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Weather, Urban Congestion, and the Everyday Risks of Delivery Work

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Abstract

This study examines how weather conditions and urban congestion shape the everyday risks experienced by app-based delivery workers in Varanasi. With the rapid expansion of food, grocery, and parcel delivery platforms, thousands of workers in Varanasi navigate extreme temperatures, monsoon disruptions, chronic traffic bottlenecks, and narrow, uneven lanes while operating under strict algorithmic time pressure. Drawing on qualitative methods, including in-depth interviews with Swiggy, and Zomato workers, participant observation at key hotspots, and contextual analysis of weather and traffic patterns, the study reveals how environmental conditions and infrastructural constraints interact with platform logics to intensify occupational hazards. Workers report heat stress, fatigue, accidents, harassment, delayed mobility, and health deterioration, which are further amplified during peak-hour congestion and severe weather events. Findings show that while workers develop informal coping strategies and collective networks, the risks remain structurally embedded due to inadequate social protection, algorithmic control, and the fragmented urban landscape of Varanasi. The study contributes to debates on urban precarity, platform capitalism, and risk society by demonstrating how gig workers become frontline negotiators of environmental volatility and urban disrepair. It argues for policy interventions including weather-based allowances, fairer incentive systems, improved road infrastructure, and stronger labour safeguards to ensure safer and more equitable working conditions in the city's evolving digital service economy.

Introduction

The rise of the gig economy has become one of the most significant labour transformations of the twenty-first century, reshaping not only employment structures but also the ways in which work is organised, monitored, performed, and experienced. In India, this transformation has been especially rapid and visible in the domain of app-based food delivery, where digital platforms such as Swiggy and Zomato have established themselves as central actors in the everyday lives of urban populations. Over the past decade, these platforms have revolutionised consumption patterns and service expectations by providing on-demand, location-specific, and time-bound food delivery. However, this convenience rests upon the labour of thousands of delivery workers who must navigate unpredictable weather, infrastructural deficits, traffic congestion, and algorithmic demands in order to complete each delivery successfully. While the gig economy is frequently celebrated for creating new employment avenues for young, semi-skilled workers, a growing body of scholarship highlights that the flexibility and independence promised by these platforms conceal deeper forms of precarity, risk, and structural vulnerability.

At the heart of the gig economy lies an ideology of flexibility. Swiggy and Zomato advertise their work as an opportunity for riders to "be their own boss," choose their working hours, and earn income based on effort and time invested. For many urban youth, including those who are unemployed, under-employed, pursuing education, or supporting family livelihoods, these platforms offer a seemingly accessible entry into the labour market. Workers need minimal educational qualifications, and the onboarding process is quick and standardised. Yet, scholars have argued that gig work represents a shift toward a risk-shifted employment model, where flexibility for companies is achieved by transferring economic, physical, and psychological risks onto workers. In traditional employment settings, employers bear responsibility for occupational safety, health protection, accident coverage, and work-related contingencies. In contrast, gig workers receive no fixed salary, no paid leave, no health insurance, and no guarantee of earnings. Their income is contingent upon the number of deliveries completed, the time of day, customer demand, the weather, and platform-specific incentives, factors largely outside their control.

The structure of gig work is inseparable from the algorithms that govern it. Platform companies rely on data-driven systems to allocate orders, track worker movements, calculate delivery times, evaluate performance, modulate incentives, and penalise delays or cancellations. Scholars refer to this system of labour control as algorithmic management. Unlike conventional managers, algorithms operate silently, continuously, and automatically, shaping behaviour through ratings, time targets, nudges, and gamified challenges. For delivery workers, this means that their earnings are strongly influenced by the platform's constantly changing logic, often pushing them to maximise speed and availability. Peak-hour bonuses, rain-mode incentives, festival surge payments, and acceptance-rate requirements create economic pressure to work during high-risk periods. As a result, workers often continue riding during extreme heat, heavy rainfall, high humidity, or low visibility, even when such conditions significantly increase their exposure to accidents and health hazards.

Weather plays a crucial role in shaping the everyday conditions of delivery work. As outdoor workers, Swiggy and Zomato riders experience the direct impacts of climatic variations and environmental extremes. During summer, temperatures in many Indian cities can reach levels that pose serious risks of heat exhaustion, dehydration, dizziness, and fatigue. Heatwaves have become more frequent and intense due to climate change, creating dangerous conditions for those who must remain outdoors for long periods. Delivery workers frequently report symptoms such as headaches, excessive sweating, weakness, and difficulty concentrating, all of which affect their riding capacity and increase vulnerability to accidents. At the same time, platforms often introduce heat-mode incentives to encourage workers to stay active, effectively linking higher income opportunities to higher physical risk.

The monsoon season presents a different set of challenges. Heavy rainfall reduces visibility, makes roads slippery, obscures potholes, and causes waterlogging in many urban areas. Navigation becomes difficult, and riders must constantly adjust speeds and routes to avoid hazards. Rain also increases mechanical risks for two-wheelers and reduces braking efficiency. Workers face the added burden of protecting their phones, delivery bags, and food items from water damage while completing deliveries within tight time constraints. Many riders do not

have access to high-quality safety gear such as raincoats, waterproof gloves, anti-slip footwear, or helmets with visors, leaving them heavily exposed to the elements. Winter months bring further complications, including fog, smog, and dropping temperatures that impair breathing and visibility. Pollution levels in Indian cities frequently exceed safe limits, causing respiratory stress for workers who spend long hours on congested roads.

Weather alone does not determine risk; it interacts closely with urban mobility patterns and infrastructural conditions. Traffic congestion has become a defining feature of Indian cities, where rapidly increasing vehicle density, insufficient road width, unregulated intersections, and disorderly traffic behaviour create unpredictable movement patterns. Delivery workers must constantly weave through cars, autos, e-rickshaws, buses, street vendors, and pedestrians in order to reach customers within expected timeframes. Delays not only reduce earnings but can trigger penalties such as lower ratings or temporary suspension of incentives. The pressure to arrive "on time" often leads riders to take risky shortcuts, overspeed, ignore minor traffic rules, or ride on footpaths during heavy jams, all of which increase the likelihood of accidents.

Scholars studying urban labour argue that mobility has become a central component of contemporary work, particularly in the service sector. Delivery workers are among the most mobility-dependent workers in the urban economy, relying on continuous movement through fragmented and congested city spaces. This makes them highly vulnerable to what urban sociologists call mobility hazards, risks emerging from infrastructure quality, traffic discipline, road design, and the spatial organisation of cities. Poor street lighting, potholes, sudden speed breakers, uneven roads, encroachments, and lack of dedicated cycling or biking lanes contribute to unsafe travel conditions. During adverse weather, these risks are magnified, creating a complex web of environmental and infrastructural threats that workers must navigate multiple times a day.

The intersection of environmental risks, infrastructural limitations, and platform logics becomes even more visible when examining the everyday experiences of delivery workers. Workers describe feeling caught between competing pressures: the need to ensure personal safety and the economic necessity to complete a high number of deliveries. In many cases, riders continue working even when they are sick, injured, or fatigued because taking a break means losing income. High variability in daily earnings creates uncertainty, compelling workers to stay logged in for long shifts, often 10–12 hours a day. This physical and psychological strain accumulates over time, leading to chronic exhaustion, back pain, joint problems, sleep disturbances, and stress.

The Risk Society framework, introduced by Ulrich Beck, offers a useful lens through which to understand this condition. Beck argues that contemporary societies generate new forms of risks that are systemic, widespread, and often beyond the control of individuals. In the context of the gig economy, weather instability, infrastructural decay, and digital management systems create risks that workers must continually manage, even though they have little power to reduce or eliminate these risks. The burden of risk falls disproportionately on those with fewer resources, highlighting inequalities in exposure, vulnerability, and coping capacity. Delivery workers become what scholars describe as "risk absorbers," absorbing the failures of infrastructure, traffic management, climate governance, and platform responsibility.

Another relevant theoretical perspective comes from Nick Srnicek's concept of platform capitalism, which highlights how digital platforms operate by extracting value from data, logistics, and labour while minimising long-term obligations. In this model, platforms prioritise efficiency and growth, often sidelining worker welfare. The on-demand system of work creates a workforce that is permanently available but structurally insecure. Weather and congestion become variables that platforms treat as manageable through incentive adjustments rather than as serious occupational hazards requiring institutional protection. The logic of platform capitalism thus deepens precarity by normalising the expectation that workers must continue delivering under adverse conditions without adequate safety measures, training, or compensation.

While there is a growing body of international research on gig work, much of it focuses on economic precarity, algorithmic control, or labour classification disputes. Far fewer studies explore the environmental and infrastructural dimensions of gig labour, particularly in the Indian context. Weather and urban congestion are often treated as mere inconveniences rather than central components shaping the labour process. Yet, for delivery workers, these factors are integral to everyday work experiences. They determine how long workers can ride, how safely they can travel, how many deliveries they can complete, and how their bodies endure the pressures of mobile labour.

This research seeks to fill this gap by examining how weather variability and urban congestion interact to produce everyday risks for Swiggy and Zomato delivery workers. By focusing on the lived experiences of workers, it aims to understand how risks are perceived, negotiated, embodied, and managed within the broader structure of gig work. It examines how workers respond to environmental uncertainty, how they develop informal coping mechanisms, how platform policies shape their decisions, and how structural constraints limit their ability to avoid risk. Importantly, it situates delivery work within wider conversations on labour precarity, urban inequality, environmental justice, and digital labour governance.

Understanding these dynamics is critical, not only for academic analysis but also for policy and practice. India's gig workforce is projected to grow substantially in the coming years, with food delivery representing one of the fastest-growing segments. Ensuring safe and equitable working conditions requires recognising delivery workers as essential components of the urban service economy, acknowledging the environmental and infrastructural risks they face, and advocating for protective mechanisms such as weather allowances, improved insurance coverage, safety gear, algorithmic transparency, and urban planning that accounts for the mobility needs of frontline workers.

The gig economy's promise of flexibility and independence masks a deeper reality of risk, uncertainty, and vulnerability. Delivery workers stand at the intersection of digital technology, environmental variability, and urban congestion, making them a crucial group for sociological inquiry. Their experiences offer insights into how contemporary labour systems operate, how risk is distributed across social groups, and how emerging forms of work challenge existing frameworks of labour rights and protections. This study contributes to these debates by examining the daily risks that Swiggy and Zomato workers navigate and by highlighting the urgent need for more comprehensive safeguards within the rapidly expanding gig economy.

Methodology

This study employed a qualitative research design to examine how weather conditions and urban congestion shape the everyday risks experienced by Swiggy and Zomato delivery workers. The research was conducted in Varanasi. A purposive sample of 34 delivery partners was selected to ensure variation in age, work experience, and shift timings. Data were collected through in-depth semi-structured interviews and field observations conducted at major delivery hotspots, including restaurant pickup points and high-congestion intersections. Supplementary material, such as platform advisories, worker-shared screenshots, and images of road conditions, was also gathered. All interviews were recorded with informed consent and analyzed using thematic analysis, allowing patterns of weather-related precarity, traffic-induced risks, and coping practices to emerge organically. Ethical considerations regarding anonymity, voluntary participation, and secure data handling were strictly followed.

Findings and Analysis

The qualitative data reveal that the everyday working conditions of Swiggy and Zomato delivery workers are shaped by a dense interaction of environmental pressures, infrastructural constraints, and platform-driven demands. Three major themes emerged from the fieldwork: (1) weather-induced vulnerabilities, (2) congestion-related mobility risks, and (3) algorithmic pressures that intensify environmental hardships. These themes demonstrate how gig labour intersects with urban infrastructure and climatic unpredictability to produce heightened precarity.

1. Weather-Induced Vulnerabilities: Heat, Rain, and Physical Exhaustion

Workers consistently highlighted extreme weather as a defining feature of their risk environment. During the summer months, prolonged exposure to heat, often exceeding 40°C, led to dehydration, dizziness, and what many riders informally described as “heat headaches.” Several workers reported skipping breaks to maintain their acceptance rate, thereby worsening their physical strain. Heatwaves also affected traffic flow, increasing waiting time at major intersections, which intensified bodily exhaustion.

The monsoon season produced a different set of challenges. Heavy rainfall flooded low-lying areas, filled potholes, and obscured visibility, making navigation significantly riskier. Workers described slippery roads as a “constant fear,” especially during late-evening deliveries. Raincoats and protective gear provided limited relief; many noted that they remained wet for hours, leading to discomfort and colds. Moreover, rainy weather typically increased order volume, pushing workers to remain mobile despite heightened risk.

Winter conditions, while less intense, still created difficulties such as fog, misty winds, and numbness during early-morning shifts. The inability to “opt out” during extreme conditions, because of income dependency, reinforces the structural precarity embedded in gig work, where workers bear the full burden of environmental risks.

2. Urban Congestion and the Strain of Navigating Chaotic Road Networks

Urban congestion emerged as one of the most significant daily stressors. Workers repeatedly

emphasized that navigating Varanasi's narrow lanes, temple precincts, commercial markets, and tourist-heavy zones increased their exposure to sudden obstacles, unpredictable pedestrian flows, and erratic vehicle movement.

Peak congestion, typically around lunch hours, evenings, and festival seasons, slowed mobility drastically. Delays increased pressure on workers to deliver orders within app-specified timelines, often leading them to take shortcuts through risky lanes, ride on sidewalks, or speed through small gaps in traffic. Many reported near-miss accidents caused by two-wheelers braking suddenly, e-rickshaw congestion, or sudden pedestrian crossings. Congestion not only delayed deliveries but also heightened stress, as workers feared penalties for late orders.

Importantly, congestion amplified weather-related risks. Flooded lanes during the monsoon season created logjams that forced workers to drive through deep water, damaging their vehicles and increasing the likelihood of accidents. This intersection of environmental and infrastructural stressors illustrates the compound vulnerabilities embedded in gig mobility.

3. Algorithmic Pressures: Dark Zones, Incentives, and Invisible Risks

While weather and congestion shaped physical risk, algorithmic management shaped psychological and structural risk. Workers repeatedly expressed that the app's order-allocation system did not account for real-time road conditions, leading to situations where they were assigned long-distance orders during extreme heat or sent into highly congested pockets during heavy rain.

The concept of *"dark zones,"* areas where GPS signals weaken or maps misrepresent routes, was mentioned frequently. These areas forced workers to stop repeatedly to check navigation, making them vulnerable to being hit by other vehicles, especially in narrow lanes.

Incentive systems also intensified risk. Workers noted that during harsh weather, platform companies often introduced "rain bonuses" or "heat incentives," which, while financially attractive, encouraged continuous mobility under unsafe conditions. The fear of losing incentives or maintaining performance metrics such as acceptance rate, cancellation rate, and on-time delivery created additional pressure to take unsafe shortcuts or ride faster than normal.

This reveals how algorithmic governance converts environmental unpredictability into measurable performance targets, transferring risk entirely onto workers' bodies and time.

4. Coping Mechanisms and Informal Support Networks

Despite high levels of precarity, workers developed a range of coping strategies. Many preferred to cluster near restaurants or traffic signals with shade to manage heat exposure. Others coordinated with fellow riders through WhatsApp groups, where they shared information about roadblocks, waterlogged zones, or police checking points.

Informal peer networks acted not only as support systems but also as spaces of collective resistance. Workers exchanged strategies to avoid "penalty-prone routes," discussed how to communicate with customer support to avoid deductions, and supported each other during breakdowns or minor accidents. These networks partially compensated for the absence of formal protections.

However, these coping mechanisms remain limited in addressing structural vulnerabilities. They mitigate immediate hardships but do not eliminate the deeper risks created by platform dependency, lack of insurance awareness, the absence of safety equipment, and the unpredictability of environmental conditions.

5. The Intersection of Climate, City, and Platform Labour

The findings demonstrate that delivery work is shaped by a multi-layered intersection of environmental, infrastructural, and digital forces. Weather generates bodily risks; urban congestion produces mobility hazards; and algorithmic systems intensify both by imposing rigid timelines and performance expectations. Workers navigate these overlapping pressures daily, revealing that what appears to be flexible gig work actually functions as a risk-internalizing labour system, where the city's weaknesses, climate's extremes, and platform demands converge on the worker's body.

Discussion

The findings of this study highlight the complex interplay between environmental conditions, urban infrastructure, and platform governance in shaping the everyday risks of Swiggy and Zomato delivery workers. These insights extend the growing body of scholarship on gig labour by demonstrating that delivery work operates at the intersection of ecological precarity, urban spatial inequality, and algorithmic control. While existing literature has emphasized platform-driven exploitation and the lack of labour protections, this study shows that workers' vulnerabilities are not only technologically produced but also materially embedded in the urban and climatic landscapes through which they move.

First, the study confirms that weather is not an external inconvenience but a central dimension of gig work's political economy. Extreme heat, heavy rainfall, and winter fog directly affect the pace, safety, and bodily capacity of workers. Gig platforms promote themselves as flexible, urban-friendly service models, yet their labour systems lack meaningful adaptations to unpredictable or harsh climatic conditions. Incentives during rain or heatwaves, framed as "support," function more as productivity accelerators than safety provisions, pushing workers to remain mobile even when conditions are hazardous. This supports broader arguments within labour sociology that neoliberal work regimes increasingly shift risk to workers under the guise of flexibility and choice.

Second, the relational connection between urban congestion and risk reveals how infrastructural inequalities disproportionately burden informal and semi-formal workers. Varanasi's dense traffic, narrow lanes, pedestrian-heavy spaces, and seasonal flooding create a mobility environment that is unpredictable and hazardous. Delivery workers navigate these spaces under time pressure and algorithmic monitoring, which magnifies the risks inherent in the city's uneven infrastructure. This finding echoes urban sociological theories that cities reproduce inequality through spatial arrangements, where certain workers face heightened exposure to harm because of where they must work and how their labour is organized.

Third, the study demonstrates that algorithmic management acts as an invisible amplifier of environmental and infrastructural risks. The allocation of orders without regard to real-time

weather or traffic conditions, the pressure to maintain acceptance and on-time rates, and the lure of weather-based incentives all position workers within a digital loop that prioritizes efficiency over safety. The platform's risk-neutral stance contrasts with workers' lived vulnerabilities. This gap shows how algorithmic systems can appear neutral but are deeply embedded in power relations that treat workers as data points rather than embodied individuals navigating hazardous environments.

Importantly, the study reveals that delivery workers do not passively accept these risks. They cultivate informal networks, peer support, and creative coping strategies to navigate urban complexity. These practices align with the notion of "everyday resistance," where marginalized workers create micro-level forms of resilience within broader structures of inequality. However, these strategies, while meaningful, remain compensatory. They mitigate short-term disruptions but do not address structural determinants such as lack of social protection, absence of weather-responsive labour policies, or the infrastructural deficiencies of the city.

This research contributes to broader debates on the ecology of gig work, a concept that views platform labour not merely as a technological arrangement but as an assemblage shaped by climate, space, governance, and bodily labour. For delivery workers, risk is produced not by a single factor but by the convergence of multiple stressors that continuously interact. Weather exacerbates congestion; congestion increases delivery delays; delays trigger algorithmic penalties; penalties push workers to take risks; and risks accumulate to form chronic precarity.

Overall, the discussion underscores that the vulnerabilities faced by Swiggy and Zomato workers are neither accidental nor temporary, they are structurally embedded in the organization of gig work within Indian cities. Policy interventions must therefore move beyond technological regulation to include urban planning reforms, climate-resilient protections for outdoor workers, and labour regulations that hold platforms accountable for environmental risk-sharing. Without such changes, gig workers will continue to bear the full burden of a system that relies on their mobility yet provides little support for their safety.

Conclusion

This study demonstrates that the everyday work of Swiggy and Zomato delivery workers is shaped by the intersecting pressures of weather extremes, urban congestion, and algorithmic control. Far from being flexible and autonomous, gig work emerges as a form of labour in which risk is continuously shifted onto workers' bodies, time, and mobility. Extreme heat, heavy rainfall, flooded lanes, and dense traffic create hazardous conditions that are intensified by platform-imposed timelines and incentive structures. While workers develop informal networks and coping strategies, these remain insufficient to counter the structural vulnerabilities embedded in platform labour and urban infrastructure. The findings highlight the need for climate-sensitive labour protections, safer city mobility planning, and greater accountability from gig platforms in sharing environmental and infrastructural risks. Ultimately, understanding delivery work through the lens of environmental precarity and urban inequality reveals a labour system in which the city, climate, and algorithm converge to shape a deeply fragile everyday experience.

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