The impact of COVID-19 on the supply chain disruption of Micro and small companies in the confection sector in Metropolitan Lima during 2020 and 2021

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Abstract

This research will seek the relationship between the effect of COVID-19 and the supply chain's disruption, delimiting the target population as the citizens of Metropolitan Lima. We will work with a sample of 100 surveys to workers who meet the requirement of 3 years working in the confection sector. The data collected will be processed and examined using Minitab Version 20.3, so the reliability and validity of the data obtained will be reviewed. Based on the results, a correlation between the dimensions of cost, sales and production in the supply chain and the severity of COVID-19 was observed, a statement supported numerically. The results of the research show how much a health phenomenon can directly impact a supply chain causing a disruption in small and micro confection companies.

Keywords
COVID-19, Supply Chain, Sales, Costs, Production, Disruption.

1. Introduction
According to Guan et al., Ivanov, and Sodhi, an incident such as an epidemic or pandemic can have substantial negative impacts on companies and supply chains, including reducing their efficiency (as cited in Chowdhury et al., 2021, p.2). The impact of Covid-19 on the textile and apparel sector has never been seen before in this industry, which has negatively affected every company regardless of size (Zhao, 2021).

The fact that the pandemic started in China and then spread to other countries in Asia, Europe, and other continents has determined that the effect on the apparel sector has been felt from the beginning, increasing its strength as the pandemic progressed, affecting both the supply and demand of these products (Landaburu, 2020, p. 147). Causing that, during the peak of the outbreak in China, raw material and input shortages were the main problems faced by garment producers (International Labor Organization [ILO], 2020).

Peru's textile and apparel sector is the third-largest contributor to the manufacturing GDP, with a 6.4% share in 2019, generating about 400 thousand direct jobs annually and representing 26.2% of the employed manufacturing population. In addition, due to its essential linkages with other sectors or industries (agriculture, livestock, manufactured fibers, chemicals, and plastics), it generates 900 thousand indirect jobs in the economy, according to estimates by the Textile and Apparel Committee of the National Society of Industries [SNI] in 2021.

The pandemic caused by the spread of the COVID-19 virus around the world caused social and economic destabilization, according to the Peruvian Foreign Trade Society. As a result, Peru has been one of the most affected countries. According to the National Center for Epidemiology, Prevention and Disease Control (2022), until May 28, 2022, 1,507,686 confirmed COVID-19 and 85,543 deaths had been confirmed in Metropolitan Lima alone, leaving a mortality rate of 5.67%.

The textile industry has been one of the most affected during the pandemic because, prior to the onset of the pandemic, "the textile and clothing sector was already experiencing a contraction due to world production at meager prices" (Chamber of Commerce of Peru [CCPM], 2020). The importance of this industry is evidenced below: 30.6% of the Peruvian manufacturing business fabric is made up of the textile and apparel industry, making it the industrial activity with the highest participation. In 2018, the garment manufacturing sector comprised 93 861 productive units, of which 99.9% of this total were identified as micro and small enterprises [SMEs] and the rest (0.1%) as large and medium-sized enterprises. (Institution for Economic and Social Studies [IEES], 2021, slide 3).

After the declaration of the state of emergency and general quarantine effective since March 16, 2020, production for export orders became impossible; this implied negotiating new delivery dates in the best of scenarios; or, on the other hand, canceling orders due to lack of production, bankruptcy, economic insolvency or uncertainty of international buyers, liquidity problems, inventories without rotation. (CCPM, 2020).

The consequences of those mentioned above are reflected in a sharp drop within the industry shown in the following graph "In 2020, the production of the textile and apparel sector fell 32.1% as a result of the decline in the largest percentage of the apparel subsector (-35.9%) and in second place of textiles (-25.7%)" (IEES, 2021, slide 7).

1.1 Objectives

1.1.1 General Objective

Determine how COVID-19 has created a disruption in the small sized enterprises in the clothing sector in Metropolitan Lima during the years 2020 and 2021.

1.1.2 Specific Objectives

- Determine how COVID-19 has created a disruption in sales in the micro and small sized enterprises in the confection sector in Metropolitan Lima during the years 2020 and 2021.
- Determine how COVID-19 has created a disruption in production in the micro and small sized enterprises in the confection sector in Metropolitan Lima during the years 2020 and 2021.
- Determine how COVID-19 has created a disruption in costs in the micro and small sized enterprises in the confection sector in Metropolitan Lima during the years 2020 and 2021.

2. Literature Review

2.1. COVID-19 Impact on Small Enterprises

COVID-19 has affected small enterprises in countries such as China, Pakistan, Mexico, Indonesia, and Ecuador in analogous ways, feeling the negative impact of policies causing declining demand, complex supply chains, and rising raw material costs. (Yi Lu, Jing Wu, Junlin Peng, Li Lu; Aftab, R., Naveed, M. and Hanif, S.; Garcia, A., Cano, P., Martinez, J., Sánchez, D.;Muhtar Lutfi, Pricylia Chintya Dewi Buntuang, Yoberth Kornelius, Erdiyansyah and Bakri Hasanuddin; Useche Aguirre, M. C., Vásquez Lacres, L. M., Salazar Vázquez, F. I., Ordóñez Gavilanes, M.) This is a consequence of globalization and how vulnerable SMEs are too drastic changes due to the lack of market control (García et al., 2020, p. 68). As a result, SMEs faced challenges in the form of supply shortages, declining demand, and shrinking workforce" (Rehan et al., 2020, p.77). In Indonesia, "SMEs have also felt the negative impact of COVID-19 policies and pandemic, such as declining demand, problematic supply chains, and rising raw material costs." (Muhtar et al., 2020, p.496), and in Pakistan, 95% of SME operations have shrunk after the onset of the pandemic. In addition, 92% of SMEs faced supply deficiencies due to supply chain failures." (Rehan et al., 2020, p.80).

The risks that impact the supply chain most strongly are excessive costs related to the performance of operational activities, employment costs, and the purchase of raw materials (Grondys et al., 2021, p.6). In turn, transportation,

variant demand, and stocks are significant hazards identified thanks to a literature review study on SMEs in Mexico. Finally, interruptions within the chain caused by abrupt changes in society, such as in Ecuador, a country that was surprised in its daily life and limited its operability and business management (Useche et al., 2021, p.14) is the last risk to be distinguished.

2.2. Supply Chain Situation in the Textile and Clothing Industry

The supply chain (SC) is a connection between customers and suppliers, which, in turn, includes distributors and retailers. This relationship occurs through a series of activities and sequence of processes, such as raw material collection, production, storage, transportation, distribution, and service to satisfy customer needs (Prabavathi, V; Vanathi, R.) (Hui sun, Xu Zhao Jie ding) (Mohammad Mahdi Paydar, Marjan Olfati & Chefi Triki). CS management is a crucial part of the modern textile and apparel business due to its relevant role in expanding some countries' economic performance. In addition, this industry has reached broader markets and established itself by selling large quantities of clothing to a more comprehensive range of people as a significant consequence of globalization (Mohammad Mahdi Paydar, Marjan Olfati, and Chefi Triki) (Prabavathi, V; Vanathi, R.). The industry is classified as a low-tech production and a digital one. On the other hand, it has a low labor cost approach because of the low availability of resources, shortage of skilled professionals and skilled labor, in addition to a high dependence on imports (Orozco-Crespo, Erik, Sablón-Cossío, Neyfe, Taboada-Rodríguez, Carlos Manuel, Staudt, Francielly Hedler) (Rudrajeet Pal, Sara Harper, and Ann Vellesalu) (Sadowski, Bogusława Dobrowolska, Beata Skowron-Grabowska, Andrzej Bujak). Because of this situation, there is currently perceived a change in the trend aimed at increasing the cost of labor precisely in low-cost countries. (Petchprakai Sirilertsuwan, Daniel Ekwall, Daniel Hjelmgren).

Indeed, demand and price are the two factors that directly affect the apparel industry supply chain, affecting its efficiency; currently, this sector is suffering due to an increase in production costs and a decrease in selling price (Mohammad Mahdi Paydar, Marjan Olfati, and Chefi Triki). To counteract this situation requires the integration of SC needs proper management of production planning and distribution programs (Neyfe Sablón-Cossío, Erik Orozco Crespo, Alexander Pulido-Rojano, Ana Julia Acevedo-Urquiaga, Sebastiana del Monserrate Ruiz Cedeño) (Prabavathi, V; Vanathi, R.).

2.3. Impact of COVID-19 on the Textile and Clothing Industry

The impact of COVID-19 in the textile and clothing sector has been one never seen before in this industry, which has negatively affected every company regardless of its size (Zhao, L., Kim, K., Nguyen, H.-K., Vu, M.-N., Santos, E., Castanho, R. A., Santos, E., Castanho, R. A.), Santos, E., Castanho, R. A.) There have been problems of shortages of labor, raw materials, increased logistics costs, and increased labor costs (Zhao, L., Kim, K., Shen, B., Li, Q., Dong, C., Perry, P.). These effects caused a breakdown in the industry's supply chain process, thus generating even greater problems such as delayed delivery times and significant price increases (Zhao, L., Kim, K., Shen, B., Li, Q., Dong, C., Perry, P., Patnaik, A.). Along with these internal problems, large percentage drops in demand contributed to an even more significant perceived effect of supply chain problems (Patnaik, A., Zhao, L., Kim, K., Santos, E., Castanho, R. A.).

Due to all these factors, it was determined that Covid-19 had a significant impact on the textile and apparel industry. Furthermore, it was determined that the vast majority of companies in the sector have little or no control over the impacts of the pandemic (Shen, B., Li, Q., Dong, C., Perry, P., Patnaik, A., Zhao, L., Kim, K.). This is why industries have needed to adapt to what is now considered the new normal through innovations in their supply chain (Huaman, J., Shen, B., Li, Q., Dong, C., Perry, P., Zhao, L., Kim, K., Santos, E., Castanho, R.).

2.4. Impact of COVID-19 on the supply chain

Unlike conflicts such as war or political conflicts, which can be planned for and countered, the problems generated by COVID-19 are unpredictable, their effects unknown, and, likewise, no response to them is foreseen in advance (Chen, J., Wang, H., & Zhong, R. Y., Chowdhury, P., Paul, S. K., Kaiser, S., & Moktadir, M. A., Agrawal, T., & Pal, R., Warasthe, R., Schulz, F., Enneking, R., Brandenburg, M.). The problem, like an epidemic or pandemic, can have substantial negative impacts on companies and supply chains, including reducing their efficiency and performance and propagating supply chain disruptions (known as domino effects) that affect their productivity. Moreover, unlike similar problems previously, COVID-19 affected all stages of the chain.

The study confirmed the previously mentioned impact of COVID-19 on the supply chain. The increase in coronavirus patients and deaths obstructs the global supply chain process (Agrawal, T., Pal, R., Warasthe, R., Schulz, F., Enneking, R., Brandenburg, M.). As a result, disruption of raw material and spare parts, logistics setbacks, and fluctuating demand gradually intensify within the period (Chen, J., Wang, H., Zhong, R. Y., Chowdhury, P., Paul, S. K., Kaisar, S., Moktadir, M. A.).

2.5. Supply chain Disruption

According to a 2020 study by Schmidt and Raman, 60% of supply chain disruptions occur in the manufacturing industry. This has caused cost increases, sales disruption and production problems (Zhou et al.). Due to this disruption, the flow of information within the chain has been compromised, causing production stoppages, increased raw material costs and reduced sales volume (Mehrotra and Schmidt, 2020). It is worth mentioning that the impact of COVID was much greater in companies in the perishable products sector, since the product has a shorter shelf life and generates greater losses due to product decomposition (Zhou et al., 2020).

It is due to the aforementioned that it can be determined that the increase in costs, reduction in sales and interruption in production was caused because of COVID-19. In the agricultural sector sales were reduced by 27.81% in China, this was complemented by an increase in raw material costs and reduction in available labor due to traffic restrictions applied to counter COVID-19(Zhou et al., 2020).

2.6. Research Framework

Referring to the literature above, **Figure 1** demonstrates the proposed conceptual framework

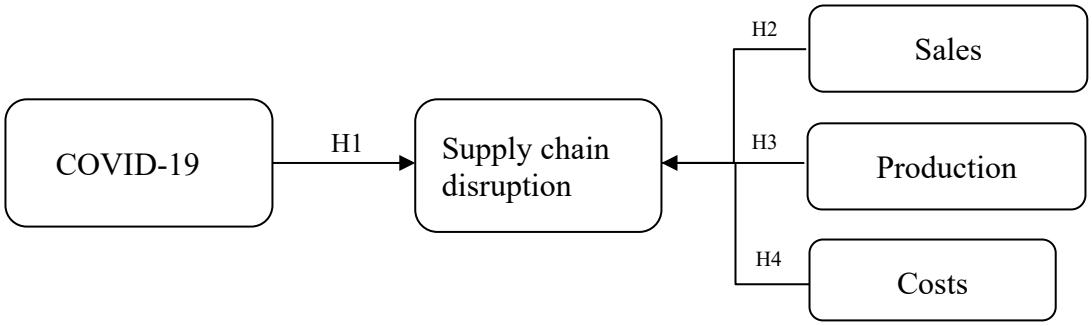

Figure 1. Research framework. Adapted from: Zhou et al., 2020; Mehrotra and Schmidt, 2020

3. Methods

The present research is descriptive-correlational. It seeks to test and interpret a phenomenon's causal hypothesis in a defined time interval. The study is non-experimental with a transversal cut in correlational terms and a mixed approach for a broad and deep perspective of qualitative and quantitative data.

Table 1. Data summary

Main problem	Secondary Problems	Hypothesis
How has Covid-19 impacted the supply chain of small sized enterprises in the clothing sector in Metropolitan Lima during the years 2020 and 2021?	How does the severity of Covid-19 affect the sales in small sized enterprises of the clothing sector in Metropolitan Lima during the years 2020 and 2021?	H1: Main Hypothesis
		Covid-19 has impacted the disruption of the supply chain of micro and small sized enterprises in the confection sector in Metropolitan Lima during the years 2020 and 2021.
	How does the severity of Covid-19 affect the production of SMEs in the garment sector in metropolitan Lima during the years 2020 and 2021?	H2: Secondary Hypothesis
		Covid-19 has impacted sales of Small sized enterprises in the confection sector in Metropolitan Lima during the years 2020 and 2021.
	How does the severity of Covid-19 affect the costs in small sized enterprises of the clothing sector in Metropolitan Lima during the years 2020 and 2021?	H3: Secondary Hypothesis
		Covid-19 has impacted production of Small sized enterprises in the confection sector in Metropolitan Lima during the years 2020 and 2021.
		H4: Secondary Hypothesis
		Covid-19 has impacted costs of Small sized enterprises in the confection sector in Metropolitan Lima during the years 2020 and 2021.

As shown in **Table 1**, the project's central theme is to study how the variable COVID-19 affected the variables sales, production and costs of the supply chain in the small sized enterprises. The project has 2 variables, of which their relationship will be studied: Covid-19 (independent variable) and supply chain disruption (dependent variable). Our main objective is to demonstrate that our hypothesis is true. In order to address the problem, dimensions are proposed for each of the variables to be treated.

Table 2. Variables and Dimensions

Variables		Dimensions
Independent	COVID-19	Severity of covid-19
Dependent	Supply chain disruption	Sales
		Production
		Costs

The methodology of our research project seeks the relationship between two variables, (Table 2) for which two surveys, previously validated and used in previous research, will be applied to a sample chosen by convenience. The data to be collected will be analyzed with the Minitab program to obtain Cronbach's Alpha for the pilot test of 20 respondents, a normality analysis for the final data, and thus determine the correlation test to be used between Spearman's correlation and Pearson's Correlation.

In addition, it is important to highlight that a Likert scale will be used in the surveys, where the following options will be available for response:

1 - Strongly disagree

2 - Disagree

3 - Neither agree nor disagree

4 - Agree

5 - Strongly agree

4. Data Collection

This research project has as its population the small enterprises of the clothing sector in Metropolitan Lima that were active prior to the beginning of the pandemic, which is why our target population will be the workers of these companies with a minimum of 3 years in the industry.

For accurate data collection, two related surveys were used. Therefore, the data used in this study corresponds to 10 small enterprises which were surveyed, giving us a total of 100 surveys as a sample for the development of the research.

Descriptive statistics and matrix graphs were used to analyze the data obtained, and the relationship between the variables was determined by employing statistical analysis by type of correlation.

5. Results and Discussion

The data used was obtained between January to June 2022 on workers with more than three years in the garment industry of the small enterprises chosen for convenience with a presence in the sector prior to the start of the pandemic in March 2021.

Regarding the results obtained with the instrument (survey form), together with the Minitab statistical system and the Likert measurement scale for the sample of 100 people, a Cronbach's alpha was obtained per survey applied divided by variable, where the result obtained was 0.8220 and 0.8182 respectively as shown in Table 3.

The range of Cronbach's alpha varies between 0 and 1, according to Oviedo and Campo (2005), the minimum acceptable value of Cronbach's alpha is 0.7 since below this value, the internal consistency of the scale used is low.

On the other hand, it does not exceed the value of 0.9 since if it is exceeded, it is considered that there is redundancy or duplication.

For the correlation of the surveys, Spearman's Rho was calculated, and the analysis criteria provided by Campos and Martinez (2015) were taken into account. The value obtained between the correlation of the sum of the two surveys is 0.688, which means a high correlation between the independent and dependent variable, according to Campos and Martinez.

5.1 Numerical Results

First, reliability is shown for the two variables:

Table 3. Cronbach's Alpha

Variable	Dimension	Cronbach's Alpha
COVID-19	Severity of COVID-19	0.8235
Supply chain disruption	Sales	0.8182
	Production	
	Costs	

The results measured by Minitab of the correlation of the variables are shown below Table 4)

Table 4. Correlation Results

Correlation	Severity of COVID-19
Sales	0.559
Production	0.691
Costs	0.587

Table 5. Decrease in sales

Dimension 1	Percentage	Valid percentage	Accumulated percentage
Strongly disagree	0.00	0.00	0.00
Disagree	8.67	8.67	8.67
Neither agree nor disagree	12.00	12.00	20.67
Agree	43.33	43.33	64.00
Strongly agree	36.00	36.00	100.00
Total	**100.00**	**100.00**	

As shown in **Table 5**, given the results of the surveys it can be affirmed that 79.33% agree with the dimension of the dependent variable "Decrease in sales", on the other hand there is a minority of 8.67% who consider that COVID-19 was not related to the reduction of sales during the pandemic.

Similarly, the second variable "Production problems" was analyzed, as shown in the following Table 6 below.

Table 6. Production problems

Dimension 2	Percentage	Valid percentage	Accumulated percentage
Strongly disagree	8.75	8.75	8.75
Disagree	21.00	21.00	29.75
Neither agree nor disagree	10.75	10.75	40.50
Agree	33.50	33.50	74.00
Strongly agree	26.00	26.00	100.00
Total	**100.00**	**100.00**	

As shown in **Table 6**, given the results of the surveys, it can be affirmed that 56.5% agree with the dimension of the dependent variable "Problems in production", on the other hand there is a minority of 29.75% who consider that COVID-19 was not related to the problems in production during the pandemic.

Similarly, the third variable "Cost increase" was analyzed, as shown in the following Table 7 below.

Table 7. Increased costs

Dimension 3	Percentage	Valid percentage	Accumulated percentage
Strongly disagree	0.67	0.67	0.67
Disagree	16.67	16.67	17.33
Neither agree nor disagree	9.67	9.67	27.00
Agree	51.67	51.67	78.67
Strongly agree	21.33	21.33	100.00
Total	**100.00**	**100.00**	

As shown in **Table 7**, given the results of the surveys, it can be affirmed that 73% agree with the dimension of the dependent variable "Increased costs", on the other hand, there is a minority of 17.34% who consider that COVID-19 was not related to the increase in costs during the pandemic.

By obtaining the results, it was possible to accept the main hypothesis, H1: COVID-19 had an impact on the disruption of the supply chain of the micro and small garment sector in Metropolitan Lima during the years 2020 and 2021. By using Minitab, it was possible to show a correlation between the two variables presented, being this labeled as a high correlation. This is evidenced by Spearman's correlation method, where the dimensions are related to the data obtained through the surveys. Dimension 1 (Sales) and Dimension 3 (Costs) show a moderate correlation while Dimension 2 (Production) shows a high correlation, all of them with respect to the independent variable. These results allow us, in the same way as the main hypothesis, to accept the 3 secondary hypotheses proposed.

5.2 Discussion

Based on the above, as mentioned by Zhao et al (2021) and other authors, we can agree that COVID-19 caused a rupture in the industry's supply chain process, generating problems in the significant increase in prices and delivery time. With respect to prices, it was found that this was due to the cost of raw materials because of a difficult relationship

with suppliers due to the scarcity of inputs. This information is supported by the percentage of agreement and total agreement in questions 1 and 2 of dimension 3, since in the first one, 91% (Table 7) of the respondents stated that they did not receive any privilege in the price of fabrics despite the current context and 61% that the investment of money and time was very demanding in order to obtain a supply from suppliers, which led to an increase in costs in micro and small garment manufacturing companies in metropolitan Lima.

It was also confirmed that due to COVID-19 there were problems in production, delays in production and delivery times and shortages of available labor, as mentioned by Rehan et al. (2020). Furthermore, according to Orozco-Crespo et al. (2021), the low technological development in the confection sector caused COVID-19 to have a severe impact on production, this can be confirmed by calculating Spearman's Rho with a value of 0.691 indicating a significant correlation (**Table 4**).

Likewise, with respect to sales, as mentioned by Mohammad et al. (2021) demand and price are the two factors that directly affect the supply chain of the apparel industry, in the micro and small business sector a great impact was visualized in the correlation of dimension 1 as 79.33% of the respondents of the same category agreed with an inability to generate income, sell their main products and maintain high profit margins. (**Table 5**).

6. Conclusion

In conclusion, it can be affirmed that both variables are highly correlated. In addition, the COVID-19 phenomenon had a significant impact on production since a high correlation was demonstrated through the survey, due to the inability to react to the abrupt changes generated by COVID-19 and the escarse technological development of the sector. On the other hand, there was a moderate impact on raw material costs and sales volume, as shown in the results of the surveys and the calculation of Spearman's Rho.

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