration is specified in the corresponding tables.

2.5 Data Analysis Plan

The data analysis plan was systematically structured to address the study objectives under a descriptive-exploratory framework. To ensure the rigor of comparisons, a data normalization protocol was established, setting the baseline price as the value recorded at the beginning of the study in March 2020. All variation calculations were conducted in the national currency (Peruvian soles).

First, a time series analysis was performed through longitudinal monitoring covering five critical phases of the pandemic. The values used to calculate the percentage variation in prices for each phase were based on specific monthly observations, using as reference the baseline price recorded at the beginning of the study and the price observed in the final month of each phase. Additionally, for the price trend graphs (2020–2024), which illustrate monthly price variation throughout the study period, only those products exhibiting a post-pandemic price variation greater than 25% were included.

Simultaneously, a spatial asymmetry analysis was conducted to compare price behavior between the two food markets. Price comparisons were performed using percentage variation. The baseline price (in soles) corresponded to the value recorded at the beginning of the study, with Ayacucho serving as the reference district. This methodological approach

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Pages: 1- 61

allowed for the identification of critical gaps in price transmission between the capital (Lima) and the regional context (Ayacucho).

To calculate the percentage price variation in products affected by shrinkflation, only those items included in the study that experienced changes in net weight were considered. The baseline price corresponded to the value recorded in the district of Ayacucho. The initial unit price (price per gram) was calculated by dividing the initial price by the initial weight, while the final unit price was obtained by dividing the final price by the final weight. The percentage variation was then calculated as the difference between the final and initial unit prices, divided by the initial unit price and multiplied by 100.

Finally, statistical processing of the data was carried out using Microsoft Excel (version 2024). Descriptive statistics and percentage-based analyses were applied. In addition, graphical representations of monthly price trends were generated.

2.6 Study Limitations

The following limitations are acknowledged. First, there is a lack of causal identification, as the study only recorded price variations across different periods without incorporating additional causal variables. Second, only two supply centers were selected, which may limit the representativeness of the findings for the entire district. Third, the comparison involves non-equivalent retail channels, given the differences in logistics, local market structure, and the quality of bulk products between the two supply centers. Finally, no additional personnel were hired to carry out price data collection across a wider range of supply centers due to budget constraints and the need to minimize exposure to potential contagion during the pandemic.

3. RESULTS

The following figures illustrate price fluctuations throughout the pandemic and post-pandemic periods for products that exhibited a price variation greater than 25% during the latter phase.

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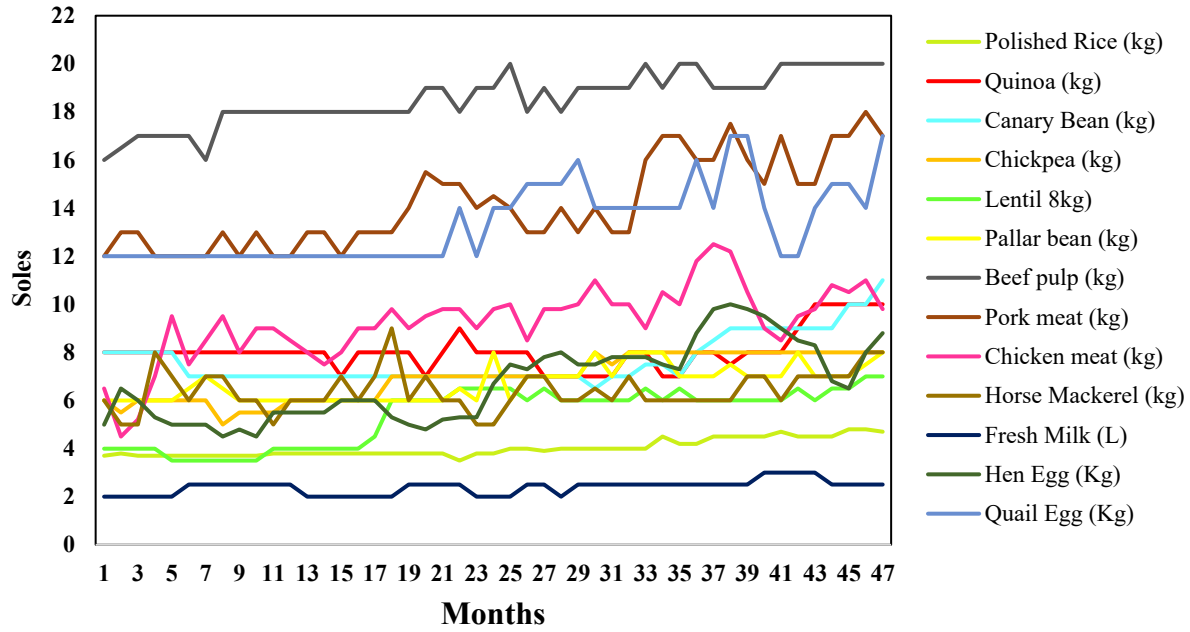
Pages: 1- 61

Figure 1: *Price of meats, dairy products, cereals, and legumes in the Ayacucho district.*



Note: Recorded from March 2020 to March 2024.

Source: Authors' own elaboration.

JIRRS
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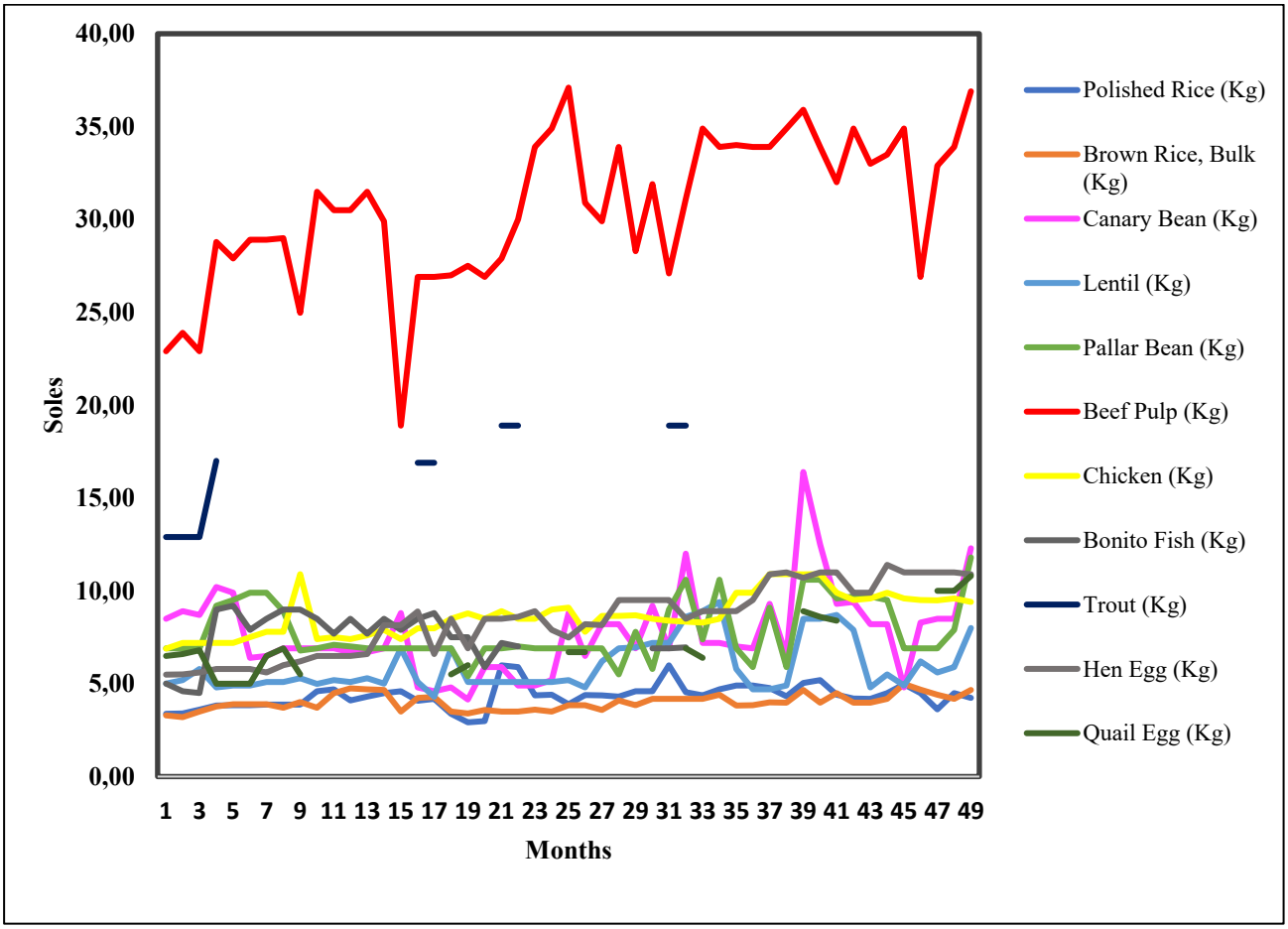
Pages: 1- 61

Figure 2: *Prices of meats, dairy products, cereals, and legumes in the district of El Agustino.*



Note(s): Recorded from March 2020 to March 2024. Dashed lines indicate product shortages.

Source: Authors' own elaboration.

JIRRS
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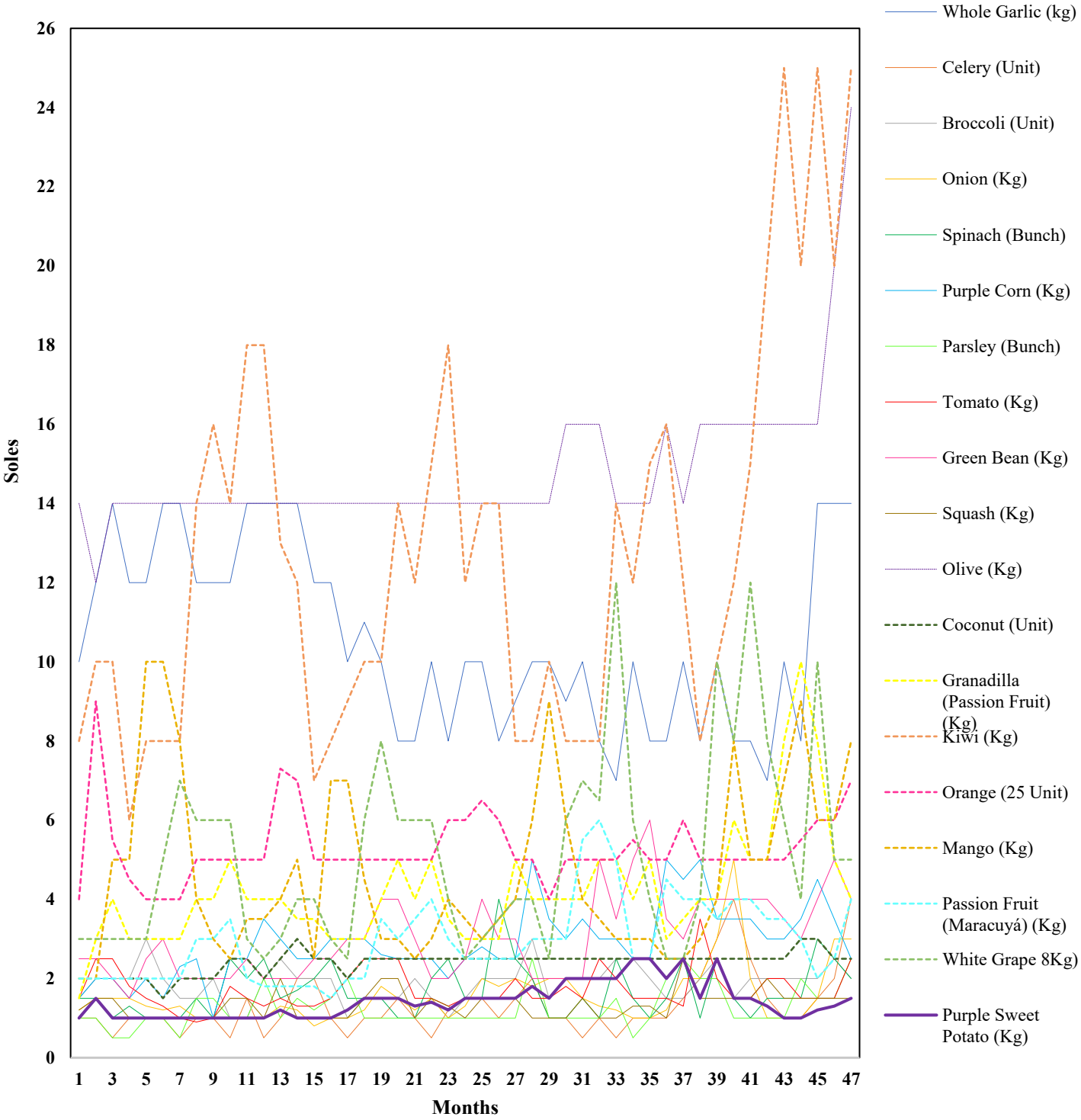
Pages: 1- 61

Figure 3: *Prices of vegetables, fruit and tubers in the district of Ayacucho.*



Note: Recorded from March 2020 to March 2024.

Source: Authors' own elaboration.

JIRRS
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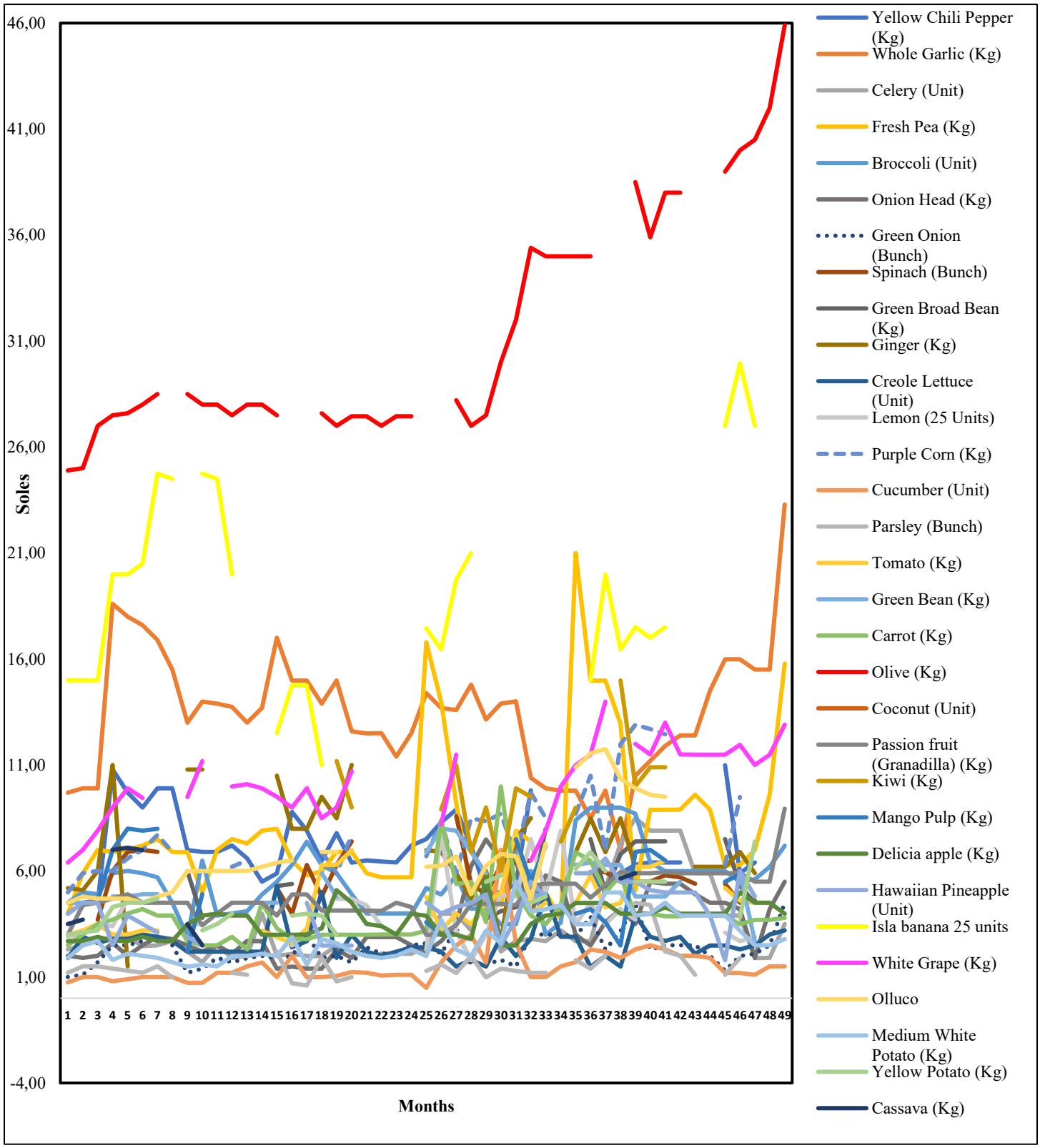
Pages: 1- 61

Figure 4: *Prices of vegetables, fruit and tubers in the district of El Agustino.*



Note(s): Recorded from March 2020 to March 2024. Dashed lines indicate product shortages.

Source: Authors' own elaboration.

JIRRS
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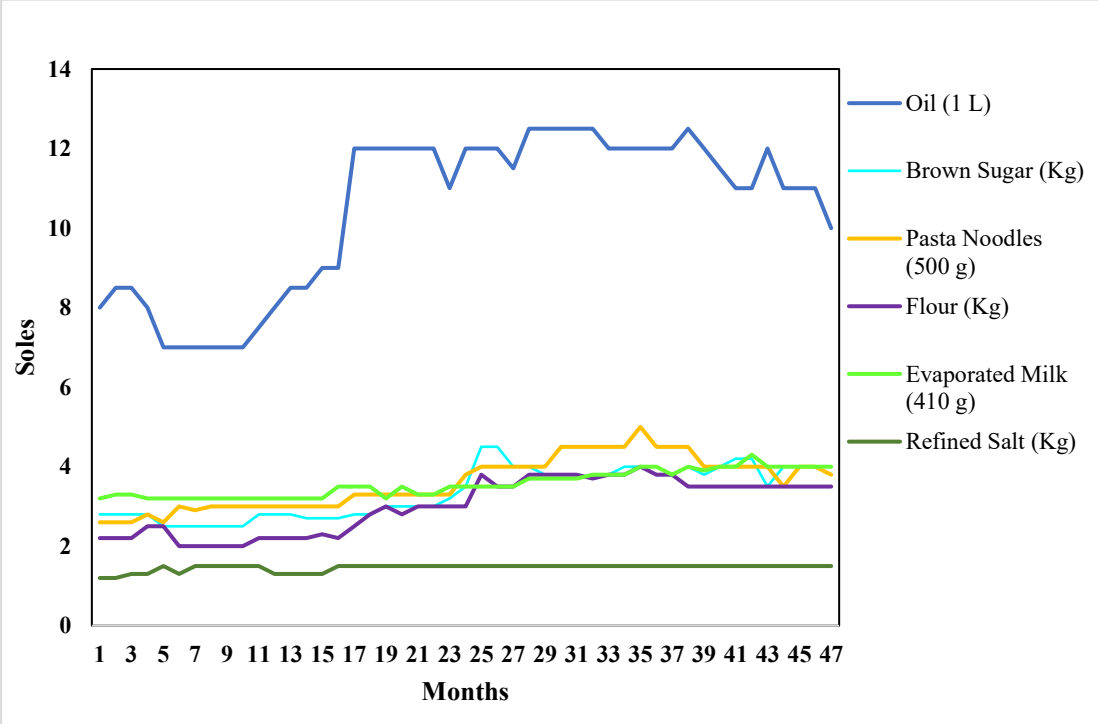
Pages: 1- 61

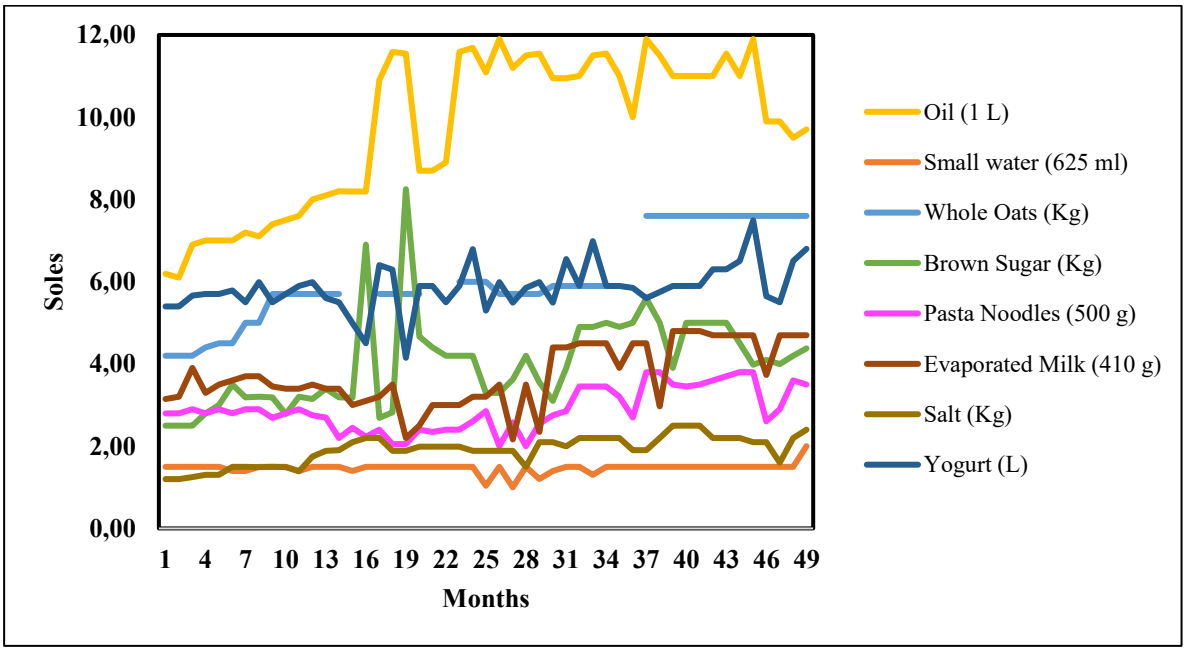
Figure 5: *Prices of processed foods in the district of Ayacucho.*



Note: Recorded from March 2020 to March 2024.

Source: Authors' own elaboration.

Figure 6: *Price of industrialized food products in the district of El Agustino.*



Note(s): Recorded from March 2020 to March 2024. Dashed lines indicate product shortages.

Source: Authors' own elaboration.

JIRRS
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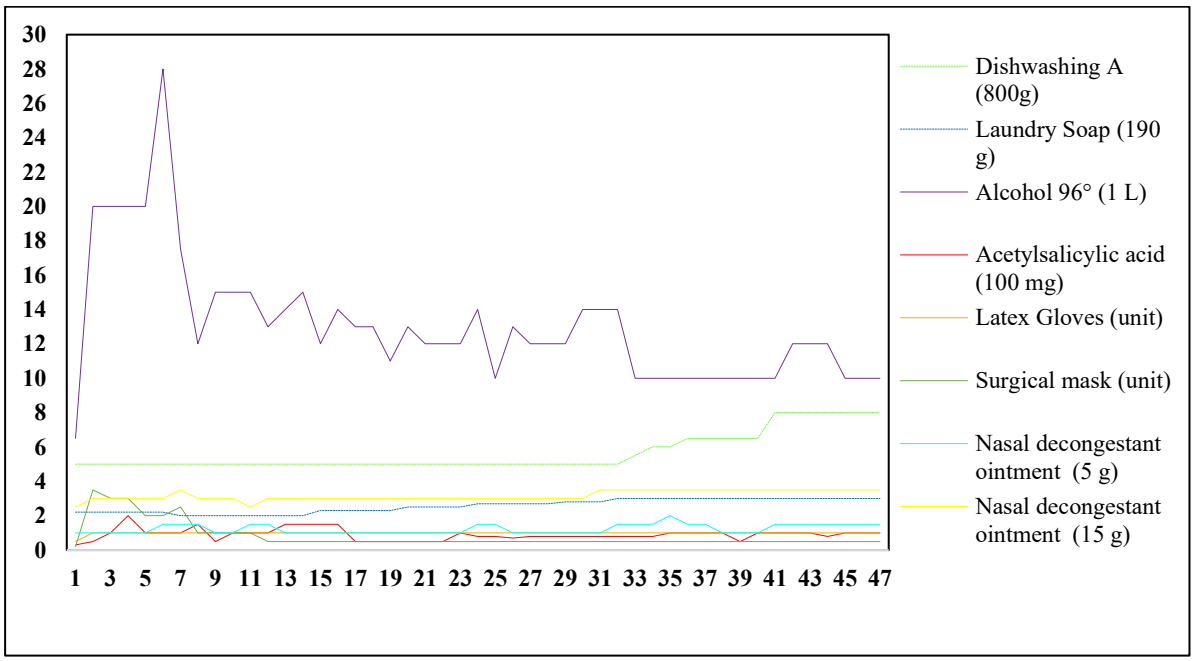
Pages: 1- 61

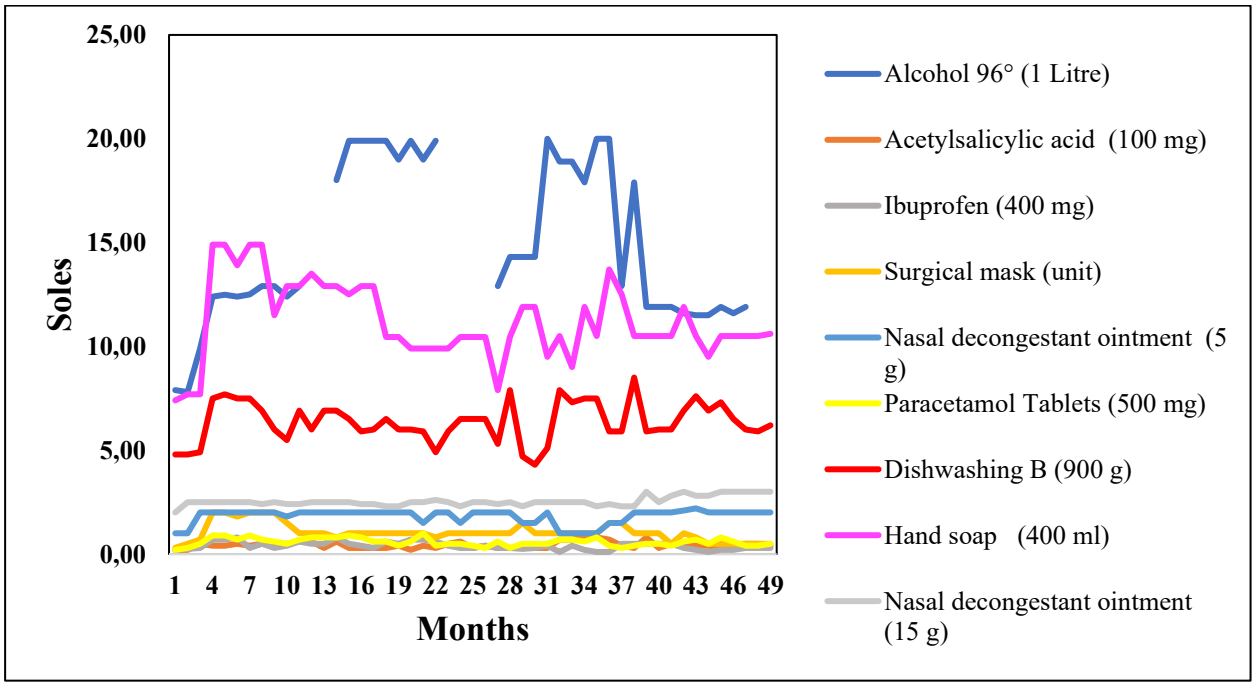
Figure 7: *Price of cleaning materials and registered medicines in the district of Ayacucho.*



Note: Recorded from March 2020 to March 2024.

Source: Authors' own elaboration.

Figure 8: *Price of cleaning materials and medicines in the district of El Agustino.*



Note(s): Recorded from March 2020 to March 2024. Dashed lines indicate product shortages.

Source: Authors' own elaboration.

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Pages: 1- 61

Tables 1 to 5 show the percentage variation in prices across the different phases of the pandemic for all products studied in Ayacucho; Tables 6 to 10 present the corresponding data for El Agustino. The periods considered were: the pre-quarantine phase (March 2020), the pandemic with mandatory quarantine phase (until June 26, 2020), the end of the health emergency period (until October 27, 2022), the end of the pandemic phase (May 5, 2023), and the post-pandemic period (March 2024).

Percentage Variation in Prices in the District of Ayacucho

Table I

Percentage of Price Variation (%PV) for cereals, legumes, meats, and dairy products in the district of Ayacucho.

Products	Prices in soles. Pre-quarantine	% PV. Pandemic with mandatory quarantine	% PV. End of the state of health emergency.	% PV. End of the pandemic.	Prices in soles. Post-pandemic.	%PV from 2020 to 2024.	%PV. In the Pre-quarantine period between the district of Ayacucho and El Agustino *
Cereals							
Polished rice (Kg)	3.70	0.00	8.11	21.62	4.60	24.32	-8.65
Brown rice (Kg)	3.50	0.00	0.00	2.86	4.00	14.29	-5.71
Quinoa (Kg)	8.00	0.00	0.00	0.00	10.00	25.00	23.75
Wheat (Kg)	3.50	0.00	14.29	14.29	4.00	14.29	-5.71
Legumes							
Canary bean (Kg)	8.00	0.00	-12.50	12.50	11.00	37.50	6.25
Chickpea (Kg)	6.00	0.00	33.33	33.33	8.00	33.33	-6.67
Lentil (Kg)	3.50	14.29	71.43	71.43	7.00	100.0	42.86
Pallar bean (Kg)	6.00	0.00	33.33	16.67	8.00	33.33	15.00
Meats and fish							
Beef pulp (Kg)	16.00	6.25	18.75	18.75	20.00	25.00	43.13
Pork meat (Kg)	12.00	0.00	8.33	33.33	17.00	41.67	107.50
Chicken meat (Kg)	6.50	7.69	53.85	61.54	9.80	50.77	6.00
Bonito fish (Kg)	10.00	-30.00	-30.00	-20.00	8.00	-20.00	-50.00
Trout (Kg)	14.00	-14.29	0.00	7.14	15.00	7.14	-7.86
Dairy products							
Fresh milk (L)	2.00	0.00	25.00	25.00	2.50	25.00	125.00

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Cheese (Kg)	18.00	0.00	22.22	33.33	22.00	22.22	44.44
Eggs							
Hen egg (Kg)	5.00	6.00	56.00	96.00	8.80	76.00	9.80
Quail egg (Kg)	12.00	0.00	16.67	41.67	17.0	41.67	-45.92

Note(s): The baseline price (in PEN) corresponds to the value recorded in March 2020. * Reference price taken from the Ayacucho district.

Source: Authors' own elaboration.

Table II

Percentage of price variation (%PV) of vegetables in the district of Ayacucho.

Products	**Prices in soles. Pre-quarantine**	**%PV. Pandemic with mandatory quarantine.**	**%PV. End of the health emergency state.**	**%PV. End of the pandemic.**	**Prices in soles. Post-pandemic.**	**%PV from 2020 to 2024.**	**%PV. In the Pre-quarantine period between the district of Ayacucho and El Agustino ****
Vegetables							
Yellow chili (Kg)	2.50	0.00	180.00	100.00	3.00	20.00	80.00
Whole garlic (Kg)	10.00	20.00	-20.00	0.00	14.00	40.00	-3.00
Celery (unit)	1.00	0.00	0.00	200.00	4.00	300.00	130.00
Fresh peas (Kg)	3.00	0.00	16.67	-16.67	2.50	-16.67	66.33
Beetroot (bunch)	2.50	-20.00	-20.00	0.00	3.00	20.00	87.60
Broccoli (unit)	1.50	33.33	33.33	66.67	2.00	33.33	200,00
Onion (head) (Kg)	1.20	25.00	8.33	150.00	3.00	150.00	65.83
Chinese onion (bunch)	1.50	-33.33	33.33	100.00	1.50	0.00	-33.30
Spinach (bunch)	1.50	-13.33	-33.33	66.67	2.00	33.33	133.33
Green broad Bean (Kg)	1.50	33.33	66.67	0.00	1.50	0.00	79,33
Ginger (Kg)	6.00	-16.67	-50.00	-16.67	4.00	-33.33	-13.33
Creole lettuce (unit)	1.00	50.00	50.00	0.00	1.00	0.00	89,00
Lemon (25 units)	4.00	-37.50	100.00	0.00	4.00	0.00	-27.75
Corn on the cob (Kg)	1.20	-16.67	-16.67	8.33	1.00	-16.67	50.00
Purple corn (Kg)	1.50	0.00	100.00	133.33	2.50	66.67	232.67

JIRRS
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DOI: 10.66104/yx5p8m96
Pages: 1- 61

Cucumber (unit)	0.50	40.00	40.00	0.00	0.50	0.00	50.00
Parsley (bunch)	1.00	-50.00	0.00	200.00	2.50	150.00	20.00
Bell pepper (unit)	1.00	50.00	50.00	50.00	1.00	0.00	20.00
Tomato (Kg)	1.50	20.00	66.67	33.33	2.50	66.67	99.33
Green beans (Kg)	2.50	-40.00	100.00	60.00	4.00	60.00	80.00
Carrot (Kg)	1.20	-16.67	-16.67	-16.67	0.80	-33.33	108.33
Squash (Kg)	1.20	-16.67	-16.67	25.00	1.50	25.00	150.00
Tubers							
Purple sweet potato (Kg)	1.00	0.00	100.00	150.00	1.50	50.00	99.00
Olluco (Kg)	2.50	-20.00	60.00	52.00	3.00	20.00	80.00
Medium white potato (Kg)	1.50	-60.00	33.33	-46.67	1.70	13.33	26.67
Yellow potato (Kg)	2.50	0.00	100.00	0.00	3.00	20.00	20.00
Cassava (Kg)	2.50	*	20.00	20.00	3.00	20.00	40.00

Note(s): The baseline price (in PEN) corresponds to the value recorded in March 2020. * Products not available during the evaluation period. ** Reference price taken from the Ayacucho district.

Source: Authors' own elaboration.

Table III

Percentage of price variation (%PV) of fruits and nuts in the district of Ayacucho.

Products	**Prices in soles. Pre-quarantine.**	**%PV. Pandemic with mandatory quarantine.**	**%PV. End of the health emergency state.**	**%PV. End of the pandemic.**	**Prices in soles. Post-pandemic.**	**%PV from 2020 to 2024.**	**%PV. In the Pre-quarantine period between the district of Ayacucho and El Agustino ****
Olive (Kg)	14.00	0.00	14.29	14.29	24.00	71.43	77.86
Coconut (unit)	2.00	0.00	25.00	25.00	2.50	25.00	110.00
Strawberry (Kg)	9.00	-100.00	-55.56	11.11	8.00	-11.11	-11.11
Passion fruit (Granadilla) (Kg)	1.50	100.00	233.33	166.67	4.00	166.67	100.00
Pomegranate (Kg)	1.50	0.00	*	33.33	3.00	100.00	280.00
Kiwi (Kg)	8.00	-25.00	0.00	25.00	25.00	212.50	8.75

JIRRS
Journal International Review of Research Studies
Received: 01/04/2026 - **Accepted:** 04/05/2026
Vol: 01.06
DOI: 10.66104/yx5p8m96
Pages: 1- 61

Orange (25 units)	4.00	12.50	25.00	25.00	7.00	75.00	265.50
Mango pulp (Kg)	2.00	*	75.00	100.00	8.00	300.00	99.50
Delicia apple (Kg)	2.50	-40.00	40.00	20.00	2.00	-20.00	7.60
Passion fruit (Maracuyá) (Kg)	2.00	0.00	200.00	75.00	4.00	100.00	175.00
Fuerte avocado (Kg)	5.00	-40.00	-20.00	-40.00	3.00	-40.00	39.80
Papaya (unit)	3.00	-66.67	-50.00	-66.67	3.00	0.00	19.67
Hawaiian pineapple (unit)	5.00	-40.00	0.00	0.00	5.00	0.00	-20.20
Seda banana (25 units)	3.50	-14.29	71.43	71.43	4.00	14.29	157.14
Isla banana (25 units)	4.00	-12.50	75.00	25.00	4.00	0.00	275.00
Striped watermelon (Kg)	1.20	-33.33	66.67	0.00	1.00	-16.67	90.83
White grape (Kg)	3.00	0.00	116.67	233.33	5.00	66.67	113.33
Nuts							
Almond (Kg)	35.00	14.29	-17.14	-20.00	32.00	-8.57	34.29
Pecan (Kg)	28.00	7.14	-14.29	-28.57	26.00	-7.14	217.50
Raisins (brown) (Kg)	12.00	16.67	16.67	16.67	14.00	16.67	158.33

Note(s): The baseline price (in PEN) corresponds to the value recorded in March 2020. * Products not available during the evaluation period. ** Reference price taken from the Ayacucho district.

Source: Authors' own elaboration.

Table IV

Percentage of price variation (%PV) of processed foods in the district of Ayacucho.

Products	**Prices in soles. Pre-quarantine**	**%PV. Pandemic with mandatory quarantine.**	**%PV. End of the health emergency state.**	**%PV. End of the pandemic.**	**Prices in soles. Post-pandemic**	**%PV from 2020 to 2024.**	**%PV. In the Pre-quarantine period between the district of Ayacucho and El Agustino ***
Oil (1L)	8.00	0.00	56.25	50.00	10.00	25.00	-22.63
Small water (625 ml)	2.00	0.00	-25.00	-25.00	2.00	0.00	-25.00
Water A (2.5 L)	4.00	0,00	0.00	0.00	4.00	0.00	-37.50
Water B (2.5 L)	4.00	0.00	0.00	0.00	4.00	0.00	-37.50
Small oatmeal (120 g)	1.00	0.00	20.0	20.00	1.00	0.00	50.00
Whole oatmeal (Kg)	5.50	9.09	0.00	0.00	5.00	-9.09	-23.64
Brown sugar (Kg)	2.80	0.00	32.14	35.71	4.00	42.86	-10.71
Canned fillet (150 g)	5.50	0.00	0.00	0.00	5.50	0.00	-10.91

JIRRS
Journal International Review of Research Studies
Received: 01/04/2026 - **Accepted:** 04/05/2026
Vol: 01.06
DOI: 10.66104/yx5p8m96
Pages: 1- 61

Pasta noodles (500 g)	2.60	7.69	73.08	73.08	3.80	46.15	7.69
Loose flour (Kg)	2.20	13.64	68.18	59.09	3.50	59.09	195.00
Evaporated milk (410 g)	3.20	0.00	18.75	21.88	4.00	25.00	-1.56
Salt (Kg)	1.20	8.33	25.00	25.00	1.50	25.00	0.00
Yogurt (1L)	5.50	0.00	18.18	18.18	6.50	18.18	-1.82

Note(s): The baseline price (in PEN) corresponds to the value recorded in March 2020. * Reference price taken from the Ayacucho district.

Source: Authors' own elaboration.

Table V

Percentage of price variation (%PV) of cleaning materials, medicines, and others in the district of Ayacucho.

Products	**Prices in soles. Pre-quarantine**	**% PV. Pandemic with mandatory quarantine.**	**% PV. End of the state of health emergency.**	**% PV. End of the pandemic.**	**Prices in soles. Post-pandemic.**	**% PV from 2020 to 2024.**	**%PV. In the Pre-quarantine period between the district of Ayacucho and El Agustino ***
Cleaning materials							
Dishwashing detergent A (800 g)	5.00	0.00	0.00	30.00	8.00	60.00	58.00
Dishwashing detergent B (900 g)	5.50	0.00	-9.09	0.00	6.00	9.09	-12.73
Bleach (680g)	1.90	0.00	5.26	5.26	2.00	5.26	-5.26
Laundry soap (190 g)	2.20	0.00	36.36	36.36	3.00	36.36	-9.09
Hand soap (400 ml)	5.00	0.00	20.00	20.00	6.00	20.00	48.00
Toilet paper (24 units)	19.00	5.26	10.53	10.53	21.00	10.53	-26.32
Shampoo (400 ml)	14.00	0.00	14.29	10.71	16.00	14.29	-7.86
Medicines							
Alcohol 96° (1L)	6.50	207.69	115.38	53.83	10.00	53.83	21.54
Alcohol 96° (70 ml)	2.00	75.00	25.00	0.00	2.00	0.00	-50.00
Acetylsalicylic acid 100 mg	0.30	566.67	166.67	66.67	1.00	233.33	-33.33
Ampicillin 500 mg	0.50	0.00	0.00	0.00	0.50	0.00	0.00
Latex gloves	0.50	100.00	100.00	100.00	1.00	100.00	-56.00
Ibuprofen 400 mg	0.25	0.00	100.00	20.00	0.250	0.00	-20.00
Surgical mask	0.20	1400.00	150.00	150.00	0.50	150.00	50.00

JIRRS
Journal International Review of Research Studies
Received: 01/04/2026 - **Accepted:** 04/05/2026
Vol: 01.06
DOI: 10.66104/yx5p8m96
Pages: 1- 61

Nasal decongestant ointment 5 g	1.00	0.00	50.00	0.00	1.50	50.00	0.00
Nasal decongestant ointment 15 g	2.50	20.00	40.00	40.00	3.50	40.00	-60.00
Paracetamol tablets 500 mg	0.250	0.00	0.00	0.00	0.25	0.00	-20.00
Tablet Cold & Flu	2.50	0.00	0.00	0.00	3.00	20.00	-4.00
Naproxen sodium 500 mg	0.50	0.00	0.00	0.00	0.50	0.00	-60.00
Basic services and others							
Domestic water 0 to 20 m^3	0.708	0.00	36.58	36.58	1.012	42.94	78.39
Domestic sewage 0 to 20 m^3	0.309	0.00	36.25	36.25	0.441	42.72	89.32
Electricity 0–30 kW·h (Residential BT5B rate)	0.5617	33.68	25.10	16.06	0.6406	14.01	-29.57
Gas cylinder 45 kg	28.00	7.14	75.00	50.00	45.00	60.71	**
Dollar to soles exchange rate	3.36	5.06	18.45	9.23	3.72	10.71	-0.89

Note(s): The baseline price (in PEN) corresponds to the value recorded in March 2020. * Reference price taken from the Ayacucho district. ** Difference in units of measurement.

Source: Authors' own elaboration.

Percentage variation of prices in the district of El Agustino

Table VI

Percentage variation of price (%PV) of cereals, legumes, meats, and dairy products in the district of El Agustino.

Products	**Prices in soles. Pre-quarantine.**	**% PV. Pandemic with mandatory quarantine.**	**% PV. End of the health emergency state**	**% PV. End of the pandemic**	**Prices in soles. Post-pandemic.**	**% PV from 2020 to 2024.**	**%PV. In the post-pandemic period between the district of Ayacucho and El Agustino****
Cereals							

JIRRS
Journal International Review of Research Studies
Received: 01/04/2026 - **Accepted:** 04/05/2026
Vol: 01.06
DOI: 10.66104/yx5p8m96
Pages: 1- 61

Polished rice (Kg)	3.38	13.02	34.32	49.11	4.24	25.44	-7.83
Brown rice (Kg)	3.30	14.55	26.67	41.21	4.66	41.21	16.50
Quinoa (Kg)	9.90	12.12	23.23	45.45	10.80	9.09	8.00
Wheat (Kg)	3.30	87.88	109.09	21.21	6.70	103.03	67.50
Legumes							
Canary bean (Kg)	8.50	20.00	41.18	45.88	12.30	44.71	11.82
Chickpea (Kg)	5.60	12.50	28.57	92.86	6.90	23.21	-13.75
Lentil (Kg)	5.00	-4.00	72.00	70.00	8.00	60.00	14.29
Pallar bean (Kg)	6.90	33.33	53.62	53.62	11.80	71.01	47.50
Meats and fish							
Beef pulp (Kg)	22.90	25.72	35.81	56.77	36.90	61.14	84.50
Pork meat (Kg)	24.90	-27.75	-21.69	32.13	16.50	-33.73	-2.94
Chicken meat (Kg)	6.89	4.35	21.19	58.06	9.40	36.43	-4.08
Bonito fish (Kg)	5.00	80.00	39.20	20.00	7.00	40.00	-12.50
Trout (Kg)	12.90	31.78	46.51	47.29	28.90	124.03	92.67
Dairy products							
Pasteurized milk (L)	4.50	26.67	31.11	6.67	4.90	8.89	96.00
Cheese (Kg)	26.00	19.19	1.88	-5.77	25.80	-0.77	17.27
Eggs							
Hen egg (Kg)	5.49	5.46	54.83	94.72	10.90	98.54	23.86
Quail egg (Kg)	6.49	-23.11	6.32	37.13	10.80	66.41	-36.47

Note(s): The baseline price (in PEN) corresponds to the value recorded in March 2020. *Products not available during the evaluated period. ** Reference price taken from the Ayacucho district in the post-pandemic period.

Source: Authors' own elaboration.

Table VII

Percentage variation of price (%PV) of vegetables in the district of El Agustino.

Products	**Prices in soles. Pre-quarantine.**	**% PV. Pandemic with mandatory quarantine.**	**%PV. End of the health emergency state.**	**% PV. End of the pandemic.**	**Prices in soles. Post-pandemic.**	**%PV from 2020 to 2024.**	**%PV. In the post-pandemic period between the district of Ayacucho and El Agustino ***
Vegetables							
Yellow chili (Kg)	4.50	139.78	117.56	40.00	10.79	139.78	259.67

JIRRS
Journal International Review of Research Studies
Received: 01/04/2026 - **Accepted:** 04/05/2026
Vol: 01.06
DOI: 10.66104/yx5p8m96
Pages: 1- 61

Whole garlic (Kg)	9.70	91.65	7.11	7.73	23.29	140.10	66.36
Celery (unit)	2.30	25.65	21.74	269.13	3.50	52.17	-12.50
Fresh peas (Kg)	4.99	38.08	48.10	2.20	15.79	216.43	531.60
Beetroot (bunch)	4.69	6.40	-31.77	44.78	4.49	-4.26	49.67
Broccoli (unit)	4.50	30.89	33.33	92.22	7.19	59.78	259.50
Onion (head) (Kg)	1.99	30.15	100.50	75.38	5.49	175.88	83.00
Green onion (bunch)	1.00	149.00	200.00	345.00	4.50	350.00	200.00
Spinach (bunch)	3.50	71.14	85.71	55.71	6.00	71.43	200.00
Green broad bean (Kg)	2.69	0.00	71.00	173.23	4.79	78.07	219.33
Ginger (Kg)	5.20	111.35	63.27	19.04	9.40	80.77	135.00
Creole lettuce (unit)	1.89	47.62	47.62	106.35	3.20	69.31	220.00
Lemon (25 units)	2.89	17.30	159.17	27.68	3.99	38.06	-0.25
Corn on the cob	1.80	-11.11	11.11	0.00	1.80	0.00	80.00
Purple corn (Kg)	4.99	20.04	94.39	158.52	14.79	196.39	491.60
Cucumber (unit)	0.75	6.67	33.33	205.33	1.50	100.00	200.00
Parsley (bunch)	1.20	12.50	-0.83	274.17	1.89	57.50	-24.40
Bell pepper (unit)	1.20	14.17	23.33	117.50	1.36	13.33	36.00
Tomato (Kg)	2.99	0.00	33.44	107.02	5.69	90.30	127.60
Green beans (Kg)	4.50	6.44	6.67	5.56	7.90	75.56	97.50
Carrot (Kg)	2.50	47.60	55.60	56.00	3.79	51.60	373.75
Squash (Kg)	3.00	16.33	-3.67	48.33	3.19	6.33	112.67
Tubers							
Purple sweet potato (Kg)	1.99	5.03	90.45	50.25	1.59	-20.10	6.00
Olluco (Kg)	4.50	4.22	4.44	118.89	7.35	63.33	145.00
Medium white potato (Kg)	1.90	-5.79	115.26	104.74	2.79	46.84	64.12
Yellow potato (Kg)	3.00	43.00	49.67	83.00	7.49	149.67	149.67
Cassava (Kg)	3.50	100.00	97.14	68.57	4.99	42.57	66.33

Note(s): The baseline price (in PEN) corresponds to the value recorded in March 2020. * Reference price taken from the Ayacucho district in the post-pandemic period.
Source: Authors' own elaboration.

Table VIII

Percentage of price variation (%PV) of fruits and nuts in the district of El Agustino.

Products	**Prices in soles. Pre-**	**%PV. Pandemic with**	**%PV. End of the**	**%PV. End of the**	**Prices in soles.**	**%PV from**	**%PV. In the post-pandemic**

JIRRS
Journal International Review of Research Studies

Received: 01/04/2026 - **Accepted:** 04/05/2026
Vol: 01.06
DOI: 10.66104/yx5p8m96
Pages: 1- 61

	quarantine.	mandatory quarantine.	health emergency state.	pandemic.	Post-pandemic.	2020 to 2024.	period between the district of Ayacucho and El Agustino *
Fruits							
Olive (Kg)	24.90	10.24	42.21	54.62	45.90	84.34	91.25
Coconut (unit)	4.20	42.62	78.57	135.71	10.59	152.14	323.60
Strawberry (Kg)	8.00	-1.25	-1.25	5.62	9.29	16.13	16.13
Passion fruit (Granadilla) (Kg)	3.00	58.00	78.00	98.00	8.94	198.00	123.50
Pomegranate (Kg)	5.70	31.58	31.58	-1.93	6.49	13.86	116.33
Kiwi (Kg)	8.70	55.06	9.08	14.83	14.99	72.30	-40.04
Orange (25 units)	14.50	40.80	35.03	29.31	15.00	3.45	114.29
Mango pulp (Kg)	3.99	75.19	37.59	72.93	7.69	92.73	-3.88
Delicia apple (Kg)	2.69	0.00	29.74	48.33	3.99	48.33	99.50
Passion fruit (Maracuyá) (Kg)	5.50	27.09	34.55	21.82	3.49	-36.55	-12.75
Fuerte avocado (Kg)	6.99	38.77	35.77	14.31	7.80	11.59	160.00
Papaya (unit)	3.59	-11.14	11.14	19.78	3.49	-2.79	16.33
Hawaiian pineapple (unit)	3.99	-37.59	37.59	37.59	6.49	62.66	29.80
Seda banana (25 units)	9.00	44.44	94.44	133.33	11.00	22.22	175.00
Isla banana (25 units)	15.00	33.33	-20.00	16.67	24.00	60.00	500.00
Striped watermelon (Kg)	2.29	0.00	22.27	-56.33	2.49	8.73	149.00
White grape (Kg)	6.40	40.47	1.41	87.50	12.90	101.56	158.00
Nuts							
Almond (Kg)	47.00	23.40	21.28	23.40	55.00	17.02	71.88
Pecan (Kg)	88.90	23.73	18.11	10.24	90.00	1.24	246.15
Raisins (brown) (Kg)	31.00	6.45	9.68	1.94	28.00	-9.68	100.00

Note(s): The baseline price (in PEN) corresponds to the value recorded in March 2020. * Reference price taken from the Ayacucho district in the post-pandemic period.
Source: Authors' own elaboration.

Table IX

Percentage variation of price (%PV) of processed foods in the district of El Agustino.

JIRRS
Journal International Review of Research Studies

Received: 01/04/2026 - **Accepted:** 04/05/2026
Vol: 01.06
DOI: 10.66104/yx5p8m96
Pages: 1- 61

Productos	**Prices in soles. Pre-quarantine.**	**%PV. Pandemic with mandatory quarantine.**	**%PV. End of the health emergency state.**	**%PV. End of the pandemic.**	**Prices in soles. Post-pandemic**	**%PV from 2020 to 2024.**	**%PV. In the post-pandemic period between the district of Ayacucho and El Agustino ***
Oil C (1L)	6.19	12.92	77.71	77.71	9.70	56.70	-3.00
Small water (625 ml)	1.50	0.00	0.00	0.00	2.00	33.33	0.00
Water A (2.5 L)	2.50	16.00	4.00	16.00	3.00	20.00	-25.00
Water B (2.5 L)	2.50	0.00	0.00	0.00	3.00	20.00	-25.00
Small oatmeal (120 g)	1.50	-6.67	6.67	0.00	1.60	6.67	60.00
Whole oatmeal (Kg)	4.20	4.76	40.48	80.95	7.60	80.95	52.00
Brown sugar (Kg)	2.50	11.60	96.00	56.00	4.38	75.20	9.50
Canned fillet (150 g)	4.90	20.41	20.41	6.12	6.00	22.45	9.09
Pasta noodles (500 g)	2.80	0.00	23.21	25.00	3.50	25.00	-7,89
Loose flour (Kg)	6.49	30.82	34.05	37.13	5.50	-15.25	57.14
Evaporated milk (410 g)	3.15	5.08	42.86	52.38	4.70	49.21	17.50
Salt (Kg)	1.20	8.33	83.33	108.33	2.40	100.00	60.00
Yogurt (1L)	5.40	5.56	8.33	20.19	6.80	25.93	4.62

Note(s): The baseline price (in PEN) corresponds to the value recorded in March 2020. * Reference price taken from the Ayacucho district in the post-pandemic period.

Source: Authors' own elaboration.

Table X

Price Variation Percentage (%VP) of Cleaning Supplies, Medicines, and Other Products in the District of El Agustino

Products	**Prices in soles. Pre-pandemic.**	**%PV. Pandemic with mandatory quarantine.**	**%PV. End of the health emergency state.**	**%PV. End of the pandemic.**	**Prices in soles. Post-pandemic**	**%PV from 2020 to 2024.**	**%PV. In the post-pandemic period between the district of Ayacucho and El Agustino ***
Cleaning materials							

JIRRS
Journal International Review of Research Studies
Received: 01/04/2026 - **Accepted:** 04/05/2026
Vol: 01.06
DOI: 10.66104/yx5p8m96
Pages: 1- 61

Dishwashing detergent A (800 g)	7.90	-32.53	-15.19	13.92	6.20	-21.52	-22.50
Dishwashing detergent B (900 g)	4.80	55.83	64.58	22.92	6.20	29.17	3.33
Bleach (680 g)	1.80	5.56	0.00	0.00	1.90	5.56	-5.00
Laundry soap (190 g)	2.00	-0.50	0.00	15.00	2.20	10.00	-26.67
Hand soap (400 ml)	7.40	101.35	41.89	41.89	10.60	43.24	76.67
Toilet paper (24 units)	24.00	15.42	4.17	14.58	26.90	12.08	28.10
Shampoo (400ml)	12.90	30.62	19.53	23.26	15.90	23.26	-0.62
Medicines							
Alcohol 96° (1 L)	7.90	56.96	139.24	50.63	10.80	36.71	8.00
Alcohol 96° (70 ml)	1.00	50.00	20.00	20.00	1.20	20.00	-40.00
Acetylsalicylic acid 100 mg	0.20	100.00	150.00	150.00	0.40	100.00	-60.00
Ampicillin 500 mg	0.50	20.00	20.00	40.00	0.60	20.00	20.00
Latex gloves	0.22	809.09	354.55	581.82	0.22	0.00	-78.00
Ibuprofen 400 mg	0.20	250.00	-65.00	150.00	0.30	50.00	20.00
Surgical mask	0.30	566.67	233.33	233.33	0.50	66.67	0.00
Nasal decongestant ointment 5 g	1.00	100.00	100.00	100.00	2.00	100.00	33.33
Nasal decongestant ointment 15 g	2.00	150.00	150.00	200.00	3.00	50.00	-14.29
Paracetamol tablets 500 mg	0.20	350.00	250.00	150.00	0.50	150.00	100.00
Tablet Cold & Flu	2.40	4.17	4.17	-8.33	2.25	-6.25	-25.00
Naproxen sodium 500 mg	0.20	300.00	300.00	150.00	0.30	50.00	-40.00
Basic services and others							
Domestic water 0 to 20 m³	1.2630	1.6627	2.6128	5.3998	1.7130	35.6295	69.27
Domestic sewage 0 to 20 m³	0.5850	1.5385	14.8718	23.2479	0.8020	37.0940	81.86
Electricity 0–30 kW·h (Residential BT5B rate)	0.3956	3.8675	6.8756	15.6977	0.4535	14.6360	-29.21
Gas cylinder 45 kg	0.76736508	0.9097	2.5792	1.9887	0.78869024	2.7790	**
Dollar to soles exchange rate	3.33	4.93	8.45	12.23	3.74	12.26	0.54

Note(s): The baseline price (in PEN) corresponds to the value recorded in March 2020. * Reference price taken from the Ayacucho district in the post-pandemic period. ** Difference in units of measurement.

Source: Authors' own elaboration.

JIRRS
Journal International Review of Research Studies

Received: 01/04/2026 - **Accepted:** 04/05/2026
Vol: 01.06
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Pages: 1- 61

PRODUCTS WITH SHRINKFLATION

Table 11 shows the products that experienced a reduction in net weight, some of which maintained their price while others also increased in price

Table XI

Products with Shrinkflation

Products	Initial Weight	Reduced Weight	Date of Weight Change	Context
Pasta noodles	500 g	450 g	February 2023	Before the end of the pandemic
Evaporated Milk	410g	400 g	February 2023	Before the end of the pandemic
		395 g	December 2023	End of the pandemic
Tuna Fillet	150 g	140 g	February 2023	Before the end of the pandemic
Small oatmeal	120 g	100 g	November 2023	End of the pandemic
Small water	625 ml	600 ml	November 2023	End of the pandemic
Cooking Oil	1000 ml	900 ml	February 2024	End of the pandemic
Dishwashin detergent A	800 g	750 g	March 2022	During the state of emergency
Dishwashin detergent B	900 g	800 g	March 2022	During the state of emergency

Note: The identified products cover the period from March 2020 to March 2024.

Source: Authors' own elaboration.

In Table 12, the price variation associated with shrinkflation is presented for products that experienced a reduction in net weight.

Table XII

Price Variation Due to Shrinkflation

Products	Reduced Weight	Initial Price (PEN)*	Final Price (PEN)**	Initial Price per g	Final Price per g	% Price Variation
Pasta noodles	50 g	2.60	3.80	0.0052	0.0084	61.54
Evaporated milk	15 g	3.20	4.00	0.0078	0.0101	29.49
Tuna fillet	10 g	5.50	5.50	0.0367	0.0393	7.08
Small oats	20 g	1.00	1.50	0.0083	0.0150	80.72
Small water	25 ml	2.00	2.00	0.0032	0.0033	3.12
Cooking Oil	100ml	8.00	11.00	0.0080	0.0122	52.50
Dishwashing detergent A	50 g	5.00	5.00	0.0063	0.0067	6.35

JIRRS
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Vol: 01.06
DOI: 10.66104/yx5p8m96
Pages: 1- 61

Dishwashing detergent B	100 g	5.50	5.00	0.0061	0.0063	3.28

Note: The products were monitored from March 2020 to March 2024. The baseline price (in Peruvian soles) corresponds to the value recorded at the beginning of the study in the district of Ayacucho (*). The final price corresponds to the value recorded in the month when the change in net weight occurred (**).

3 DISCUSSIONS

In Figures 1, 3, and 5, the price trends over the four years of evaluation (2020–2024) in Ayacucho can be observed. In the group of cereals and legumes, the trend shows an upward pattern. For meats and eggs, the trend is also upward, with a slight decline followed by a rise again. In the case of vegetables and fruits, prices generally fluctuate according to the seasons, showing the greatest decrease during the lockdown mandatory quarantine phase and then alternating between rises and falls. Regarding processed foods, most show an upward trend. Meanwhile, in El Agustino, Figures 2, 4, and 6, show that eggs, lentils, and beans maintained low prices. However, polished rice and bonito fish exhibited price rise; in particular, polished rice had the highest price. For vegetables, fruits, and tubers, most products showed low prices. Nevertheless, olives experienced a sharp and sudden price increase, bananas and garlic showed price rise, and peas had two price peaks during the pandemic and one in the post-pandemic period. Processed products such as salt, and sugar maintained low prices; however, cooking oil had the highest and most unstable price, while evaporated milk and oats showed price rise.

The upward trend in cereals and legumes in Ayacucho (2020–2024) is consistent with the inflationary effects of lockdowns described by Singh *et al.* (2020), who compared the capital city, Kathmandu, with markets in remote Himalayan districts of Nepal. Their findings indicate that price gaps and supply disruptions are more pronounced in peripheral areas and in nodes dependent on interprovincial transport. The increase in prices of milled rice and oil in both contexts aligns with Akter (2020), who attributes price spikes in processed foods to global market uncertainty and dependence on external inputs rather than local production factors.

A notable finding in Ayacucho is the decline in prices of vegetables and fruits during the quarantine period. Although counterintuitive, this phenomenon can be explained through the work of Narayanan and Saha (2020), who, using a place-based comparative methodology in India, found that in producing regions, the disruption of supply routes to capital cities generates local oversupply, leading to a sharp drop in producer prices. In contrast, in El Agustino, the increase in the prices of garlic, peas, and bananas, peaking during and after the

JIRRS
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Vol: 01.06
DOI: 10.66104/yx5p8m96
Pages: 1- 61

pandemic, supports Akter's (2020) model regarding the sensitivity of fresh foods to disruptions in cold chains and last-mile transportation.

The trend observed in meat and egg prices in Ayacucho (increase, slight decline, and rebound) is consistent with the findings of Singh *et al*. (2020), who identified that local poultry production is highly vulnerable to the cost of imported feed.

The national Consumer Price Index (CPI) for March 2024 was 0.94%; in Metropolitan Lima, it was 1.01%, and in Ayacucho, 0.89% (base year: December 2021). At the national level, Ayacucho showed the highest percentage of price variation during the period from April 2023 to March 2024, with a variation of 3.28%, while Metropolitan Lima registered 3.05% (INEI, 2024a). The National Consumer Price Index is a statistical indicator that measures the average behavior of prices, from one period to another, for a set of goods and services habitually consumed by a group of households with different income levels nationwide at a specific point in time (INEI, 2024a). Therefore, it is not only influenced by food prices but also by 11 additional consumption divisions as defined by INEI—Education, Transport, Alcoholic Beverages and Tobacco, Restaurants and Hotels, Health, Housing, Water, Electricity, Gas and Other Fuels, Miscellaneous Goods and Services, Clothing and Footwear, Furnishings, Household Equipment and Maintenance, Recreation and Culture, Education, and Communications. Since each category carries a different weight depending on its consumption level, the CPI represents an average value influenced by various factors, which explains why the figure tends to be lower compared to the percentage of price variation that directly compares the base month's price with another month's price, where greater differences are observed.

In Tables 1 to 5, the percentage of price variation in the post-pandemic period in the district of Ayacucho (March 2024) can be observed. Within the group of meats, chicken showed the highest price increase, followed by pork and beef pulp. It should be noted that the maximum increase in the price of chicken was 61.54% at the end of the pandemic. Likewise, during the strict lockdown period, a price drop of -30% was observed for bonito fish. In Tables 6 to 10, the percentage of price variation (%PV) is shown for the district of El Agustino, where, in the post-pandemic period, the meats with the highest price increases were trout and bonito fish, while pork experienced a decline of -33.73%. Mead et al. (2020) point out that the pandemic led to increases in food prices, especially meat, dairy products, eggs, and other perishables, due to disruptions in production and distribution.

JIRRS
Journal International Review of Research Studies
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Vol: 01.06
DOI: 10.66104/yx5p8m96
Pages: 1- 61

According to INEI (2024a), as of March 2024 (base December 2021), at the national level the highest price increases were observed for bonito fish (3.1%), trout (2.2%), and eviscerated chicken (7.1%); in our study, chicken showed the greatest price increase. According to Riofrio (2020), the landings of bonito and jack mackerel during the pandemic months (April–August) did not differ significantly from those recorded in non-pandemic months. In March 2020, in Ayacucho, the recorded price per kilogram was 10 soles for bonito, showing a decrease in the price of bonito throughout the pandemic period. In general, in El Agustino, fish products have shown fluctuations, but all have ended up with higher prices. The disparity in fish prices (jack mackerel) between the coast and the highlands supports the economic geography framework of Krugman (1991). The higher cost observed in Ayacucho is a direct result of "spatial frictions" and refrigeration costs associated with a journey of approximately 10 hours from Lima.

For the group of cereals in Ayacucho, polished rice showed the highest post-pandemic price increase, followed by quinoa. In El Agustino, polished rice experienced a slight and steady increase, while brown rice (41.21%) and wheat (103.03%) reflected the impact of imported wheat and global inflation. In Ayacucho, within the group of legumes, lentils had the highest price increase, followed by canary beans, chickpeas, and Lima beans. Meanwhile, in El Agustino, lima beans were the product with the greatest price increase; canary beans (44.71%), and lentils (60.00%) also recorded a significant rise. Legumes have increased considerably over the four-year period, affecting the accessibility of an important source of plant-based protein in the diet. According to INEI (2024a), for March 2024 (base: December 2021), at the national level, cereals such as purple corn decreased in price by -6.2%. However, in our research, purple corn showed a sharp price increase. Laborde *et al*. (2020) state that the price of rice in the global market decreased after Vietnam lifted its rice export ban in early July. Our results differ from those reported, as rice prices remained stable throughout the lockdown period; however, beginning in January 2021, a noticeable price increase was observed. This difference may be due to the fact that Peru is a rice-producing country and therefore was less affected by global trade fluctuations, although it also imports rice of different qualities.

Similarly, the increase of up to 73.08% in wheat-derived products (pasta) in Ayacucho highlights the lack of food sovereignty. According to Morett-Sánchez and Cosío-Ruiz (2023), dependence on imports directly transmits external inflation to the Peruvian basic consumption basket, disproportionately affecting regions with lower purchasing power.

JIRRS
Journal International Review of Research Studies
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Vol: 01.06
DOI: 10.66104/yx5p8m96
Pages: 1- 61

In the post-pandemic period in Ayacucho, fresh milk showed a price increase of 25.00%, hen eggs 76.00%, and quail eggs 41.67%. The maximum price increase for hen eggs reached 96.00% at the end of the pandemic. Meanwhile, in El Agustino, while hen eggs increased by 98.54% and quail eggs by 66.41% price increase. According to INEI (2024a), for March 2024 (base: December 2021), at the national level eggs increased in price by 11.9%. Our results indicate a greater price increase. Eggs are a staple food product, and their prices have been subject to fluctuations due to farm supply levels, the cost of inputs (such as corn and soy used in poultry feed), and external factors such as avian influenza (Zuazo and Amarista, 2023).

Regarding vegetables, the post-pandemic price increase in Ayacucho was variable, as follows: celery (300.00%), onion and parsley each (150.00%), and tomato (66.67%). The vegetables that decreased in price were ginger and carrot, each (-33.33%). Likewise, it was observed that during the lockdown period, vegetables showed greater price decreases than throughout the rest of the pandemic period, with parsley (-50.00%), lemon (-37.50%), green beans (-40.00%), and Chinese onion (-33.33%). Meanwhile, in El Agustino, it is evident that Chinese onion was the vegetable with the highest post-pandemic price increase (350.00%), followed by fresh peas (216.43%), bulb onion (175.88%), and tomato (90.30%). According to INEI (2024a), for March 2024 (base December 2021), at the national level, the prices of red bulb onion increased by 38.9%, celery by 30.7%, spinach by 26.9%, green beans by 20.2%, tomato by 17.3%, green peas by 13.6%, lettuce by 13.2%, and broccoli by 8.7%. According to our results, the price increases for celery, onion, broccoli, spinach, green beans, and tomatoes were higher than those reported by INEI. Compared to the findings of Roy et al. (2020) in East Java, the price fluctuations of shallots increased from the period prior to the COVID-19 pandemic due to panic buying and distribution delays caused by the implementation of social distancing measures.

In Ayacucho regarding fruits, those that showed the highest price increases in the post-pandemic period (March 2024) were mango, kiwi, granadilla, pomegranate, and passion fruit, while avocado experienced a price decrease of (-40.00%). Likewise, lemon had a price increase of (100.00%) at the end of the state of emergency; however, in the post-pandemic period, its price declined again. During the lockdown, the fruits that decreased in price were strawberry (-100.00%), papaya (-67.67%), pineapple and delicia apple each (-40.00%), watermelon (-33.33%), and kiwi (-25.00%). In El Agustino, the fruits that experienced the greatest price increases were granadilla, coconut, and white grapes.

JIRRS
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Vol: 01.06
DOI: 10.66104/yx5p8m96
Pages: 1- 61

In Ayacucho, regarding tubers, sweet potato increased by (50.00%) in the post-pandemic period, while white potato had a price decrease of (-60.00%) and olluco (-20.00%) during the lockdown. In El Agustino, the price variation of yellow potato (149.67%), olluco (63.33%), and white potato (46.84%) in the post-pandemic period, was probably driven by higher fertilizer and transportation costs, which were the main factors contributing to price increases. According to INEI (2024a), for March 2024 (base December 2021), at the national level, prices decreased for granadilla (-15.1%), fuerte avocado (-12.8%), table orange (-5.8%), seda banana (-2.4%), and lemon (-1.0%). However, in our research, the prices of most fruits increased. Singh *et al*. (2020), in their study conducted in Bardiya, found that fruit and vegetable prices increased by 27%, while in Jumla they decreased by 2.4%. The difference in price inflation between districts is mainly due to the nature of agricultural markets and trade. The district of Bardiya is well integrated into the national agricultural supply chain due to its location and topography. In contrast, the district of Jumla is located in the high ranges of the Himalayas, and its population depends largely on their own production for domestic consumption. This phenomenon is similar to the context of the present research, as Ayacucho is a district located about ten hours by land from Lima, where agriculture is the main economic activity.

Chaca and Fernández (2016) mention that Peru is a country with a great variety of ecosystems such as coast, highlands, and jungle and thanks to this diversity, it is a producer of a wide range of foods. However, access to these foods varies according to social strata. Peru is also an exporter of quinoa, with the United States being its main export market, accounting for a total of US$ 44,777 thousand (Huacani *et al*., 2024). Grapes are another major export product; during the 2023/2024 season, grape exports reached US$ 1,532.4 million (CIEN, 2024b). Peru also exports many other products such as blueberries, avocados, mangoes, organic bananas, and fishmeal, as well as liquefied natural gas (GNL Global, 2022).

In 2020, Peruvian exports of quinoa and its derivatives amounted to US$ 134.7 million, mainly in the “quinoa grain” presentation, which accounted for 95% of the total (CIEN, 2020). In our research, it was observed that quinoa prices remained stable from March to December 2020. There was good domestic production and availability; however, in the post-pandemic period, both quinoa and grapes experienced a considerable price increase. Higuchi *et al*. (2022), in their study, found that health-conscious consumers in Lima increased their quinoa consumption during the pandemic due to nutritional concerns.

JIRRS
Journal International Review of Research Studies
Received: 01/04/2026 - **Accepted:** 04/05/2026
Vol: 01.06
DOI: 10.66104/yx5p8m96
Pages: 1- 61

The ASOCOBAORO Association of banana (Ecuador) also experienced an economic impact due to the pandemic, as both income and production volume in 2020 were lower than those recorded in 2019 (Apolo *et al*., 2021). Regarding domestic marketing, our research shows that in Ayacucho, seda banana (decreased in price during the lockdown by (-14.29%) and isla banana by (-12.50%). Later, at the end of the state of emergency, prices rose again, with seda banana increasing by (71.43%) and isla banana by (75.00%). In the post-pandemic period, the price of seda banana declined again, stabilizing at 14.29%, while isla banana maintained its price. This shows that fruit price fluctuations are highly variable and unpredictable, depending on many factors such as climate, overproduction, and rising transportation costs, among others (Roitbarg, 2021).

The industrialized foods with the greatest price increases in Ayacucho were brown sugar, which rose by (44.23%) and reached their highest increase (73.08%) at the end of the state of emergency; bulk flour (59.09%), which reached a peak of (68.18%) at the end of the emergency; and oil, which rose to a maximum of (56.25%) by the end of the sanitary emergency. In the district of El Agustino, the foods with the greatest price increases in the post-pandemic period were whole oats, brown sugar, oil, and evaporated milk. This could be due to the rising costs of wheat and other raw materials, global inflation, and higher production and distribution costs—phenomena collectively known as the commodities bubble (Roitbarg, 2021). According to INEI (2024a), at the national level for March 2024 (base December 2021), lower prices were observed for vegetable oil (-3.3%), noodles (-0.8%). However, our research shows a greater increase in prices. In Ayacucho, noodle prices rose up to 73.08%. This can be partly explained by the fact that Peru is an importing country, primarily of wheat. In 2021, wheat imports reached US$ 573 million (AgroForum.pe, 2021). Likewise, in March 2024, wheat imports from Argentina amounted to US$ 53.4 million (CIEN, 2024a). The lack of food sovereignty regarding this product limits the country's ability to control prices.

As noted by Morett-Sánchez and Cosío-Ruiz (2023), the absence of food sovereignty has become a new characteristic of underdeveloped countries, deepening their dependency. While in wealthy nations only 6.4% of food is imported, in impoverished countries 56% of the food supply must be obtained from abroad. According to our results, the price increases in Ayacucho and El Agustino were particularly high for imported foods such as lentils, lima beans, chickpeas, noodles and bulk flour. These foods are staples of daily consumption and have clearly impacted household budgets.

JIRRS
Journal International Review of Research Studies
Received: 01/04/2026 - **Accepted:** 04/05/2026
Vol: 01.06
DOI: 10.66104/yx5p8m96
Pages: 1- 61

In the district of El Agustino, the increase in prices of products such as vegetable oil and milled rice is consistent with the commodity bubble described by Roitbarg (2021). Unlike the traditional market in Ayacucho, modern retail in Lima showed a stronger correlation with international prices and exchange rate fluctuations, suggesting that formal retail channels are more vulnerable to global macroeconomic shocks, whereas traditional markets in Ayacucho exhibit greater resilience through direct negotiation with producers.

In Figure 7, the price trends over the four years of evaluation (2020–2024) in Ayacucho can be observed. For cleaning materials, prices show an upward trend, while for medicines, some remain stable. However, during the lockdown period, prices of certain medicines tended to rise, and after the pandemic, they stabilized at levels higher than those of the pre-quarantine period. Meanwhile, in El Agustino, Figure 8 shows how the health crisis unequally affected the local market. The most expensive products were alcohol and face masks, which also experienced shortages due to high demand and limited supply. In contrast, cleaning products such as soap and medicines like acetylsalicylic acid maintained prices.

Regarding cleaning and household care products, the main source of imports comes from Asia, amounting to US$ 113.1 million. Household cleaners are imported from China (US$ 2.6 million), while dishwashing detergents are imported from Mexico (US$ 4.0 million). In terms of exports, Bolivia is the main destination market for cleaning and household care products, with a value of US$ 33.0 million (CIEN, 2023). As for cleaning materials, the trend shows an upward pattern. In Ayacucho, dishwashing detergent A increased in price by (60.00%) and laundry soap by (36.36%). In El Agustino, dishwashing detergent B increased by (29.17%) and hand soap by (43.24%).

The main supplier of medicines for human use to the Peruvian market is India, with exports valued at US$ 90.8 million. Between 2018 and 2022, Peruvian imports of medicines for human use increased at an average annual rate of 5.5%, with a notable rise in the purchase of hormone-based medicines. Peruvian exports of antibiotics, analgesics, and anti-inflammatory medicines for human use reached US$ 44.1 million, representing a 7.1% growth compared to the previous year. The main export destinations in 2022 were countries in South America (US$ 36.8 million) (CIEN, 2022). According to these references, Peru is both an importer and exporter of medicines. Regarding medicines, there were sharp price spikes for some products, particularly during the lockdown, followed by a decline and subsequent stabilization at levels higher than the initial pre-pandemic prices. In Ayacucho, alcohol prices

JIRRS
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DOI: 10.66104/yx5p8m96
Pages: 1- 61

increased by up to (207.69%) during the lockdown and by (53.83%) in the post-pandemic period; Acetylsalicylic acid 100 mg increased by (233.33%); latex gloves by (100.00%); simple face masks increased by as much as (1400.00%) during the lockdown and (150.00%) in the post-pandemic period; and Nasal decongestant ointment 5g by (50.00%). In El Agustino, during the lockdown, price increases were observed for face masks (566.67%), latex gloves (809.09%), Naproxen sodium 500 mg (300.00%), and Acetylsalicylic acid 100 mg (100.00%). By the end of the health emergency, nasal decongestant ointment 15 g prices had also increased by (50.00%). Álvarez and González (2020) indicate that, at the factory exit level, the ranking of countries from the lowest to the highest medicine prices is as follows: 1st Argentina, 2nd Peru, 3rd Mexico, 4th Chile, 5th Colombia, and 6th Brazil. At the pharmacy exit level, Peru has the lowest prices. In the case of pure generic medicines, Peru and Chile are among the cheapest. According to our results, it was observed that the prices of generic medicines remained stable, whereas branded medicines showed an increase in price.

Regarding basic services, in Ayacucho, water prices increased by (42.94%). According to INEI (2024a), at the national level for March 2024 (base December 2021), domestic potable water tariffs rose by only 0.3% (adjustment in the cities of Piura, Tumbes, and Huaraz). Our results therefore indicate a significantly higher price increase in water service. Being an essential product for daily consumption, this increase undoubtedly affected household budgets.

Independent companies that manage gas distribution in Peru offer a variety of services, ranging from cylinder distribution to the installation of natural gas systems (Benavides, 2011). Likewise, Peru has its own natural gas resources, and the most well-known company is Cálidda (Osinergmin, 2024). As shown in Table 5, in Ayacucho, the price of gas cylinders reached its highest increase at the end of the health emergency, with a rise of (75.00%), and during the post-pandemic period, it remained at (60.71%). In El Agustino, the highest variation in the natural gas network service per cubic meter occurred in the post-pandemic period (2.7790%), while the lowest was during the lockdown (0.9097%). According to INEI (2024a), at the national level for March 2024 (base December 2021), prices increased by 1.7% for domestic gas and 1.7% for household piped natural gas. A significant difference can therefore be observed. Despite being an exporter of natural gas (GNL Global, 2022), domestic prices in Peru have risen considerably throughout the pandemic period.

The distribution of electric power in Peru is managed by Luz del Sur, Edelnor, Edelsa, Hidrandina, Electrocentro, Electro Oriente, Electro Sur Este, Electro Puno, and others

JIRRS
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Vol: 01.06
DOI: 10.66104/yx5p8m96
Pages: 1- 61

(Osinergmin, 2016). In Ayacucho, the company in charge is Electrocentro. Table 5 shows that electricity reached its highest price increase (33.68%) during the mandatory lockdown and later decreased in the post-pandemic period, maintaining an increase of 14.01%, a considerable figure since it is a daily consumption service. Meanwhile, in El Agustino, the company supplying electricity is Pluz; the price increase was 15.69% at the end of the pandemic, and in the post-pandemic period it decreased to 14.64%. However, the lowest price was recorded during the lockdown period (3.87%). According to INEI (2024a), as of March 2024 (base December 2021), at the national level, residential electricity rates decreased by -0.1% due to the adjustment balance from the previous month. Nevertheless, in our research, the price of the electricity service did increase. Many users are often unaware of electricity rates and assume that price increases are solely due to higher consumption, without noticing the details of rate adjustments.

The main currency of exchange is the Peruvian sol, which is used for domestic consumer purchases, as specified in Law No. 30381 (Official Gazette El Peruano, 2015). In terms of its strength, the Peruvian sol has proven to be one of the most stable currencies in Latin America. In 2024, it was consolidated as the strongest currency in the region, surpassing the Chilean peso and the Bolivian boliviano (Arce, 2024). This strength is attributed to timely monetary policies, solid international reserves, and the autonomy of the Central Reserve Bank of Peru (BCRP). Despite its strength, the Peruvian sol has shown a loss in value against the U.S. dollar. Its highest price increase in Ayacucho occurred during the state of emergency, at 18.45%, and in the post-pandemic period it reached 10.71%, which is considerable. In El Agustino, the greatest increase was recorded at the end of the pandemic period (12.26%).

Both Ayacucho and El Agustino show an increase in the prices of most products during the post-pandemic period. However, El Agustino presents higher percentage variations in several cases, especially in fresh and perishable products. In contrast, Ayacucho shows more moderate increases in some basic food items. In the post-pandemic comparative analysis, the following foods recorded higher prices in El Agustino than in Ayacucho: wheat (67.50%), lima bean (pallar) (47.50%), trout (92.67%), beef pulp (84.50%), cheese (17.27%), hen egg (23.86%), fresh pea (531.60%), carrot (373.75%), yellow potato (149.67%), coconut (323.60%), and pecan (246.15%). Regarding cleaning products, hand soap (76.67%); and in medicines, paracetamol 500 mg (100.00%). The higher prices in El Agustino compared to Ayacucho can be explained by several factors. As part of Metropolitan Lima, El Agustino faces greater food

JIRRS
Journal International Review of Research Studies
Received: 01/04/2026 - **Accepted:** 04/05/2026
Vol: 01.06
DOI: 10.66104/yx5p8m96
Pages: 1- 61

demand, higher transportation and marketing costs, as well as a longer chain of intermediaries. This pattern may also be associated with inflationary pressures and speculative dynamics that tend to affect large cities such as Lima more rapidly and intensely. Additionally, in Ayacucho, prices were recorded in the main high-attendance market, which also operates at the wholesale level, whereas in Lima, data were collected from a supermarket. Supermarkets tend to offer lower prices on processed products due to their efficiency, economies of scale, and bargaining power. However, in the case of fresh products, their participation is more limited, and prices tend to be higher because of transportation, operational, and labor costs. In Ayacucho, traditional markets represent the main source of food, offering more affordable prices.

The Consumer Price Index (CPI) does not independently capture shrinkflation, a phenomenon extensively documented in this study, According to Inesem (2024), shrinkflation is common in packaged products, where the size or quantity of the contents is reduced without changing the price, affecting consumers who pay the same for less product. Table 11 shows the food items affected by shrinkflation. This practice, adopted by companies, is a strategy to increase prices by decreasing the net weight of the product with the intention of misleading the buyer. Often, consumers do not notice this change; however, it already impacts their household budget.

The analysis of shrinkflation (see Table 12) shows that price variation was higher for pasta, oats, oil, and evaporated milk, as these products not only reduced their net weight but also increased in nominal price. Gupta et al. (2023) argue that reducing product content while maintaining nominal prices constitutes a form of “hidden inflation” that distorts consumer perception and welfare metrics, reinforcing the need for stricter regulatory and measurement frameworks.

A critical observation is the discrepancy between our findings and the Consumer Price Index reported by INEI (2024a). This difference is methodological: INEI uses December 2021 as its base period, which statistically smooths the inflationary spike observed in 2020._In general, when considering the base price of March 2020, the price increases of the products analyzed in this research were higher than those reported by INEI, which established its base price in December 2021, when most food products had already risen in price, as shown in Figures 1 to 6 in month 22, corresponding to December 2021. This, in a way, has influenced INEI’s results, which show lower percentages of price variation. Furthermore, INEI presents national average results, while this study analyzes the increase in price variation throughout the

JIRRS
Journal International Review of Research Studies
Received: 01/04/2026 - **Accepted:** 04/05/2026
Vol: 01.06
DOI: 10.66104/yx5p8m96
Pages: 1- 61

entire course of the pandemic, making the findings more concerning, since the price increases are considerably higher.

Díaz-Canel and Núñez (2020) point out the great importance of collaboration between scientists and the government. In Peru, science and government generally work in isolation; in most cases, research findings are not considered when formulating public policies, resulting in repeated mistakes. There is also a lack of support for the development of further research. Successive governments have been more focused on the corruption that has persisted for years. As Romero (2022) notes, in Peru, in recent years, former presidents García, Fujimori, Toledo, Humala and his wife, Kuczynski, Vizcarra, and currently Castillo, along with their spouses and relatives, have been seriously involved in corruption cases. Romero also mentions that corruption increases every year; in 2021, the Comptroller General of the Republic indicated that the associated cost had risen to approximately 6 billion soles.

Finally, the contrast between the Nery García Zárate Market and the supermarket demonstrates that, although modern retail offers advantages in hygiene and traceability (IFAD, 2020), traditional markets continue to function as more effective social buffers for price stabilization during supply crises.

In Chile, according to information published up to May 2020 by the National Institute of Statistics (INEI), food prices recorded an increase during the first four months of the year, ranging from a minimum of 0.7% to a maximum of 1.0% (Prada *et al*., 2020). Mesa and Esparcia (2023) report that in Spanish households, increased demand during lockdown led to higher price growth, particularly for vegetables (7.5%) and fruits (with peaks of up to 20.7%). Mugabe et al. (2022), in a survey conducted in December 2020 in rural Tanzanian villages, found that 40% of smallholder farmers reported increases in the prices of oil, fats, sugar, and meat, according to our research in Ayacucho, results showed the opposite trend to the studies mentioned above, since fruit and vegetable prices experienced a considerable decrease during the mandatory lockdown period from March to May 2020. These findings are consistent with those reported by Pu and Zhong (2020) in China, who also observed a decline in fruit and vegetable prices. Jiménez (2022) conducted an online survey in May 2021 among university students in Tabasco, Mexico, and found an increase in the prices of chicken, fish, meat, eggs, fruits, vegetables, and cereals such as corn tortillas, pasta, and bread. Similarly, in both Ayacucho and El Agustino, by 2021, most food prices were already on the rise.

JIRRS
Journal International Review of Research Studies
Received: 01/04/2026 - **Accepted:** 04/05/2026
Vol: 01.06
DOI: 10.66104/yx5p8m96
Pages: 1- 61

According to data collected nationwide by CAPMA (the China Agricultural Products Marketing Association) through an online platform in February and March 2020, there was an oversupply of fruits (53%), animal products (18%), vegetables (16%), aquatic products (7%), and grains and edible oils (3%) (Pu and Zhong, 2020). These findings partially align with our research results, as during our field visits from March to May, there was a notable availability of food in the markets, especially fruits, vegetables, and chicken, which even experienced further price decreases. Regarding cereals, legumes, and processed foods, there was availability as well, although in some cases prices had already begun to rise. In El Agustino, between March and May, there was also greater availability of fruits. However, regarding vegetables, there was a shortage of lemon and ginger (kion) during the pandemic and post-pandemic periods, likely because many people, in the context of COVID-19, believed these products could cure or prevent the virus, which led to panic buying. On the other hand, the availability of peas and garlic was low, and their prices remained high. In terms of meat, the availability of chicken remained constant over time, but there were periods of scarcity for fish and trout.

Jámbor *et al*. (2020) analyzed articles published in April 2020 concerning the impact of coronavirus on agriculture. Many of these papers expressed concern about food supply, noting that farmers faced issues such as longer storage times that reduced the value of their products. Probably the most significant impact described in these articles was panic buying and stockpiling. A similar situation was reported by Aldaco *et al*. (2020), who mentioned that in Spain, during the first two weeks of lockdown, substantial quantities of food were stockpiled in households. In the supermarkets of El Agustino, there were times when shelves were left empty due to panic buying during the pandemic, particularly in March and April 2020. When the lockdown was announced in March, many people rushed to supermarkets to stock up on essential goods, causing rapid product shortages. Purchase limits per person were imposed on essential items, and new alternatives emerged, such as home delivery of fresh produce via WhatsApp, social networks, or delivery services.

In Addis Ababa, Ethiopia, when comparing data from April 2019 and April 2020, it was found that around 37% of respondents stated that their households had “much less income” compared to the previous year. Approximately two-fifths reported having savings sufficient to cover up to 14 days of food expenses, and only 10% of households reported having enough savings for more than one month of food supply (Hirvonen *et al*., 2020). Meuwissen *et al*. (2021) analyzed the effects of the crisis on different agricultural systems across Europe. In

JIRRS
Journal International Review of Research Studies
Received: 01/04/2026 - **Accepted:** 04/05/2026
Vol: 01.06
DOI: 10.66104/yx5p8m96
Pages: 1- 61

northeastern Spain, farmers kept sheep on their farms for a longer period to cope with an oversupply in the market. Low cooperation among farmers was observed due to distrust, labor shortages, and price fluctuations. Similarly, Mugabe *et al*. (2022) reported that in the village of Kikombo, "hired labor in the fields became scarce because people were afraid of the pandemic, which led to an increase in labor costs." Similarly, Middendorf et al. (2022) report that in Burkina Faso, during August and October 2020, 98.5% of respondents experienced increased post-harvest losses; 95.9% reported difficulty in accessing sufficient food regularly; 92.3% observed rising food prices; and 97.4% indicated that markets where they sold their products were closed. In Ayacucho, during the months of August and October, the mandatory lockdown had already ended; however, certain restrictions were still in place. It was also observed that the prices of most food items were increasing. Meanwhile, in Lima, restrictions were more drastic since it is a cosmopolitan and the most populated city in Peru. The measures were stricter than in any other region of the country. Many people living in Lima, due to the lack of transportation, migrated to other regions on foot through the hills with their children and animals (dogs and cats). They had to walk for several days and cover long distances to reach their hometowns. Others hid in vegetable trucks, traveling like packages to evade police checkpoints.

During the pandemic, the Peruvian government chose to comply with the guidelines established by the WHO, implementing one of the strictest mandatory quarantines, which lasted for more than three months and severely affected both public health and household economies. Although the Peruvian government provided financial aid to families in extreme poverty and to self-employed workers (Emergency Decrees N°. 027-2020, N°. 033-2020, and N°. 052-2020), these measures were insufficient to cover basic expenses. Lossio (2020) reports that by April 7, around 52,000 people had been detained for violating social isolation measures. Informality and labor precariousness partly contributed to noncompliance with the lockdown. Cardwell and Ghazalian (2020) indicate that the measures implemented to contain the spread of the coronavirus created recessionary economic conditions in almost every country. Formal and informal markets were closed, travel was restricted, and incomes declined. The economic hardships resulting from these conditions were more severe in developing countries, where a large proportion of workers depend on income from the informal sector and were disproportionately affected. In Peru, the informal sector is one of the largest in Latin America and represents a significant part of the national economy. It is characterized by a lack of

JIRRS
Journal International Review of Research Studies
Received: 01/04/2026 - **Accepted:** 04/05/2026
Vol: 01.06
DOI: 10.66104/yx5p8m96
Pages: 1- 61

regulation, limited social protection, and lower productivity compared to the formal sector. The advantage is that it generates employment and allows millions of Peruvians to subsist; however, the disadvantage is that it reduces tax revenues, limits productivity, and exposes workers to precarious conditions (Loayza, 2008). Mongrut *et al*. (2024) conducted research in Peru during 2020 and reported that informal female workers in the provinces were the most affected by income reduction and job loss. Moreover, public assistance was insufficient to alleviate unemployment and was mainly concentrated in the metropolitan area of Lima.

The FAO (2021) states that rising food prices have directly affected families' ability to purchase sufficient food, and nutrition levels have been notably impacted by the pandemic. The groups most affected were low-wage workers, some farmers, and informal traders and street vendors. O'Hara et al. (2020) mention that in 2020, in the commercial districts of the Washington, D.C. area, vendors experienced a significant loss of sales due to social distancing regulations during the pandemic. In Ayacucho, it was also observed that many food businesses were forced to close, with street vendors being among the most affected. Many informal traders attempted to continue selling their products, but since it was prohibited, their goods were often confiscated, sometimes violently, causing distress and frustration among the vendors. These actions were perceived as unjust and generated a sense of helplessness among bystanders.

Durant *et al*. (2023) found that in California, between March and December 2020, 60% of farmers expressed concern about the impacts of the pandemic. Luque *et al*. (2021) reported that there was a loss of perishable products (vegetables, fruits, etc.), which affected the economy of small agricultural producers. In our research, it was observed that during the strict lockdown period, the prices of most perishable foods decreased, possibly due to the higher availability of products and the reduced presence of consumers in the markets. This situation may have caused an imbalance in farmers' income. Mugabe *et al*. (2022) reported that in December 2020, 85% of small-scale farmers in Tanzania experienced a reduction in income. Half (50%) of the respondents reported greater difficulties in transporting their products to the market and selling them due to the absence of international trade, decreased purchasing power, and voluntary isolation. In Ayacucho, markets were closed on certain days; however, overall, food availability remained stable. Nevertheless, access to food was affected because of the low turnout of buyers. In el Agustino, although most markets remained open, food access was also limited due to mobility restrictions, fear of contagion, and reduced public transportation. This situation

JIRRS
Journal International Review of Research Studies
Received: 01/04/2026 - **Accepted:** 04/05/2026
Vol: 01.06
DOI: 10.66104/yx5p8m96
Pages: 1- 61

particularly affected low-income families and informal workers, who, as their income decreased, faced greater difficulties in purchasing food on a regular basis.

Morett-Sánchez and Cosío-Ruiz (2023) analyzed foreign trade data from 107 developing countries in 2019. Their research found that 65.6% of these countries lack food self-sufficiency, a situation that forces them to depend on food imports from external markets, where the interests of large transnational agrifood corporations prevail. This dependence gradually distances these nations from food sovereignty and leaves small farmers without adequate support. In Peru, small farmers lack both financial and technical assistance. Many cultivate without proper planning or guidance, which often leads to overproduction of certain crops, causing prices to fall below production costs. As a result, some farmers prefer to let their products rot in the fields. This lack of regulation and state support not only leads to significant food waste but also severely impacts the economy of small producers, who rely on these harvests for their livelihoods. Furthermore, according to our findings, during the mandatory lockdown period, the reduction in demand and difficulties in distribution caused a greater drop in the prices of fruits and vegetables, further devaluing farmers' work and seriously affecting their income. Therefore, it is urgent to implement policies that ensure better agricultural planning, access to financing, technical assistance, and marketing strategies that allow farmers to secure stable markets and fair prices for their production.

Normal inflation in Peru varies depending on the economic context, but historically, during periods of stability, inflation has remained between 2% and 3%, which is within the Central Reserve Bank of Peru's (BCRP) target range of 1% to 3%. However, in recent years, following the pandemic and the global economic crisis, inflation has been higher. From 2020 to 2024, inflation reached its peak in 2022 at 8.5%, before decreasing and returning to the BCRP's target range in 2024 (BCRP, 2025). For 2020, 2021, 2022, 2023, and 2024, annual inflation rates were 2.0%, 6.4%, 8.5%, 3.2%, and 1.97%, respectively (BCRP, 2025). Although food prices increased substantially, declines or stability in other sectors kept overall inflation relatively moderate, a pattern explained by core inflation (Lahura and Grande, 2022). This demonstrates that overall inflation does not always reflect what occurs in specific sectors such as food.

In Caracas, Venezuela, data collected on food prices in January and February 2023 showed that, per kilogram of product, the legume group registered the lowest average value (9.5 USD), while the meat and dairy group recorded the highest (99.6 USD); cereals (30.7

JIRRS
Journal International Review of Research Studies
Received: 01/04/2026 - **Accepted:** 04/05/2026
Vol: 01.06
DOI: 10.66104/yx5p8m96
Pages: 1- 61

USD), tubers and plantains (16.7 USD), vegetables (45.9 USD), and fruits (19.2 USD) (Jardim *et al*., 2022). In Ayacucho, food prices expressed in USD at the end of January 2023 (1 USD = 3.88 PEN) were as follows per kilogram: lentils (1.7 USD), milk (0.6 USD), chicken (2.6 USD), polished rice (1.1 USD), quinoa (1.8 USD), white potato (0.6 USD), purple sweet potato (0.6 USD), and carrots (0.3 USD). Clearly, food prices in USD in Peru are lower than those in Venezuela, which is understandable given the severe economic crisis Venezuela has faced for years, characterized by extremely high inflation levels, 2020: 2968.8%, 2023: 189.8% (BCV, 2025), a key factor driving mass emigration from the country. It is worth recalling that Peru also experienced a period of hyperinflation in the 1990s under President Alan García, when the annual inflation rate reached 7,650%. This led to devastating consequences for the Peruvian economy, including a dramatic loss of purchasing power, shortages of basic goods, and a deep economic crisis that affected large segments of the population (BCRP, 1990).

The evolution of food prices has been highly uneven throughout the pandemic, and recent trends indicate a global increase in food price inflation, with effects felt in most countries, although to varying degrees. Food supply chains of all kinds have faced disruptions that have affected the availability of nutritious foods, as well as food security and nutrition, particularly in countries with limited diversity in food production and distribution channels. Moreover, food import sources have been especially impacted (FAO, 2021).

At the global level, during the pandemic there were sudden declines in food security due to income losses among workers who were fully or partially laid off, affecting their ability to purchase food; as well as due to stay-at-home orders and restricted physical access to food markets (Stephens *et al.,* 2020). Arndt *et al*. (2020) indicated that the lockdown measures implemented in South Africa to contain the coronavirus had negative implications that clearly endangered the food security of households. Indeed, after the pandemic, several studies found negative effects on food security, as shown in numerous investigations (Prada *et al*., 2020; Lizano-Vega *et al*., 2021; Omotayo, 2022). Similarly, Viteri-Robayo *et al*. (2020) conducted a survey among families in Ecuador in July 2020 and found that those living in urban areas showed greater insecurity compared to those in rural areas. This is most likely because rural households have land on which to grow their own food, giving them a sense of protection. These findings are consistent with the cited literature. In this study, two distinct realities were observed: one in the highlands (Ayacucho), where households still have access to agricultural land, and another on the coast (El Agustino), where such access is lacking. Consequently, food

JIRRS
Journal International Review of Research Studies
Received: 01/04/2026 - **Accepted:** 04/05/2026
Vol: 01.06
DOI: 10.66104/yx5p8m96
Pages: 1- 61

availability at the household level is greater in the highlands compared to urban areas, where dependence on the market is more pronounced. Consequently, in the highlands there is greater household food availability compared to cities, where market dependence is more evident. In addition, local production in the highlands allows access to fresh and diverse foods, whereas on the coast, such as in Lima, families allocate a larger share of their income to purchasing food, which may affect their food security, especially in contexts of economic and health crises.

Landaeta-Díaz *et al*. (2021) conducted a study in 12 Spanish-speaking countries (April–May 2020) and found that Peru was one of the countries with the highest number of fried food servings per day. Spain, on the other hand, presented the healthiest eating pattern. They also found that anxiety was associated with the consumption of palatable foods, including sugary drinks, pastries, fried foods, and fast food. León-Paucar *et al.* (2021) found that the largest proportion of Peruvian adults with symptoms of depression during the early stages of lockdown reported an increase in the consumption of junk food and sugary beverages, as well as foods rich in fats and sugars, findings similar to those reported by Casas *et al*. (2021). In a study conducted in Italy, researchers used available data on consumption trends from February 23 to March 29, 2020, and reported a general increase in the purchase of packaged products, which were generally perceived as more hygienic (Bracale and Vaccaro, 2020). Similarly, Ruíz-Roso *et al*. (2020) agreed that during the pandemic there was an increase in the consumption of ultra-processed foods. However, in other countries there was a decrease in these foods and a rise in the consumption of healthy products, as reported by Lizano-Vega *et al*. (2021) in Costa Rica and Jiménez (2022) in Tabasco, Mexico. According to our findings, the prices of perishable foods tend to fluctuate, while the prices of industrialized foods generally show a steady increase. This dynamic is not only a result of economic and market factors, but also of deeply ingrained consumption patterns in society. Regardless of price increases, human cravings for ultra-processed foods cannot easily be controlled, as reflected in the studies cited, desire often prevails, granting power to foods that, in many cases, control us, overcoming the conscious drive for self-care. Consequently, the demand for ultra-processed products continues to rise, driven by their accessibility, high palatability, and marketing strategies designed to foster loyalty and, in many cases, dependence. This invites reflection on the role of food education and regulatory policies in building a more conscious and healthy relationship with food.

Cardwell and Ghazalian (2020) point out that during the pandemic in Peru, community kitchens (comedores populares) were reactivated, contributing to affordable food access. After

JIRRS
Journal International Review of Research Studies
Received: 01/04/2026 - **Accepted:** 04/05/2026
Vol: 01.06
DOI: 10.66104/yx5p8m96
Pages: 1- 61

the mandatory social lockdown, 73% of the 13,644 kitchens under the Food Supplementation Program (PCA) resumed operations (MIDIS, 2024).

Luque *et al.* (2021) indicate that the National School Feeding Program, known as Qali Warma, continued supplying nutrient-rich foods. However, we disagree with the claim that the Qali Warma program delivers nutritious foods. According to Pillaca-Medina and Chavez-Dulanto (2017), the 2017 report by the Office of the Comptroller General of the Republic analyzed 158 food rations distributed by Qali Warma and found that the sugar content in some products exceeded by 400% the maximum limit recommended by the Pan American Health Organization (PAHO) to prevent overweight, obesity, and chronic diseases, while saturated fat content exceeded by more than 230% the recommended limit. The composition and processing of these foods should be thoroughly reviewed, as they may be detrimental to health in the long term.

Altieri and Nicholls (2020) argue that COVID-19 exposed the tragedy of industrial animal farms and extensive monocultures that lead to dramatic biodiversity loss, obesity, malnutrition, food waste, and poor working conditions for migrant laborers, undermining the livelihoods of small farmers. In light of this grim reality, agroecology is emerging as a key agricultural approach. We agree with these suggestions, food production should indeed be diversified, and small-scale producers should be encouraged to adopt practices that minimize agrochemical use, thereby achieving a wider diversity of safe foods. Escobar-López *et al.* (2021) conducted a study aimed at analyzing the perceptions of social actors involved in ecological markets. Producers considered these foods superior to conventional ones, which justifies their higher prices. In both Ayacucho and Lima, ecological agriculture fairs are not as frequent or impactful as desired; therefore, it is recommended to promote ecological agriculture at least among a segment of farmers as a strategy to diversify production and strengthen the local economy, generating higher incomes for farmers who, due to price instability in conventional agriculture, often end up discarding their produce, causing significant economic losses. Promoting this agricultural model would increase the availability of ecological foods at fair prices, offering a healthier option for both consumers and producers. To achieve this, public policy support, financial incentives, and awareness campaigns are essential to encourage both farmers to adopt these practices and consumers to demand ecological products as part of their daily diet. By aligning with global consumer preferences for environmentally responsible

JIRRS
Journal International Review of Research Studies
Received: 01/04/2026 - **Accepted:** 04/05/2026
Vol: 01.06
DOI: 10.66104/yx5p8m96
Pages: 1- 61

products, Peruvian exporters can sustain growth and strengthen their leadership in the organic food industry (De Almeida, 2025).

The quality of the food consumed by most of the population in developing countries is low, as food surveillance efforts are primarily focused on exports, neglecting domestic control. Moreover, products that fail to meet international standards are often redirected to domestic markets; conversely, developed countries export to dependent nations foods that cannot be sold in their own markets because they lack the minimum required quality or are considered waste (Morett-Sánchez and Cosío-Ruiz, 2023).

We concur with this statement since, according to AgroPerú (2025), 47% of the samples analyzed in the third Citizen Monitoring of Pesticides in Food were found to be unfit for human consumption, containing agrochemical residues above the permissible limits. There is an urgent need for greater investment in monitoring programs, farmer education, and stricter regulations to ensure equitable access to safe and healthy food.

This research contributes to the development of economic theories related to the effects of systemic crises, price formation, and the vulnerability of local markets to exogenous shocks such as a pandemic. From the perspective of behavioral and structural economics, it is evident that factors such as health uncertainty, lockdowns, and logistical disruptions affect the dynamics of supply and demand for basic products, causing price fluctuations that do not always follow the classical principles of market equilibrium (Thaler and Sunstein, 2008; Stiglitz and Greenwald, 2003).

Likewise, the empirical findings are linked to the theory of supply and demand shocks, which states that unexpected events can alter production and consumption levels, generating short- and long-term effects on prices (Blanchard and Johnson, 2012). In the case of COVID-19, these distortions were observed differently in Ayacucho and El Agustino, confirming that the local socioeconomic structure influences the magnitude of the impact.

The results of this research highlight the need to strengthen decentralized price monitoring systems, especially for basic food products, in order to detect and respond to market distortions in a timely manner (FAO, 2020).

In emergency situations, the implementation of temporary price regulations is advisable to prevent speculative practices and ensure access to essential goods (Stiglitz, 2020).

JIRRS
Journal International Review of Research Studies
Received: 01/04/2026 - **Accepted:** 04/05/2026
Vol: 01.06
DOI: 10.66104/yx5p8m96
Pages: 1- 61

Furthermore, the role of institutions such as INDECOPI and local governments is crucial to protect consumers from abuses and to guarantee fair prices, even in contexts of high demand or scarcity (OECD, 2021).

Although Peru has a broad availability of food, this supply does not guarantee accessibility or safety. The country requires concrete actions within an integrated framework that combines food safety control, education, support for local production, and the promotion of healthier consumption habits. By doing so, Peru can ensure its population's right to safe, nutritious, and affordable food, thereby contributing to the improvement food security in households.

4 CONCLUSIONS

Processed foods increased in price throughout the pandemic in both the Nery García Zárate Market (Ayacucho) and the supermarket in El Agustino. However, vegetable prices dropped during the mandatory quarantine phase in Ayacucho likely due to local oversupply, unlike in El Agustino, where they remained stable.

The products with the highest post-pandemic price increases in the district of Ayacucho were: chicken (50.77%), polished rice (24.32%), lentils (100.00%), hen's eggs (76.00%), celery (300.00%), mango (300%) and brown sugar (42.86%). Among cleaning products and medicines, dishwashing detergent A (60.00%) and Acetylsalicylic acid 100 mg (233.33%) stood out. Regarding basic services, water (42.94%) and gas cylinder (60.71%) showed significant increases. In El Agustino, trout (124.03%), wheat (103.03%), lima beans (71.01%), hen's eggs (98.54%), Chinese onion (bunch) (350.00%), passion fruit (198.00%), yellow potato (149.67%), brown sugar (75.20%), and salt (100.00%); among cleaning products, hand soap (43.24%); and among medicines, Acetylsalicylic acid 100 mg (100.00%) showed the most drastic surges. These findings reflect a structural vulnerability linked to a lack of food sovereignty.

Protective supplies and basic medicines experienced extreme distortions (e.g., a 1400% increase in face masks), driven by information asymmetry and hoarding. Furthermore, significant increases in essential services, water and gas, strained household budgets, exacerbating welfare disparities between the capital and regional areas.

Prices were generally higher in El Agustino than in Ayacucho. As an urbanized district in Lima, El Agustino relies on long-distance transportation and complex intermediary chains for

JIRRS
Journal International Review of Research Studies
Received: 01/04/2026 - **Accepted:** 04/05/2026
Vol: 01.06
DOI: 10.66104/yx5p8m96
Pages: 1- 61

perishable goods, whereas Ayacucho's local production and traditional market structure acted as a social buffer. This contrast suggests that modern retail is more susceptible to global macroeconomic shocks, while traditional markets offer greater resilience for fresh products.

The study identified shrinkflation in noodles, evaporated milk, cooking oil, oats, canned tuna, and dishwashing detergent. These products reduced their net content, effectively increasing their real cost per unit. The impact was most severe in pasta, oats, and oil, where a simultaneous reduction in weight and an increase in nominal price were observed, a practice that distorts consumer perception of inflation.

Overall, the prices of basic goods increased substantially, while household incomes for most individuals remained unchanged. This situation has direct implications for household food security.

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We also acknowledge the global health crisis caused by COVID-19, which, despite its challenges, motivated us to investigate, reflect, and contribute meaningful insights to the field. We are deeply grateful to the farmers, fishermen, and merchants whose tireless work ensures the availability of food; their contribution was fundamental to the context of this study. Special thanks go to Erilagg Pillaca Medina for assisting with the translation and helping to make this work accessible to a broader audience.

JIRRS
Journal International Review of Research Studies

Received: 01/04/2026 - **Accepted:** 04/05/2026
Vol: 01.06
DOI: 10.66104/yx5p8m96
Pages: 1- 61

Finally, we extend our appreciation to the readers of this article. We hope it inspires further exploration, research, and contributions toward the advancement of science and a deeper understanding of the economic and social challenges our societies face today.

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JIRRS
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Received: 01/04/2026 - **Accepted:** 04/05/2026
Vol: 01.06
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Pages: 1- 61

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