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MICROECONOMIC COPING, HEALTH FINANCING, AND DEMOGRAPHIC DETERMINANTS OF COVID-19 VULNERABILITY: EVIDENCE FROM ERODE DISTRICT

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Abstract

This study evaluates the reach and perceived effectiveness of government relief packages, as well as the financial exposure of households affected by COVID-19, in Erode District, Tamil Nadu. Primary data were collected during 2022–2023 via structured questionnaires administered to 250 infected households, comprising 155 rural and 95 urban families. The empirical analysis utilizes descriptive statistics, rural-urban cross-tabulations evaluated through Pearson Chi-square tests of association, and Ordinary Least Squares (OLS) regression models. The empirical findings reveal that Tamil Nadu state-level relief achieved high nominal coverage, reaching 94.4% of households. However, Central Government scheme penetration was significantly weaker, leaving 72.4% of households without support. Private hospital treatments for 67 respondents resulted in a substantial financial shock of INR 8,141,000, with average expenditures significantly higher in urban areas (INR 185,842) than in rural areas (INR 144,063). Formal healthcare insurance proved highly ineffective, providing financial relief to only 4.0% of the sample, while Ayushman Bharat (PMJAY) cardholder

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penetration stood at a negligible 1.2%. Consequently, 58.0% of the households resorted to debt accumulation as their primary coping mechanism during lockdowns, resulting in severe balance-sheet erosion. The article concludes with policy suggestions emphasizing the need for universal social registries, legally capped private healthcare tariffs, and the revitalization of primary healthcare networks to build systemic resilience against future macroeconomic and public health shocks.

Keywords: COVID-19, out-of-pocket expenditure, government relief, household vulnerability, health insurance, Tamil Nadu.

1.1 INTRODUCTION

The COVID-19 pandemic represented a dual public health and macroeconomic shock that disrupted livelihoods while simultaneously escalating medical care costs. In developing economies like India, where informal employment remains the primary source of household income and public healthcare financing is historically underfunded, this compound shock severely tested household resilience. The containment measures, including prolonged lockdowns, suspended economic activities, disrupted supply chains, and triggered an unprecedented surge in unemployment, particularly among daily-wage earners and informal-sector workers. Concurrently, infected households faced sudden, unavoidable out-of-pocket expenditures (OOPE) for testing, quarantine, specialized critical care, therapeutics, and emergency transportation.

Although both the central and state governments formulated emergency social safety nets to cushion the vulnerable, their structural implementation, delivery efficiency, and adequacy relative to actual household economic losses remain contested. In Tamil Nadu, the state government disbursed cash assistance to ration cardholders alongside food rations through the Public Distribution System (PDS). In contrast, the central government rolled out financial transfers and agricultural inputs under the Pradhan Mantri Garib Kalyan Yojana (PM-GKY) and the Aatmanirbhar Bharat stimulus packages. Evaluating the coverage, efficiency, and microeconomic impact of these overlapping interventions requires detailed district-level empirical investigations that bridge the gap between aggregate macro-statistics and localized household realities.

This article examines these dynamics by analyzing primary empirical data collected from Erode District, Tamil Nadu. Erode presents an ideal case study given its distinct transition-

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zone characteristics, combining a highly productive agrarian economy, famous for turmeric and turmeric processing, with dense urban and semi-urban industrial clusters specializing in textile manufacturing and handloom weaving. By focusing specifically on households that experienced direct SARS-CoV-2 infection, this paper analyzes three interrelated dimensions: the localized socio-demographic determinants of pandemic vulnerability, the financial exposure incurred through private-sector healthcare utilization, and the microeconomic coping mechanisms employed by households in the absence of effective health insurance.

1.2 REVIEW OF LITERATURE AND RESEARCH GAP

Socioeconomic literature surrounding pandemic shocks consistently underscores the regressive nature of such crises, showing that low-income and marginalized households bear a disproportionate share of both economic and clinical burdens. Early macroeconomic assessments characterized the pandemic as a severe shock to an already-slowing Indian economy, predicting long-term structural deceleration across the industrial, manufacturing, and services sectors. Empirical studies in rural geographies documented how the nationwide lockdown abruptly curtailed agrarian labor demand, severed rural-urban remittance flows, and forced vulnerable migrant workforces into reverse migration, triggering a local labor surplus and downward pressure on daily wages.

In the healthcare domain, public health financing research has long highlighted India's heavy reliance on out-of-pocket medical expenditures as a key driver of catastrophic health expenditure (CHE) and temporary impoverishment. During the pandemic, this reliance intensified as public healthcare facilities became rapidly saturated, compelling many moderate- and low-income patients to seek treatment in the private sector. Statistical evaluations of COVID-19 hospitalizations showed that private-sector treatments incurred exceedingly high financial outlays compared to public-sector treatments, even when public insurance schemes like the Ayushman Bharat-Pradhan Mantri Jan Arogya Yojana (PMJAY) were operational.

While research exists on state-level food security and national-level macroeconomic trends, a critical empirical gap remains. Specifically, there is a lack of integrated microeconomic analyses that simultaneously trace household socioeconomic characteristics, exact private treatment expenditures, the receipt of specific central versus state welfare packages, and household balance-sheet adjustments within a single, localized sample. Most existing studies rely on aggregate secondary datasets or post-facto national surveys that lack

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the clinical granularity to evaluate the role of oxygen, ventilators, and antiviral therapies in determining out-of-pocket expenditures. This article addresses this empirical gap using primary data from Erode District to model the precise channels through which medical expenses and relief packages influenced household vulnerability and debt accumulation.

1.3 METHODOLOGY

This study employs a descriptive-analytical case study design based on primary data collected in Erode District, Tamil Nadu. The sample was drawn using purposive sampling to identify households where at least one member had a confirmed SARS-CoV-2 infection during the primary pandemic waves. Primary data collection was conducted during 2022–2023 through a comprehensive, pilot-tested structured questionnaire administered to 250 households. The sample is geographically distributed to capture rural-urban variations, comprising 155 rural or semi-urban households (62.0%) and 95 urban households (38.0%). In this context, the rural category includes semi-urban localities and blocks such as Kodumudi, Perundurai, Chennimalai, and Gobichettipalayam.

The structured questionnaire was designed to gather detailed information across multiple modules. These modules include household demographic characteristics (head of household age, gender, education, community, occupation, family structure, and ration card type), clinical infection characteristics (wave of infection, source of contagion, adherence to precautionary protocols, vaccination status, and hospitalization or quarantine duration), critical care interventions (necessity for supplemental oxygen, artificial respiration, and antiviral injections), healthcare expenditures (precise out-of-pocket spending in private facilities and costs associated with fatalities), and economic indicators (pre- and post-pandemic household income and expenditure). The final module evaluated social safety nets and coping mechanisms, measuring the sources and types of relief received, the benefits under central and state schemes, satisfaction levels, doorstep delivery, and lockdown-financing strategies.

Quantitative analysis of the data was performed using IBM SPSS Statistics. Descriptive analysis used frequencies, percentages, means, and standard deviations to profile the sample. To identify statistically significant differences between groups, inferential statistical tools were applied. Two-sample Z-tests were used to compare mean perceptions of the usefulness of adherence, vaccination, and insurance across genders and family types. Pearson Chi-square tests of association (Chi-Square2) were used to evaluate relationship patterns among

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categorical demographic indicators, infection waves, clinical requirements, and relief reception, with effect sizes reported using Cramér's V. One-way Analysis of Variance (ANOVA) was implemented to assess differences in mean treatment costs, family incomes, and expenditure patterns across age groups, educational qualifications, and occupations. Finally, the study presents OLS Multiple Linear Regression models extracted from the primary research findings to identify key household-level predictors of total treatment costs, relief adequacy, and doorstep delivery. Statistical significance for all tests is set at the 5% level ($p < .05$).

1.4 RESULTS AND DISCUSSION

Socioeconomic and Demographic Profile of the Sample

The demographic distribution of the heads of the surveyed households shows a significant male predominance, with male-headed households constituting 81.6% (n = 204) and female-headed households 18.4% (n = 46) of the total sample. Geographically, rural households account for 62.0% (n = 155) of the sample, while urban households account for 38.0% (n = 95). The age distribution of the household heads shows that the largest concentration is in the middle-aged bracket of 46–50 years (27.2%, n = 68), followed closely by the 41–45 years age bracket (20.4%, n = 51). The socioeconomic composition of the sample is detailed in Table 1, showing household head characteristics across rural and urban locations.

Table 1

Socioeconomic and Demographic Profile of the Heads of COVID-19 Infected Households

Demographic Variable	*Rural (n=155)*	*Urban (n=95)*	*Total (N=250)*	*Percentage (%)*
Gender of Head				
Male	133	71	204	81.6
Female	22	24	46	18.4
Community Class				
Backward Classes (BC)	101	49	150	60.0
Most Backward Classes (MBC)	23	18	41	16.4
Scheduled Castes (SC)	15	14	29	11.6
Scheduled Caste Arunthathiyar (SCA)	16	13	29	11.6

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Demographic Variable	*Rural (n=155)*	*Urban (n=95)*	*Total (N=250)*	*Percentage (%)*
Other Communities (OC)	0	1	1	0.4
Education of the Head				
Illiterate	29	20	49	19.6
Primary (I to V Standard)	24	21	45	18.0
Middle (VI to VIII Standard)	29	14	43	17.2
High School (IX to X Standard)	21	11	32	12.8
Higher Secondary (XI to XII Standard)	21	11	32	12.8
Undergraduate (UG Degree)	21	6	27	10.8
Postgraduate (PG Degree)	4	7	11	4.4
Higher Professional Degree	6	5	11	4.4
Occupation of Head				
Daily Wage Earners	62	47	109	43.6
Private sector employee	34	18	52	20.8
Own business / self-employed	17	14	31	12.4
Unemployed / No active job	18	7	25	10.0
Government sector employee	10	8	18	7.2
Agricultural cultivator	14	1	15	6.0

Note. Source: Primary Survey (2022–23).

The occupational analysis shows that daily wage earners comprise the largest segment of household heads (43.6%, n = 109), highlighting the significant representation of the informal workforce in Erode District. The educational profile reveals that 37.6% of household heads have primary-level education or are illiterate, indicating potential vulnerabilities in accessing

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health information and navigating public administrative structures during crises. Additionally, 96.8% (n = 242) of households use "Rice Cards," which qualify them for the maximum in-kind benefits under the state's Public Distribution System. Family structure trends indicate a dominance of nuclear family setups, which represent 75.2% (n = 188) of the total sample, compared to joint family structures, which account for 24.8% (n = 62). The modal household size is four persons (44.8%, n = 112), while three-person families constitute the second-largest group (20.8%, n = 52).

Clinical Profile and Healthcare Expenditures

COVID-19 affected 333 individuals across 250 households (mean = 1.33 infections/household), with infections predominantly involving single household members (76.0%). Cases were higher among males (59.8%) and rural residents (62.5%). Wave II accounted for 60.0% of affected households, and public spaces were the major source of infection (64.8%). Despite 76.0% full vaccination coverage and 61.2% perfect adherence to preventive measures, substantial morbidity persisted, with 46.4% requiring antiviral injections, 26.4% oxygen support, and 21.2% ventilator support. Most patients were treated in government facilities (43.8%) or through home quarantine (36.0%), whereas private treatment resulted in notable out-of-pocket expenditures.

Table 2 Out-of-Pocket Expenditure Incurred for COVID-19 Treatment in Private Hospitals

Treatment Cost Range (INR)	Rural Households	Urban Households	Total Households	Percentage (%)
No Expenses / Public Treatment	123	76	199	79.6
1,000 to 15,000	2	4	6	2.4
15,001 to 50,000	8	5	13	5.2
50,001 to 100,000	9	5	14	5.6
100,001 to 300,000	10	4	14	5.6
300,001 to 400,000	1	0	1	0.4
Above 400,000	2	3	5	2.0
Total Households	155	95	250	100.0

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Total Private Expenditure	INR 4,610,000	INR 3,531,000	INR 8,141,000	—
Average Cost per Treated Patient	INR 144,063	INR 185,842	INR 159,627	—

Note. Source: Primary Survey (2022–23).

For the 67 patients treated in private hospitals, total out-of-pocket expenditure amounted to INR 8,141,000, with an average cost of INR 159,627 per patient. Urban patients had a higher average financial burden (INR 185,842) than rural patients (INR 144,063). This financial strain was further exacerbated in cases involving fatalities. Among the 20 reported deaths, 9 patients received private hospital treatments, generating a total expenditure of INR 2,685,000. This includes 8 deceased male patients who incurred an average treatment cost of INR 248,750 in rural areas and INR 410,000 in urban locations, alongside one female patient with an urban treatment cost of INR 50,000.

Performance of Public Health Insurance

The primary data reveals a significant gap in financial protection offered by public and private insurance networks. Of the 250 households, 96.0% (n = 240) reported that health insurance did not provide any financial assistance during their infection period, as shown in Table 3. Only 4.0% (n = 10) of households accessed insurance support, comprising 6 government-sponsored and 4 privately sponsored claims. Possession of the central government's Ayushman Bharat Yojana (PMJAY) card was also very low, with only 1.2% (n = 3) of the households reporting ownership of the card, while the remaining 98.8% (n = 247) had no coverage under this scheme.

Insurance-Related Variables by Rural and Urban Residence

Table 3 *Distribution and Utility of Health Insurance Networks*

Variable	Category	Rural (n=155)	Urban (n=95)	Total (N=250)	Percentage (%)
Insurance Utility	Assisted in treatment	7	3	10	4.0
	Did not assist in treatment	148	92	240	96.0
Type of Insurance Used	Government supported	5	1	6	2.4

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	Private supported	2	2	4	1.6
	No insurance assistance	148	92	240	96.0
Possession of PMJAY Card	Yes	2	1	3	1.2
	No	153	94	247	98.8

Note. Source: Primary Survey (2022–23).

This minimal coverage and utility of insurance during a major health crisis highlight a significant vulnerability. Public health policies designed to provide cashless treatments under schemes such as PMJAY or the state's Chief Minister's Comprehensive Health Insurance Scheme (CMCHIS) did not translate into effective financial protection for the majority of infected households in this sample. Consequently, families using private healthcare had to pay these expenses out of pocket.

Coverage and Perceived Effectiveness of Government Relief Packages

To evaluate the microeconomic impact of state and central social safety nets, this study analyzed the reach and perceived adequacy of various relief initiatives. Under the Government of Tamil Nadu's welfare programs, 41.2% (n = 103) of households received all primary benefits, including INR 1,000 cash assistance, a subsequent cash transfer of INR 4,000, and free food supplies (15 kg rice, dal, and cooking oil) through PDS shops. Overall, state relief measures reached 94.4% (n = 236) of the households in some form. In contrast, the reach of central government relief programs was much lower. Only 22.0% (n = 55) of households reported receiving benefits under the Aatmanirbhar Bharat stimulus package, while 5.6% (n = 14) accessed assistance through PM-GKY programs. The majority of households (72.4%, n = 181) did not receive any support from central government schemes.

Table 4 Coverage of Central and State Government Relief Packages

Relief Package Variable	Rural (n=155)	Urban (n=95)	Total (N=250)	Percentage (%)
Tamil Nadu Government Support				
Received all listed benefits	62	41	103	41.2
Received INR 4,000 cash	39	15	54	21.6

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Received INR 1,000 cash	23	23	46	18.4
Free PDS food items only	21	12	33	13.2
Did not receive any state support	10	4	14	5.6
Central Government Support				
Aatmanirbhar Bharat	26	29	55	22.0
PMGKY	8	6	14	5.6
No central support	121	60	181	72.4
Free Rice Benefit (5 kg)				
Received	130	79	209	83.6
Did not receive	25	16	41	16.4

Note. Source: Primary Survey (2022–23).

In-kind food support was the most successful component of the relief packages, with 83.6% (n = 209) of households receiving the free 5 kg rice allocation per person. However, satisfaction with the overall relief measures was moderate. While 51.6% (n = 129) of households reported that the relief "somewhat helped," 40.0% (n = 100) felt the assistance was "not enough" to cover their needs, and only 8.4% (n = 21) found it highly effective. Additionally, doorstep delivery of relief was limited: only 11.6% (n = 29) of households received assistance directly at home, while 88.4% (n = 221) had to collect it from administrative centers.

Macroeconomic and Household-Level Coping Strategies

The pandemic reduced household incomes while increasing monthly expenditures, indicating a clear deterioration in economic well-being. Households earning above ₹25,000 declined from 30.8% to 19.2%, whereas those earning ₹7,501–10,000 increased from 22.4% to 25.6%. Simultaneously, households with monthly expenditures of ₹15,001–20,000 rose from 15.6% to 19.6%, reflecting higher living and healthcare costs and compelling families to adopt various financial coping strategies during the pandemic.

Table 5 Household Financial Coping Strategies during Lockdowns

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Coping Strategy Category	Rural (n = 155)	Urban (n = 95)	Total (N = 250)	Percentage (%)
Borrowing / Debt accumulation	91	54	145	58.0
Depleting savings	39	33	72	28.8
Financial aid from relatives	7	1	8	3.2
Agricultural output earnings	6	0	6	2.4
Financial support from siblings	3	0	3	1.2
Government direct support	2	1	3	1.2
Household salary / Remittances	0	1	1	0.4
Miscellaneous alternative options	7	5	12	4.8

Note. Source: Primary Survey (2022–23).

Borrowing was the primary coping mechanism, with 58.0% (n = 145) of households accumulating debt to finance basic consumption and treatment costs. Another 28.8% (n = 72) relied on depleting their savings. Direct government aid was identified as the primary coping strategy by only 1.2% (n = 3) of households, indicating that formal safety nets, while helpful, were insufficient on their own to prevent the accumulation of household debt. These results indicate that the economic shock of the pandemic has led to long-term financial strain, with 30.4% (n = 76) of households reporting they were highly affected economically, and 36.8% (n = 92) continuing to face economic challenges.

Statistical Inferences and Hypothesis Testing

Gender-Based Parametric and Non-Parametric Evaluations

Two-sample Z-test results indicate that gender significantly influenced perceived adherence to COVID-19 precautions ($Z = 2.797$, $p = .005$) and ventilator requirement ($Z = 2.698$, $p = .006$), with males reporting higher precaution adherence (Mean = 1.43 vs. 1.37) and a greater need for ventilator support (81.6% vs. 18.4%). However, vaccination status ($p = .289$),

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antiviral injection requirement (p = .233), bribery experiences (p = .636), ongoing health issues (p = .206), insurance usefulness (p = .895), and Ayushman Bharat card possession (p = .504) showed no significant gender differences, indicating comparable perceptions and experiences across these domains.

Family Type and Household Structure Comparisons

Two-sample Z-test results indicate no significant differences between nuclear and joint families in adherence to precautionary measures (Z = 0.771, p = .441), vaccination status (Z = 0.477, p = .634), antiviral injection requirement (p = .216), ventilator support (p = .959), bribery experiences (p = .082), ongoing health issues (p = .228), insurance usefulness (p = .792), or PMJAY card possession (p = .319). These findings suggest that household structure had no statistically significant influence on COVID-19 preventive behavior, clinical severity, or health insurance utilization in the study population.

Chi-Square Analysis of Categorical Variables

Pearson's Chi-square analysis showed that respondent age was significantly associated with oxygen requirement ($\chi^2 = 19.299$, p = .013), COVID-19's impact on children ($\chi^2 = 16.011$, p = .042), type of impact on children ($\chi^2 = 58.594$, p = .003), children's activities ($\chi^2 = 47.569$, p = .038), post-pandemic status of children ($\chi^2 = 71.081$, p < .001), treatment preference ($\chi^2 = 33.219$, p < .001), and receipt of Tamil Nadu government support ($\chi^2 = 52.149$, p = .014), while showing no significant association with household infection count, infection wave, infection source, precautionary adherence, vaccination status, ventilator requirement, central government relief, health outcomes, or insurance variables (all p > .05). Furthermore, infection wave was significantly associated with precautionary adherence ($\chi^2 = 17.136$, p = .047), vaccination timing ($\chi^2 = 14.893$, p = .021), duration of treatment/quarantine ($\chi^2 = 58.238$, p < .001), antiviral injection requirement ($\chi^2 = 18.010$, p < .001), children's outcomes ($\chi^2 = 27.426$–47.375, all p < .01), and relief sources ($\chi^2 = 30.842$, p = .009), indicating that age primarily influenced disease severity, children's well-being, healthcare utilization, and welfare access, whereas pandemic wave shaped preventive behaviour, treatment patterns, and family impacts.

Analysis of Variance (One-Way ANOVA)

A series of One-way Analysis of Variance (ANOVA) tests was conducted to evaluate differences in mean economic and treatment indicators across demographic groups, as summarized in Table 6.

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Table 6 ANOVA Results by Age of Head

Dependent Variable	F	p	Inference
Source of infection	1.292	.248	Not Significant
Adherence to precautions	1.188	.307	Not Significant
Vaccination status	0.379	.931	Not Significant
Identification method	0.731	.664	Not Significant
Oxygen requirements	2.520	.012	Significant
Ventilator requirement	1.696	.100	Not Significant
Antiviral requirements	1.248	.272	Not Significant
Private hospital cost	1.985	.049	Significant
Impact on children	2.061	.040	Significant
Children's activities	1.640	.114	Not Significant
Family food expenses	1.374	.209	Not Significant
Pre-pandemic income	3.382	.001	Highly Significant
Post-pandemic income	1.286	.251	Not Significant
Pre-pandemic expenses	1.047	.401	Not Significant
Post-pandemic expenses	1.396	.199	Not Significant
Total treatment cost	1.646	.113	Not Significant
Source of relief	2.611	.009	Highly Significant
Type of assistance	2.584	.010	Significant
Central support	1.254	.269	Not Significant
Tamil Nadu supports	4.786	.000	Highly Significant
Relief adequacy	1.939	.055	Reported Significant

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Additional relief need	1.694	.100	Not Significant
Lockdown management	1.827	.073	Not Significant

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Table 6a ANOVA Results by Education

Dependent Variable	F	p	Inference
Infections in the family	2.690	.011	Significant
Source of infection	0.446	.872	Not Significant
Adherence to precautions	1.807	.087	Not Significant
Vaccination status	1.302	.250	Not Significant
Identification method	1.262	.276	Not Significant
Oxygen requirements	0.219	.981	Not Significant
Ventilator requirement	0.442	.875	Not Significant
Antiviral requirements	1.076	.379	Not Significant
Private hospital cost	4.026	.000	Highly Significant
Impact on children	1.126	.347	Not Significant
Children's activities	1.113	.356	Not Significant
Family food expenses	1.747	.099	Not Significant
Pre-pandemic income	11.522	.000	Highly Significant
Post-pandemic income	5.650	.000	Highly Significant
Pre-pandemic expenses	3.366	.002	Highly Significant
Post-pandemic expenses	2.899	.006	Highly Significant
Total treatment cost	5.075	.000	Highly Significant
Source of relief	0.450	.870	Not Significant
Type of assistance	2.534	.010	Significant
Central support	3.789	.001	Highly Significant
Tamil Nadu supports	9.536	.000	Highly Significant
Relief adequacy	3.188	.003	Highly Significant
Additional relief need	0.413	.894	Not Significant
Lockdown management	1.065	.386	Not Significant

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Table 6b ANOVA Results by Occupation

Dependent Variable	F	p	Inference
Infections in the family	3.051	.011	Significant
Source of infection	4.519	.001	Highly Significant
Adherence to precautions	2.426	.036	Significant
Vaccination status	2.357	.038	Significant
Identification method	1.352	.243	Not Significant
Oxygen requirements	1.126	.347	Not Significant
Ventilator requirement	2.300	.046	Significant
Antiviral requirements	0.732	.600	Not Significant
Private hospital cost	3.222	.008	Highly Significant
Impact on children	6.610	.000	Highly Significant
Children's activities	1.425	.216	Not Significant
Family food expenses	5.525	.000	Highly Significant
Pre-pandemic income	11.383	.000	Highly Significant
Post-pandemic income	5.609	.000	Highly Significant
Pre-pandemic expenses	4.758	.000	Highly Significant
Post-pandemic expenses	3.414	.005	Highly Significant
Total treatment cost	6.278	.000	Highly Significant
Source of relief	1.529	.181	Not Significant
Type of assistance	1.160	.329	Not Significant
Central support	7.914	.000	Highly Significant
Tamil Nadu supports	16.637	.000	Highly Significant
Relief adequacy	3.755	.003	Highly Significant
Additional relief need	2.854	.016	Significant
Lockdown management	6.138	.000	Highly Significant

ANOVA results indicate that age of the household head significantly influenced oxygen requirement ($F = 2.520$, $p = .012$), private treatment cost ($F = 1.985$, $p = .049$), impact on children ($F = 2.061$, $p = .040$), and pre-pandemic family income ($F = 3.382$, $p = .001$). Education showed highly significant associations with pre- and post-pandemic income ($F =$

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11.522 and 5.650, $p < .01$), household expenditure ($F = 3.366$ and 2.899, $p < .01$), and COVID-19 treatment cost ($F = 5.075$, $p < .01$), indicating strong socioeconomic disparities. Occupation exhibited the broadest influence, significantly affecting family infection rate ($F = 3.051$, $p < .05$), infection source ($F = 4.519$, $p < .01$), precautionary adherence ($F = 2.426$, $p < .05$), vaccination status ($F = 2.357$, $p < .05$), ventilator requirement ($F = 2.300$, $p < .05$), private treatment cost ($F = 3.222$, $p < .01$), food expenditure ($F = 5.525$, $p < .01$), and lockdown economic management ($F = 6.138$, $p < .01$), highlighting occupation as the strongest determinant of both health and economic outcomes.

Multiple OLS Linear Regression Models

Multiple Linear Regression models were estimated to identify key household-level predictors of treatment costs, relief adequacy, and doorstep delivery. The first model evaluates the determinants of the total out-of-pocket treatment cost, as summarized in Table 7.

\text{Total treatment cost} = f(\text{Age, Education, Occupation, Family size, Infection timing, Stay duration, Oxygen requirement, etc.})

Table 7 Multiple Regression Analysis of Factors Influencing Total COVID-19 Treatment Costs

Predictor Variable	B	SE	β	t	p
Constant (Intercept)	1.181	1.440	—	0.821	.413
Age of the head of the family	0.291	0.115	0.153	2.527	.012
Educational qualifications	0.287	0.121	0.164	2.369	.019
Occupation category	-0.099	0.159	-0.038	-0.622	.535
Timing of infection wave	-0.136	0.278	-0.029	-0.489	.626
Number of family members infected	0.775	0.324	0.149	2.392	.018
Identified source of infection	0.090	0.197	0.026	0.457	.648
Adherence to precaution measures	0.252	0.366	0.041	0.687	.493

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Hospital/quarantine stay duration	-0.420	0.170	-0.184	-2.475	.014
Identification method of infection	-0.483	0.285	-0.098	-1.696	.091
Oxygen requirements	1.136	0.487	0.142	2.333	.020
Nature/type of assistance	0.043	0.141	0.018	0.307	.759
Support from the central government	0.350	0.285	0.082	1.227	.221
Lockdown economic management	0.211	0.144	0.086	1.460	.146

Note. Dependent Variable: Total COVID-19 Treatment Cost. Model Summary: R = .528, R^2 = .279, Adjusted R^2 = .239, SE = 3.092. ANOVA: F(13, 236) = 7.012, p = .000 < .01. Source: Primary Survey (2022–23).

The regression analysis indicates that the model is highly significant (F = 7.012, p < .01) and explains 27.9% of the variation in total COVID-19 treatment costs (R^2 = .279). Significant predictors include the age of the household head (B = 0.291, p = .012), educational qualifications (B = 0.287, p = .019), the number of family members infected (B = 0.775, p = .018), the duration of stay (B = -0.420, p = .014), and oxygen requirements (B = 1.136, p = .020). For example, the positive coefficient on age indicates that older household heads incurred higher medical expenses, consistent with the higher severity of illness observed in this cohort. Similarly, oxygen requirements significantly increased out-of-pocket costs, while longer stays in public quarantine centers had a negative coefficient, indicating lower costs compared to private hospital admissions.

A second regression model evaluated the factors influencing the perceived adequacy of government COVID-19 relief, as summarized in Table 8.

Table 8: Multiple Regression Analysis of Perceived Adequacy of Government Relief

Predictor	B	SE	β	t	p
Constant (Intercept)	0.886	0.270	—	3.286	.001
Age of the head of the family	-0.038	0.022	-0.114	-1.759	.080

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Educational qualifications	-0.045	0.023	-0.148	-1.998	.047*
Occupation category	0.010	0.030	0.022	0.335	.738
Timing of infection wave	0.112	0.052	0.136	2.142	.033*
Number of family members infected	0.032	0.061	0.035	0.527	.599
Identified source of infection	0.042	0.037	0.070	1.127	.261
Adherence to precaution measures	0.010	0.069	0.009	0.139	.889
Hospital/quarantine stay duration	0.053	0.032	0.132	1.659	.099
Identification method of infection	-0.003	0.053	-0.004	-0.065	.948
Oxygen requirements	-0.089	0.091	-0.063	-0.974	.331
Nature/type of assistance	-0.045	0.026	-0.108	-1.690	.092
Support from the central government	-0.144	0.053	-0.193	-2.697	.008**
Lockdown economic management	0.034	0.027	0.079	1.263	.208

Note. Dependent Variable: Adequacy of Government COVID-19 Relief. Model Summary: R = .419, R^2 = .175, Adjusted R^2 = .130, SE = 0.579. ANOVA: F(13, 236) = 3.858, p = .000 < .01. Source: Primary Survey (2022–23).

The regression analysis indicates that the model is statistically significant (F = 3.858, p < .01) and explains 17.5% of the variation in the perceived adequacy of government COVID-19 relief (R^2 = .175). Significant predictors include educational qualifications (B = -0.045, p = .047), the timing of infection (B = 0.112, p = .033), and central government support (B = -0.144, p = .008). The negative coefficient on educational qualifications suggests that more-educated household heads had a lower perception of relief adequacy, which may reflect higher expectations or greater financial losses. Additionally, the negative coefficient for central support indicates that families relying primarily on central schemes found them less adequate compared to those accessing state-level relief.

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Finally, a third regression model evaluated the factors influencing the doorstep delivery of government relief, as summarized in Table 9.

Table 9: Multiple Regression Analysis of Doorstep Relief Delivery

Predictor Variable	B	SE	β	t	p
Constant (Intercept)	0.219	0.142	—	1.543	.124
Age of the head of the family	-0.030	0.011	-0.175	-2.667	.008
Educational qualifications	-0.016	0.012	-0.098	-1.304	.194
Occupation category	-0.014	0.016	-0.058	-0.886	.377
Timing of infection wave	-0.017	0.027	-0.040	-0.616	.538
Number of family members infected	0.068	0.032	0.143	2.118	.035
Identified source of infection	0.003	0.019	0.010	0.155	.877
Adherence to precaution measures	0.022	0.036	0.040	0.622	.535
Hospital/quarantine stay duration	0.023	0.017	0.110	1.365	.174
Identification method of infection	0.049	0.028	0.110	1.751	.081
Oxygen requirements	0.003	0.048	0.004	0.064	.949
Nature/type of assistance	-0.055	0.014	-0.256	-3.943	.000
Support from the central government	0.042	0.028	0.110	1.514	.131
Lockdown economic management	0.021	0.014	0.095	1.479	.141

Note. Dependent Variable: Government Staff Delivering Relief to Doorsteps. Model Summary: R = .385, R^2 = .148, Adjusted R^2 = .101, SE = 0.304. ANOVA: F(13, 236) = 3.158, p = .000 < .01. Source: Primary Survey (2022–23).

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The regression model is statistically significant ($F = 3.158$, $p < .01$) and explains 14.8% of the variation in doorstep delivery ($R^2 = .148$). Significant predictors include the age of the household head ($B = -0.030$, $p = .008$), the number of family members infected ($B = 0.068$, $p = .035$), and the type of assistance received ($B = -0.055$, $p < .01$). The negative coefficient for age indicates that older household heads were less likely to receive doorstep delivery of relief, showing a potential gap in assistance for vulnerable elderly groups. Conversely, a larger number of family infections was positively associated with doorstep delivery, suggesting that administrative staff prioritized households with multiple active cases.

1.5 POLICY RECOMMENDATIONS

Revitalizing Primary Healthcare Networks

The primary data show that 20.1% of infected individuals used private hospitals, resulting in an average out-of-pocket cost of INR 159,627. This indicates a clear need to strengthen public primary healthcare, particularly in rural areas like Erode. Public health policies should prioritize upgrading local Primary Health Centers (PHCs) and government hospitals. Upgrades should focus on installing oxygen-generation plants, maintaining functional artificial-respiration systems, and ensuring a consistent supply of essential antiviral medications. Additionally, expanding mobile medical units and localized health camps can improve early detection and treatment, reducing the need for costly private sector hospitalization. Providing regular clinical training for rural healthcare workers is also essential to ensure effective emergency management.

Improving Health Insurance Coverage and Portability

The high rate of households reporting no help from health insurance (96.0%) and the very low possession of PMJAY cards (1.2%) highlight major gaps in health financing. To address this, public policy should focus on expanding enrollment in schemes like CMCHIS and PMJAY. This can be achieved through targeted community campaigns, simplified registration processes, and the integration of local databases. Furthermore, strict regulatory oversight is necessary to ensure private hospitals honor public insurance policies without exclusions or delays during emergencies. Enhancing the portability of insurance schemes across state borders is also crucial for protecting migrant workers and transient workers from high treatment costs.

Capping Private Healthcare Tariffs

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The high average cost of private treatments, which reached INR 410,000 for deceased urban patients, shows the need for state-level regulation of private healthcare pricing. Governments should establish clear, legally enforceable price caps for diagnostic tests, ward charges, ICU stays, and therapeutic interventions during public health emergencies. Additionally, establishing real-time grievance redressal systems and mandating transparent, itemized billing can protect patients from overcharging. Regular audits of private hospital billing during crises can also help ensure compliance with state-mandated price controls.

Reforming Welfare Delivery Mechanisms

The low rate of doorstep relief delivery (11.6%) and the high percentage of households requesting simpler access (77.6%) highlight opportunities for administrative reform. Future relief programs should utilize direct benefit transfers (DBT) and localized distribution models to minimize physical collection barriers. Prioritizing doorstep delivery for vulnerable groups, such as the elderly and quarantined individuals, is essential. Additionally, establishing a universal, updated social registry can ensure more accurate and timely distribution of both cash and in-kind benefits during emergencies.

Universalizing Social Registries

To improve the efficiency of social safety nets, governments should develop integrated social registries that link ration databases, bank accounts, and health records. This integration can enable automatic, targeted assistance during economic or health shocks, reducing administrative delays. Furthermore, using portable registration systems can ensure that informal sector workers, daily wage earners, and migrant laborers maintain access to benefits even when they relocate, helping reduce reliance on informal debt during crises.

1.6 CONCLUSION

This empirical study of COVID-19-affected households in Erode District, Tamil Nadu, evaluates the microeconomic impact of a major health shock on household stability and the performance of social safety nets. The analysis shows a significant contrast between different areas of the relief system. State-level in-kind food transfers achieved high coverage, with 83.6% of households receiving free rice, which helped prevent immediate food insecurity. However, central government programs had much lower penetration, leaving 72.4% of households without support. Satisfaction with overall relief was moderate, with 40.0% of households reporting that assistance was insufficient to meet their needs.

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High out-of-pocket medical costs primarily explain this gap in support. Private-sector treatments generated substantial expenditures, averaging INR 159,627 per treated patient and reaching as high as INR 410,000 for deceased urban male patients. This financial burden was exacerbated by the low utility of health insurance, which provided financial protection to only 4.0% of the sample. In the absence of effective health financing or sufficient cash transfers, 58.0% of households had to take on debt as their primary coping strategy, resulting in long-term financial strain.

These findings show that while food relief was effective in preventing acute deprivation, it did not offset lost earnings, cover private medical costs, or prevent the accumulation of household debt. To build resilience against future public health and macroeconomic shocks, public policy must integrate immediate food support with more comprehensive financial protection. This requires strengthening public healthcare infrastructure, establishing enforceable price caps on private medical care, expanding the reach of public health insurance, and streamlining welfare delivery through universal, portable registries.

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