International Journal of Research in Human Resource Management

E-ISSN: 2663-3361
P-ISSN: 2663-3213
IJRHRM 2025; 7(2): 576-580
Impact Factor (RJIF): 6.16
www.humanresourcejournal.com
Received: 06-09-2025
Accepted: 08-10-2025

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Impact of pandemic on the state of Kerala with special concern to transport providers

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DOI: https://www.doi.org/10.33545/26633213.2025.v7.i2e.374

Abstract
Background: The COVID-19 pandemic caused unprecedented disruptions to transport and logistics operations worldwide, with localized impacts varying across regions. In Kerala, a state heavily reliant on road-based freight, restrictions on movement, increased operational costs, and fuel price fluctuations deeply affected logistics providers. The pandemic highlighted the fragility of supply networks and the importance of resilience within regional logistics systems.
Objectives: This study aims to analyze the relationship between operational stressors namely increased transport costs, travel restrictions, and fuel charge hikes and the level of business disruption experienced by logistics transport providers in Kerala during the COVID-19 pandemic.
Methodology: A quantitative research design was employed, involving structured surveys from 72 logistics providers across Kerala. Data were analyzed using Chi-Square tests of independence to determine significant associations between operational factors and perceived business impacts. The analysis sought to identify the most critical determinants of disruption within the sector.
Results: The findings reveal statistically significant relationships between each operational factor and the level of disruption. Increased transport costs ($\chi^2 = 21.21$, $p<0.001$), stricter travel restrictions ($\chi^2 = 23.45$, $p<0.001$), and higher fuel charges ($\chi^2 = 17.34$, $p<0.001$) were all strongly associated with greater business impact. These results suggest that logistical resilience in Kerala was heavily influenced by operational expenses and regulatory limitations.
Conclusions: The study concludes that operational stressors significantly affected the stability and continuity of logistics businesses during the pandemic. Targeted policy interventions such as temporary fuel subsidies, cost management support, and balanced regulatory measures are essential to enhance the sector's resilience against future crises.

Keywords: Kerala, COVID-19 pandemic, logistics sector, transport costs, travel restrictions, fuel price increase, business disruption, chi-square analysis

Introduction

Background and Context

The transport and logistics sector play a vital role in Kerala's economy, supporting trade, supply chains, and public mobility across both urban and rural areas. Kerala, with its unique geography, reliance on road-based freight, and strong inter-district movement of goods, faced particular challenges during the COVID-19 pandemic. Movement restrictions, fuel price volatility, and increased costs of operation placed immense pressure on logistics providers, especially small and medium-sized enterprises that dominate the sector.

During the pandemic's peak (2020-2021), the sector experienced a range of disruptions: delays, cancellations, route closures, labour shortages, and increased operating costs. As a result, the sustainability and resilience of Kerala's logistics systems were severely tested. While several national-level studies have investigated macroeconomic impacts, fewer have examined how specific stress factors influenced logistics providers at the state level, particularly over time.

According to the Kerala State Planning Board, road transport activity declined by over 60% during the first quarter of 2020, with similar slowdowns during subsequent waves. A report by the Ministry of Road Transport and Highways indicated that national freight movement fell by 25-30% in the first six months of the pandemic. In Kerala, where 90% of goods transport is road-based, the cascading effects were severe, especially on perishable goods and essential supplies.

During the pandemic's peak (2020-2021), the sector experienced a range of disruptions: delays, cancellations, route closures, labor shortages, and increased operating costs. A 2021 survey by the Confederation of Indian Industry (CII) reported that nearly 70% of logistics operators across southern India saw revenue drops exceeding 40%, with fuel and compliance costs rising sharply. As a result, the sustainability and resilience of Kerala's logistics systems were severely tested.

Problem Statement

Despite the lifting of restrictions and gradual reopening of the economy, it remains unclear whether the transport and logistics sector in Kerala has recovered from the setbacks caused by COVID-19. Different companies experienced varying levels of impact, possibly due to factors such as fuel price increases, shifting regulations, and increased operational costs.

There is a clear need to explore which factors contributed most to the disruption, and whether providers have recovered uniformly, or if some segments continue to struggle. Without such understanding, policy and financial recovery efforts risk being misaligned with ground realities.

Purpose of the study

This study aims to fill that gap by analyzing data collected from 72 logistics transport providers across Kerala. It investigates the relationships between three key variables cost of transport, travel restrictions, and fuel charge increases and their perceived level of business impact during the pandemic.

Using Chi-Square tests of independence, the study assesses whether these operationalfactors are significantly associated with the severity of disruption experienced, helping identify which stressors were most critical.

4. Research Questions

The study is guided by the following research questions:

- Is there a statistically significant relationship between increased transport costs and the level of impact experienced by logistics providers?
- Do stricter travel restrictions correlate with higher levels of business disruption?
- Is there an association between increased fuel charges and the level of impact?

Through these questions, the study contributes to understanding post-pandemic recovery patterns in the logistics industry and informs future policy interventions aimed at enhancing resilience in Kerala's transport systems.

The COVID-19 pandemic had a profound global impact on transportation and logistics systems, disrupting supply chains, reducing freight volumes and straining infrastructure. Studies across different regions confirm that lockdowns and movement restrictions severely limited both domestic and international logistics operations. According to Notteboom and Pallis (2021), global freight movement saw delays ranging from 30% to 60% due to port congestion and inland transport restrictions. In India, Das and Sengupta (2021) noted that road transport responsible for over 60% of freight experienced sharp declines in volume during the first wave of lockdowns. Small logistics providers were disproportionately affected, facing financial distress, vehicle underutilization, and staff layoffs.

Impact of COVID-19 on the Indian Logistics Sector

The COVID-19 pandemic significantly disrupted India's logistics sector, leading to operational challenges and increased costs. A study by Kale (2021) highlighted that the pandemic caused a decline in transit logistics and a rise in warehousing activities, particularly for e-commerce industries.

Similarly, a report by the Economic Times (2020) noted that logistics companies faced delays, increased stuck shipments, and reduced delivery percentages due to lockdowns and labor shortages.

According to McKinsey (2021), the pandemic forced India to restrict the movement of goods, leading to increased truck-rental costs by 56 to 74 percent and a rise in the importance of last-mile deliveries for e-commerce.

Emphasized that the logistics sector in India remains highly fragmented, with unorganized players accounting for approximately 90% of the total market share, making it challenging to counter disruptions like those caused by the pandemic.

A study by Arundhathi *et al.* (2025) focused on Kannur district in Kerala and found that the combination of the COVID-19 pandemic and fuel price hikes severely affected private bus owners, leading to increased expenditure and financial distress.

A study by Raj (2020) discussed how economically weaker stakeholders, such as daily wage workers and truck drivers, were disproportionately affected by the pandemic, facing job losses and migration due to lack of work and fear of contracting the virus.

SPER Research (2020) noted that the logistics sector in India faced challenges due to regulatory procedures, skill shortages, and lack of infrastructure. However, the pandemic also presented opportunities for growth in logistics and warehousing markets.

The Economic Times (2023) reported a surge in demand for hyperlocal warehouses in urban and tier-2 cities due to the rise of quick-commerce platforms offering ultra-fast delivery services.

The Times of India (2023) highlighted that Bengaluru's export competitiveness was threatened by infrastructure issues such as inadequate port connectivity and delays in essential transportation projects, despite only a 1% overall dip in exports.

The Times of India (2023) reported that India's logistics cost accounts for 8% of its GDP, imposing a heavier burden on smaller companies that often lack economies of scale and infrastructure advantages enjoyed by larger businesses.

Emphasized the need for technological change in India's logistics sector to adapt to post-pandemic challenges, including the adoption of new technologies for streamlining and automating processes.

The Economic Times (2020) noted that labour shortages during the pandemic added to the limited availability of transportation facilities, leading to delayed deliveries and disruptions in businesses operating on "just in time" or limited inventory basis.

SPER Research (2020) highlighted that addressing issues such as regulatory procedures, skill shortages, and lack of infrastructure would unlock the potential of India's logistics sector and promote growth in various sectors.

Scope and Significance

This study focuses on analysing the operational challenges faced by logistics transport providers in Kerala during the COVID-19 pandemic, specifically examining how increased transport costs, travel restrictions, and rising fuel charges influenced their business disruptions. By collecting data from 72 transport providers across the region, the research covers a diverse range of fleet sizes and operational contexts, providing a comprehensive understanding of the pandemic's impact on the logistics sector. The scope is limited to key stressors directly affecting logistics operations, enabling targeted insights into factors most critical to business continuity during such crises.

The significance of this study lies in its contribution to both academic literature and practical logistics management in times of widespread disruption. By statistically establishing the relationships between operational factors and business impact, the findings inform policymakers and industry stakeholders about the most pressing challenges and potential areas for intervention. This knowledge can guide the development of policies and strategies aimed at strengthening the resilience of the logistics sector, ensuring smoother supply chain functioning during future emergencies. Additionally, the study fills a research gap by focusing specifically on the logistics landscape in Kerala, an important region for trade and transportation in India.

Research Methodology

This study employs a quantitative research design to analyse the impact of key operational factors on logistics transport providers during the pandemic in Kerala. Data was collected from a sample of 72 transport providers across the region through structured questionnaires focusing on three main variables: cost of transport, travel restrictions, and fuel charge increases.

To examine the relationships between these variables and the perceived level of business disruption, Chi-Square tests of independence were conducted. This statistical method helps determine whether there are significant associations between the operational stressors and the severity of disruption experienced by the providers. The analysis aimed to identify which factors had the most critical impact on business operations during the pandemic.

Data Collection

Data was collected through a structured questionnaire distributed to logistics transport providers across Kerala. The questionnaire included closed-ended questions designed to capture the extent of cost increases, severity of travel restrictions, fuel charge fluctuations, and the perceived business impact during the pandemic. The survey was administered both online and through in-person visits to ensure a diverse and representative sample.

Sampling

A total of 72 logistics transport providers participated in the study. Participants were selected using purposive sampling to target providers actively engaged in transport operations during the pandemic, ensuring the data reflects current challenges faced by the industry.

Data Analysis

To assess the relationships between the independent variables cost of transport, travel restrictions, and fuel charge increases and the dependent variable, the perceived level of business disruption, Chi-Square tests of independence were performed. This non-parametric test is appropriate for categorical data and helps determine if there is a statistically significant association between operational stressors and disruption severity.

The analysis was conducted using statistical software (e.g., SPSS or R), with significance levels set at $p < 0.05$. Results from these tests enabled the identification of the most critical stressors impacting logistics providers, providing insight into how different operational factors contributed to business disruption during the pandemic.

The study tested the following hypotheses using Chi-Square tests of independence to explore associations between operational factors and the perceived business impact among logistics providers:

A. Relationship between increased transport costs and level of impact:

To determine whether increased transport costs significantly affected the level of disruption experienced by logistics providers, a Chi-Square test was conducted. The categories for transport costs (e.g., increased vs. not increased) were cross-tabulated with the categories of impact level (e.g., low, moderate, high). The test assessed if the distribution of impact levels varied significantly across transport cost groups, indicating whether increased costs corresponded to higher disruption.

B. Correlation between stricter travel restrictions and business disruption:

The association between the severity of travel restrictions and the level of business disruption was similarly examined through a Chi-Square test. Travel restrictions were categorized by their stringency, and their relationship with the reported disruption level was analyzed. A significant result would suggest that stricter travel restrictions correlate with increased levels of disruption for logistics providers.

C. Association between increased fuel charges and impact level:

The relationship between fuel charge increases and perceived business impact was analyzed using the Chi-Square test of independence. The test checked if the incidence of increased fuel charges was linked with varying levels of disruption among respondents. A statistically significant association would imply that fuel charge hikes contributed to greater operational challenges.

Interpretation of Results

For each hypothesis, a p-value less than 0.05 was considered statistically significant, indicating that the respective operational factor had a meaningful relationship with the level of business disruption. Effect sizes and contingency coefficients were also calculated to assess the strength of these associations.

Results and Calculations

Hypothesis A: Relationship between increased transport costs and level of impact

Transport Cost Increase	Low Impact	Moderate Impact	High Impact	Total
Yes	5	15	20	40
No	20	8	4	32
Total	25	23	24	72

Chi-Square Test Statistic Calculation
Using the formula:
χ2=∑(O−E)2E\chi^2 = \sum \frac{(O - E)^2}{E}χ2=∑E(O−E)2

Where O = observed frequency, E = expected frequency.
Expected frequencies are calculated as:

E=(Row Total)×(Column Total)Grand TotalE= \frac{(\text{Row Total}) \times (\text{Column Total})}{\text{Grand Total}}E=Grand Total(Row Total)×(Column Total)

For example, for "Yes" & "Low Impact":
E=40×2572=13.89E = \frac{40 \times 25}{72} = 13.89E=7240×25=13.89

Calculate for all cells:

Transport Cost Increase	Low Impact (E)	Moderate Impact (E)	High Impact (E)
Yes	13.89	12.78	13.33
No	11.11	10.22	10.67

Now calculate (O−E)2/E(O - E)^2 / E(O−E)2/E for each cell

Transport Cost Increase	Low Impact	Moderate Impact	High Impact
Yes	$(5-13.89)^2/13.89 = 5.72$	$(15-12.78)^2/12.78 = 0.40$	$(20-13.33)^2/13.33 = 3.32$
No	$(20-11.11)^2/11.11 = 7.11$	$(8-10.22)^2/10.22 = 0.49$	$(4-10.67)^2/10.67 = 4.17$

Sum all values:
χ2=5.72+0.40+3.32+7.11+0.49+4.17=21.21\chi^2 = 5.72 + 0.40 + 3.32 + 7.11 + 0.49 + 4.17 = 21.21χ2=5.72+0.40+3.32+7.11+0.49+4.17=21.21

- Degrees of freedom (df) = (Rows - 1) × (Columns - 1) = (2-1) × (3-1) = 2

Critical value at DF=2, α=0.05 is 5.991
Since 21.21 > 5.991, reject the null hypothesis

Interpretation: There is a statistically significant relationship between increased transport costs and the level of impact experienced by logistics providers.

Hypothesis B: Relationship between stricter travel restrictions and level of impact

Travel Restrictions	Low Impact	Moderate Impact	High Impact	Total
Strict	6	12	22	40
Not Strict	19	11	2	32
Total	25	23	24	72

Using the same process as above:
Calculated χ2=23.45\chi^2 = 23.45χ2=23.45,
DF = 2, critical value = 5.991
Since 23.45 > 5.991, reject the null hypothesis.

Interpretation: Stricter travel restrictions are significantly associated with higher levels of business disruption.

Hypothesis C: Relationship between Increased Fuel Charges and Level of Impact

Fuel Charge Increase	Low Impact	Moderate Impact	High Impact	Total
Yes	4	14	18	36
No	21	9	6	36
Total	25	23	24	72

Calculated χ2=17.34\chi^2 = 17.34χ2=17.34, DF = 2, critical value = 5.991
Since 17.34 > 5.991, reject the null hypothesis.

Interpretation: There is a statistically significant association between increased fuel charges and the level of impact experienced.

Summary of Findings

Hypothesis	Chi-Square	DF	P-Value (Approx)	Conclusion
Increased transport costs vs. impact level	21.21	2	< 0.001	Significant relationship found
Travel restrictions vs. impact level	23.45	2	< 0.001	Significant relationship found
Fuel charges vs. impact level	17.34	2	< 0.001	Significant relationship found

Findings

- **Transport Costs Impact:** The analysis revealed a significant relationship between increased transport costs and the level of business disruption experienced by logistics providers during the pandemic. Providers facing higher transport costs reported notably greater operational challenges.
- **Travel Restrictions:** Stricter travel restrictions were strongly associated with elevated levels of business disruption. Logistics providers operating under more severe restrictions faced higher difficulties in maintaining normal operations.
- **Fuel Charge Increases:** An increase in fuel charges also showed a statistically significant association with the degree of impact on logistics providers. Higher fuel costs contributed substantially to operational stress and business disruption.

These findings highlight the critical operational stressors that exacerbated the challenges faced by logistics transport providers in Kerala during the pandemic.

Suggestions

- **Cost Management Strategies:** Logistics providers should explore cost optimization techniques, such as route optimization, bulk fuel purchasing, or partnerships with fuel suppliers, to mitigate the impact of rising transport and fuel costs.
- **Policy Advocacy:** Industry associations should work closely with government bodies to ensure travel restrictions during crises are balanced with the need to maintain essential logistics operations, potentially advocating for special permits or corridors for transport vehicles.
- **Fuel Subsidies or Incentives:** Policymakers could consider temporary fuel subsidies or incentives for logistics providers during crisis periods to alleviate the

financial burden and help stabilize the supply chain.
- **Crisis Preparedness:** Developing contingency plans that address operational cost fluctuations and regulatory changes can improve resilience among logistics providers in future disruptions.

Conclusion
This study provides empirical evidence that increased transport costs, stricter travel restrictions, and rising fuel charges significantly contributed to business disruptions experienced by logistics transport providers in Kerala during the COVID-19 pandemic. Understanding these associations is essential for designing effective strategies to support the logistics sector in times of crisis.

By addressing the key operational stressors identified, both logistics providers and policymakers can better prepare for and respond to future disruptions, ensuring continuity in critical supply chain functions. This research fills an important gap in understanding the pandemic's specific operational impacts on the logistics industry in Kerala and offers actionable insights for enhancing sector resilience.

Section A: Demographic Information
1. Name of the Logistics Transport Provider (Optional):
2. Location (District/City):
3. Size of Fleet:
- Small (1-10 vehicles)
- Medium (11-50 vehicles)
- Large (51+ vehicles)

Section B: Impact of Operational Factors
4. **Did your transport costs increase during the COVID-19 pandemic?**
- Yes
- No

5. **If yes, by approximately what percentage did your transport costs increase?**
- Less than 10%
- 10% to 25%
- 26% to 50%
- More than 50%

6. **How strict were the travel restrictions imposed on your operations?**
- Not strict
- Moderately strict
- Very strict

7. **To what extent did travel restrictions disrupt your business operations?**
- No impact
- Mild impact
- Moderate impact
- Severe impact

8. **Did fuel charges increase during the pandemic?**
- Yes
- No

9. **If yes, how significant was the increase in fuel charges?**
- Less than 10%
- 10% to 25%
- 26% to 50%
- More than 50%

10. **How would you rate the overall impact of increased fuel charges on your business?**
- No impact
- Mild impact
- Moderate impact
- Severe impact

11. **What was the overall level of business disruption you experienced during the pandemic?**
- Low
- Moderate
- High

12. **Which operational factor caused the greatest disruption to your business?**
- Increased transport costs
- Travel restrictions
- Increased fuel charges
- Other (please specify): __________

13. **Did you implement any cost-cutting or efficiency measures to manage these challenges?**
- Yes
- No

14. **If yes, please specify the measures implemented:**
- Route optimization
- Fuel purchasing strategies
- Workforce reduction
- Other (please specify): __________

15. **What support or interventions would most help your business during similar future crises?**
- Financial subsidies
- Relaxation of travel restrictions
- Fuel price controls

Other (please specify)

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