

Health and safety risk perceptions and needs of app-based drivers during COVID-19

Kerry L. Beckman MPH¹  | Lily M. Monsey BA²  | Megan M. Archer BS² |
Nicole A. Errett PhD, MSPH²  | Ann Bostrom PhD, MBA³  | Marissa G. Baker PhD² 

¹Department of Health Systems and Population Health, University of Washington School of Public Health, Seattle, Washington, USA

²Department of Environmental and Occupational Health Sciences, University of Washington School of Public Health, Seattle, Washington, USA

³Evans School of Public Policy and Governance, University of Washington, Seattle, Washington, USA

Correspondence

Marissa G. Baker, Department of Environmental and Occupational Health Sciences, University of Washington School of Public Health, 4225 Roosevelt Way NE Suite 100, Seattle, WA 98105, USA.
Email: bakermg@uw.edu

Funding information

University of Washington Population Health Initiative, Grant/Award Number: Economic Recovery Grant

Abstract

Background: App-based drivers face work disruptions and infection risk during a pandemic due to the nature of their work, interactions with the public, and lack of workplace protections. Limited occupational health research has focused on their experiences.

Methods: We surveyed 100 app-based drivers in Seattle, WA to assess risk perceptions, supports, and controls received from the company that employs them, sources of trust, stress, job satisfaction, COVID-19 infection status, and how the pandemic had changed their work hours. Data were summarized descriptively and with simple regression models. We complemented this with qualitative interviews to better understand controls and policies enacted during COVID-19, and barriers and facilitators to their implementation.

Results: Drivers expressed very high levels of concern for exposure and infection (86%–97% were “very concerned” for all scenarios). Only 31% of drivers reported receiving an appropriate mask from the company for which they drive. Stress (assessed via PSS-4) was significantly higher in drivers who reported having had COVID-19, and also significantly higher in respondents with lower reported job satisfaction. Informants frequently identified supports such as unemployment benefits and peer outreach among the driver community as ways to ensure that drivers could access available benefits during COVID-19.

Conclusions: App-based drivers received few protections from the company that employed them, and had high fear of exposure and infection at work. There is increased need for health-supportive policies and protections for app-based drivers. The most effective occupational and public health regulations would cover employees who may not have a traditional employer–employee relationship.

KEYWORDS

app-based drivers, COVID-19, gig economy, vulnerable workers, worker stress

1 | BACKGROUND

The COVID-19 pandemic has had a profound impact on workers, with the majority facing either increased risk of exposure to the SARS-CoV-2 virus, or increased stresses due to job displacement or insecurity as they are unable to do their job from home.¹ App-based drivers, who provide delivery or transportation services in a personal vehicle arranged through a company's online application, represent a workforce that faces unique and compounding risks during a pandemic. Their economic livelihood depends on their ability to continue driving and a demand for their services, but their classification as independent contractors under labor standards may give them decreased access to workplace benefits and other regulatory protections (e.g., unemployment insurance, paid sick leave, workers compensation).² While the Federal CARES Act did provide unemployment insurance for contingent workers, accessing these funds often proved challenging, and the program is not expected to continue in perpetuity.^{3,4} The nature of app-based driving also presented increased opportunity for COVID-19 transmission between drivers, passengers, and community members, as many individuals were occupying the same enclosed space over the course of a shift and sharing air, which is the primary route through which SARS-CoV-2 spreads.^{5,6}

Despite the prevalence of app-based drivers across the United States, limited public health research studies have looked at the experiences of these workers, and how their work affects their health, particularly during the COVID-19 pandemic. However, a study commissioned by the San Francisco Local Agency Formation Commission surveyed over 600 on-demand food delivery and ride-hailing workers in San Francisco to investigate how the COVID-19 pandemic has economically affected this workforce, finding that this is a highly diverse workforce that was struggling financially, with the COVID-19 pandemic increasing financial insecurity as the demand for their services decreased early in the pandemic.⁷ The drivers also reported receiving limited support during the pandemic both from the company they work for and from public policies; few drivers reported receiving training from the company they work for on how to protect themselves during the pandemic.

As app-based drivers are not formally counted as workers by the Bureau of Labor Statistics, some drivers drive for multiple companies, and hours worked can be highly variable, it is challenging to know how many app-based drivers are active drivers in the United States and how this might have changed during the pandemic. Estimates from the two primary companies (Uber and Lyft) put the total number between 1 and 2 million at the end of 2020.⁸ In Seattle, Washington, app-based drivers are represented by a worker organization affiliated with Teamsters Local 117. As such, these drivers have had access to additional resources through this union to help them navigate the pandemic, and the union has helped to secure additional protections for app-based drivers operating in Seattle, including minimum pay mandates (ensuring they earn the city's minimum wage of \$16.69/h), pay for time spent between rides, access to an independent Driver Resolution Center, and other worker-protective actions such as hazard pay for food delivery drivers.^{9,10} During the COVID-19 pandemic, both Uber and Lyft enacted paid sick leave for drivers infected with COVID-19 but the amount drivers received and the ease drivers

had in accessing it varied between drivers, and was influenced on hours driven, documentation, and municipal-specific regulations.¹¹ Companies also had other COVID-19 specific protections such as providing training or information on mitigating COVID-19 hazards, and getting personal protective equipment (PPE) to drivers (either for free or at cost). Before the pandemic, the independent contractor classification of drivers meant drivers would not be eligible for paid sick or vacation leave, employer-subsidized health care, or a guaranteed minimum hourly wage from the company they drive for, unless municipal-specific regulations had been established, as in Seattle. In result, the experiences of union-affiliated drivers in the greater Seattle area may represent a best-case scenario relative to drivers in many other parts of the country, where they lack union supports and municipal-specific protective policies.

Here, we utilized a mixed-methods study design to descriptively characterize the experience of Seattle app-based drivers during the COVID-19 pandemic, and to explore existing and potential opportunities to reduce SARS-CoV-2 exposure. We characterized the primary outcomes of perceived stress, job satisfaction, and self-reported COVID-19 status in 100 app-based drivers affiliated with Teamsters Local 117 (Seattle, WA) using a telephone survey. Additional questions explored what their exposure and health risk perceptions were, health protective behaviors they had taken while driving, supports they had received from the company they work for, who they trusted to make decisions and recommendations. This survey was complemented with semistructured interviews with Teamster 117 leadership and drivers to better understand what types of controls were implemented and needed by drivers to protect them and their communities from exposure to SARS-CoV-2, which was hypothesized to have a positive impact on stress and feelings of job satisfaction. This study is important for understanding the experiences faced by an underserved yet essential occupational population, particularly as jurisdictions look to pass policies and regulations that either increase or decrease job-related protections for app-based drivers, such as California's Proposition 22, which by state vote classified app-based drivers as independent contractors (rather than employees of ride share companies), absolving rideshare companies of providing any state mandated benefits.¹² Moreover, this study further explores the experiences of workers during this public health emergency, which has brought to light many ways in which worker health and public health are integrated

2 | METHODS

Researchers collaborated with Teamsters Local 117 who represent thousands of app-based drivers in Seattle, WA, on this mixed-methods study featuring a cross-sectional survey and qualitative interviews. The mixed-methods design allowed us to assess our primary outcomes using a cross-sectional survey, and collecting more in-depth information about how to improve outcomes for this population utilizing the qualitative interviews. The University of Washington Human Subjects Division determined this project to be

exempt from review as no identifying information was being collected by researchers.

2.1 | Survey development and metrics

Working with union and driver representatives, we developed a survey that adapted questions from previously validated scales and included new questions developed specifically for this population and the COVID-19 pandemic. The wording of many questions was adapted to increase clarity for app-based drivers, and at the advice of our community partners, responses for most measures were simplified from a five- or six-point Likert scale (e.g., scored 1, 2, 3, 4, 5) to a three-point Likert scale (e.g., scored 1, 3, 5) to streamline data collection and increase comprehension during the telephone-based survey. The survey was pilot-tested with four app-based drivers and two union representatives, and the survey was revised based on their feedback. The full survey took about 10 min to administer over the phone.

Four community liaisons (active app-based drivers who liaise between the union and other drivers) administered the survey over the phone to a total of 100 active app-based drivers identified by the union utilizing a convenience sampling approach. Before administering the survey, the community liaisons met with the research team to talk through all questions on the survey and receive training on how to consistently administer the survey. The survey was administered between August 11, 2020 and September 7, 2020.

Three primary outcomes were collected from the survey: perceived stress, job satisfaction, and self-reported COVID-19 infection status. Perceived stress was measured using the four-point perceived stress scale (PSS-4)¹³ but instead using the 5-point response scale of Never, Almost Never, Sometimes, Fairly Often, Very Often, we used a 3-point response scale of Rarely, Sometimes, and Often. After scoring each measure based on established PSS-4 scoring guidance, the four scores were summed, with higher scores indicating more stress. In a review of six studies utilizing a PSS-4, Cronbach's α ranged from .60 to .82. We calculated $\alpha = .65$ in our sample indicating a lower test reliability.¹⁴

The five job satisfaction questions on our survey were inspired by the 36 question Spector Job Satisfaction Scale (JSS).¹⁵ Respondents were asked whether or not they agree with a statement about their job using a three-point agreement scale (Agree, Neither Agree or Disagree, and Disagree). The five scores were averaged to create a composite job satisfaction score, with higher scores indicating more job satisfaction across the metrics. Recognizing the reduced access to COVID-19 testing early in the pandemic and among our community of interest, to assess COVID-19 infection we asked respondents if at any time since March 1, 2020 they thought they had COVID-19 which we used as our primary measure for COVID-19 infection.

The survey also included two scales assessing psychometric judgments of how concerned drivers were about five scenarios related to COVID-19 exposures in their vehicles and six scenarios

related to infection with COVID-19, including physical health and economic health outcomes. For both sets of questions, respondents answered as "very concerned," "somewhat concerned," or "not at all concerned." Both scales were averaged separately to create two composite scores related to exposure and health outcomes, with higher scores indicating greater concern about exposure to COVID-19 when driving their vehicle, or the effects related to infection with COVID-19. A third set of questions asked drivers to either agree or disagree with six statements, to assess which individuals and entities they trust to provide accurate and truthful information during the COVID-19 pandemic to keep them safe at work. Drivers also indicated how frequently they undertook six health-protective behaviors that at the time of the survey were believed to reduce exposure to SARS-CoV-2 while driving their vehicle, and indicated which exposure controls the company they work for provided them during the pandemic. The full survey instrument can be found in Supporting Information Material 1.

Demographic measures (age, race, ethnicity, and gender) were also collected, along with measures asking about their current work (driving passengers or for delivery, both, or none), current hours worked, hours worked before the pandemic, and the number of years they have worked as a driver.

2.2 | Survey data analysis

Raw survey data were downloaded from REDCap. We first conducted descriptive analyses on the 100 respondents who completed the survey. Linear regression analyses were used to assess associations between our primary outcomes of job satisfaction, self-reported COVID-19 status, and stress controlling for age, current hours driving, change in hours driving, and years working as a driver. These covariates were selected based on a review of the literature that indicated these items were associated with stress or job satisfaction in other occupational studies.¹⁶⁻²⁰ Plots of means and confidence intervals were used to illustrate notable bivariate results. All analysis was conducted in Stata 16, plots were generated using R Studio 1.2.5.

2.3 | Qualitative methods

We conducted six semistructured interviews with eight Teamster 117 organizers and community liaisons who fit our a priori defined inclusion criteria¹: Knowledge of relationships between app-based drivers and the companies that employ them²; Knowledge of driver safety measures implemented before and during COVID-19³; Insight into app-based driver concerns and risk-related behaviors. Our first informants were recruited from our union contacts, and subsequent informants were recruited using a snowball sampling approach, with new informants identified by prior informants. Informants were asked to identify administrative controls, engineering controls, and PPE used to promote health and safety of app-based drivers, as well as

the public they serve, during the COVID-19 pandemic. Additionally, interviews explored barriers and facilitators to implementing these workplace controls. The study team worked with Teamsters 117 organizers to identify prospective interviewees. Interviews were conducted over video conferencing using a Zoom Video Communications product, and with participant consent, recorded and professionally transcribed.

The study team employed a combination of deductive and inductive approaches to analysis. First, we developed codes inspired by the National Institute for Occupational Safety and Health's (NIOSH) hierarchy of controls²¹ focusing on engineering controls, administrative controls, and PPE, as well as barriers and facilitators to their implementation. Following a data familiarization process where two members of the study team (LM and MA) each read and reread all interview transcripts, subcodes were developed to capture emergent themes within these codes. Codes and their definitions, along with examples of when to apply, were memorialized into a codebook. The same two members of the study team each independently applied the codebook to two interview transcripts using NVivo qualitative data analysis software. They then met to compare code application, adjudicate any discrepancies, and clarify code definitions. Following resultant codebook updates, they each independently coded the remainder of the transcripts, and met to compare code application and adjudicate discrepancies. Coded text was then reread and synthesized to summarize key themes, with supporting rich description and counterpoints, within each of the codes. To assess qualitative confirmability, memos were cross-referenced against the original transcripts to ensure interpretation was supported by the original data.²²

3 | RESULTS

Demographics and background information from the survey respondents are presented in Table 1. Respondents were predominantly male (97%), identified as Black or African (84%), and were under the age of 55 (87%). A total of 30% of respondents believed they had been infected with COVID-19 at some point before taking the survey. The pandemic brought changes in hours worked, with only two respondents reporting an increase in hours driven during the pandemic, 25 drivers reporting no change in hours, and 73 drivers reporting a decrease in hours driven due to the pandemic, including 42 respondents who reported they were no longer working as a driver due to the pandemic.

Findings from the psychometric judgment scales are presented in Table 2. Overall, drivers expressed very high levels of concern about all five exposure scenarios (89%–90% were “very concerned,” for all scenarios) and all six infection scenarios (86%–97% were “very concerned,” for all scenarios). Table 2 also presents the COVID-19 protections and controls that drivers reported receiving from the company that employs them, and their sources of knowledge and trust. Only 31% of drivers reported receiving any mask (cloth, surgical, or more protective) from the company that employs them, and a similar percentage reported receiving hand sanitizer from their company. Those who had received a mask or hand sanitizer indicated

TABLE 1 Participant demographics and background information

	N (%)	Mean (SD)
Age		
18–34	23 (23%)	
35–54	64 (64%)	
55–64	6 (6%)	
65+	2 (2%)	
Prefer not to answer or missing	5 (5%)	
Race		
White	4 (4%)	
Black or African	84 (84%)	
Asian	8 (8%)	
Middle Eastern/North African	2 (2%)	
Prefer not to answer	2 (2%)	
Gender		
Male	97 (97%)	
Female	3 (3%)	
Hours currently driving each week		
I am not working as a driver currently	42 (42%)	
0–20 h	6 (6%)	
20–40 h	27 (27%)	
More than 40 h	25 (25%)	
Hours driving each week before pandemic		
0–20 h	0 (0%)	
20–40 h	13 (13%)	
More than 40 h	87 (87%)	
Years working as a driver		3.90 (1.7)
At any time, have you felt you might have had COVID-19?		
No	61 (61%)	
Yes	30 (30%)	
I am not sure	8 (8%)	
Prefer not to answer	1 (1%)	
Current work		
I am driving passengers	30 (30%)	
I am doing delivery driving	5 (5%)	
I am both driving passengers and delivery driving	25 (25%)	
I am not driving at this time	40 (40%)	
Perceived Stress Scale (0–16 score)		9.2 (3.7)

that the amount supplied was insufficient. Despite this, most drivers responded that they always wore masks and sanitized their hands when working. The majority of respondents reported receiving health-related information (82%) or exposure-related information

TABLE 2 Determinants of risk perceptions

	N (%)	Mean (SD)
On the job risk perception (Scale 1–5, overall average)		4.79 (0.52)
<i>How concerned are you about...</i>		
Exposure due to lack of cleanliness?		4.79 (0.74)
Exposure due to passenger sneezes?		4.79 (0.79)
Exposure due to surfaces?		4.84 (0.62)
Exposure due to lack of PPE?		4.77 (0.81)
Exposure due to lack of handwashing?		4.77 (0.81)
Number of respondents who were “very concerned” about the following determinants of COVID-related stress...		
Contracting Covid-19 at work	97 (97%)	
Infecting my family members	95 (95%)	
Infecting my passengers	86 (86%)	
Not being able to work if I got sick	97 (97%)	
Having fewer passengers	93 (93%)	
Challenges in juggling work and family due to COVID	93 (93%)	
Health perceptions		
Number of respondents who were “very concerned” about COVID exposure in the following scenarios...		
General cleanliness of the vehicle I drive for work	89 (89%)	
People sneezing, coughing, spitting in my vehicle	90 (90%)	
Touching dirty door handles or other surfaces in my vehicle	90 (90%)	
Access to PPE while working	89 (89%)	
Access to handwashing facilities	89 (89%)	
Sources of Trust and Knowledge (disagree, ¹ undecided, ³ agree ⁵)—total average		3.13 (1.01)
Number of respondents who agree that...		
I know enough about coronavirus to make decisions about my safety at work.	78 (78%)	
Scientists know enough about coronavirus to make recommendations about my safety at work.	64 (64%)	
The company I work for knows enough about coronavirus to make decisions about my safety at work.	38 (38%)	
The government knows enough about coronavirus to make recommendations to keep me safe at work.	57 (57%)	
I trust the company I work for to keep me safe at work during the coronavirus pandemic.	13 (13%)	
I trust the passengers to help keep me safe at work.	7 (7%)	
Job Satisfaction (disagree, undecided, ³ agree)—total average		3.08 (.49)
Number of respondents who agree that...		
I am paid a fair amount for my work.	2 (2%)	
I like my work.	65 (65%)	
The work I do is appreciated by the community.	76 (76%)	
I am proud of the work I do.	88 (88%)	

(Continues)

TABLE 2 (Continued)

	N (%)	Mean (SD)
My pay has kept up with the cost of living.	2 (2%)	
Health Protective Behaviors (Scale 1–5)—total average		3.64 (.61)
<i>How frequently have you...</i>		
Hand wash or sanitizer after interacting with a passenger?		4.81 (.77)
Worn a cloth or paper face covering?		4.84 (.71)
Worn an N95 or KN95 mask at work?		2.66 (1.69)
Worn gloves at work?		3.00 (1.54)
Disinfected your work area?		4.64 (.93)
Worn a face shield?		1.71 (1.42)
Workplace Controls—Total # of "Yes" (out of 9)		2.51 (1.62)
Number of respondents who reported that at <i>any time during the pandemic their employer.....</i>		
Provided cloth or paper masks?	31 (31%)	
Provided KN95 or N95 masks?	9 (9%)	
Provided any type of masks for passengers?	8 (8%)	
Provided a face shield?	0	
Provided hand sanitizer for you?	30 (30%)	
Provided hand sanitizer for passengers?	1 (1%)	
Provided disinfectant supplies?	17 (17%)	
Provided health information about the coronavirus?	82 (82%)	
Provided exposure information about the coronavirus?	69 (69%)	

(69%) from the company they worked for, but most respondents did not agree that the company they worked for had the knowledge to keep drivers safe during a pandemic (38% agreed), nor did respondents trust the company to keep them safe during a pandemic (13% trusted the company to do this).

Utilizing linear regression models, we investigated the relationship between stress, job satisfaction, and COVID-19 infection status in this population (Table 3). Comparing measures of job satisfaction and stress, a one-point increase in reported job satisfaction was associated with a 1.83-point decrease, on average, in perceived stress (95% CI: -3.46, -0.20) when controlling for COVID-19 infection status, driver age, years driving, current hours driven in a week, and change in driving hours during the pandemic. Self-reported infection with COVID-19 was also significantly associated with PSS-4 score in this model, with respondents reporting a COVID-19 infection having a PSS-4 score 2.08 points higher, on average (95% CI: 0.22, 3.93) compared to drivers who did not report a COVID-19 infection at a time before the survey (see also Figure 1).

We conducted a total of six interviews with eight key informants, including two group interviews. Key informants included two union representatives and six driver liaisons. To better understand how drivers were protected from exposure to SARS-CoV-2, informants were asked about administrative and engineering controls employed during the initial phases of the pandemic, as well as barriers and facilitators to their implementation. Administrative controls represented the majority

TABLE 3 Determinants of stress in app-based drivers

	Coef. (SE)	95% CI
Job satisfaction	-1.83 (0.82)*	-3.46, -0.20
COVID-19 status (Ref: No COVID-19)		
Yes, COVID-19	2.08 (0.93)*	0.22, 3.93
Don't know	1.34 (1.46)	-1.57, 4.25
Age	-0.31 (0.51)	-1.32, 0.71
Years driving	-0.07 (0.26)	-0.60, 0.45
Current hours driving (Ref: 0 h/week)		
1–20	2.35 (2.31)	-2.24, 6.96
21–40	7.17 (4.34)	-1.48, 15.81
40+	8.35 (5.16)	-1.93, 18.64
Change in hours driven (REF: No change)		
Increase in hours worked	-2.50 (3.73)	-9.93, 4.94
1–20 h decrease	1.95 (2.73)	-3.50, 7.40
21–40 h decrease	5.37 (4.94)	-4.49, 15.22
40+ h decrease	9.31 (5.16)	-0.97, 19.59

* $p < .05$.

of controls discussed. While only one informant described engineering controls, most emphasized the importance of PPE and culturally appropriate dissemination strategies (Table 4).

3.1 | Barriers to control implementation

Informants discussed the added financial burden of procuring adequate PPE and an overall lack of income due to reduced ridership in the pandemic, which were compounded by challenges in accessing unemployment. An informant noted difficulties obtaining partitions for vehicles due to high costs and lack of compensation. As one informant shared, "And then every person in your vehicle, you have to sanitize your vehicle. And then we buy all those equipment. So that's the thing and my issue

personally... But for now, I just continue buying from my own pocket." Informants also emphasized the difficulty full time drivers face in making ends meet, paying bills, and supporting family at home. One informant described how drivers already exist on a financial "knife's edge" and how the uncertainty and depleted ridership in the pandemic have created an even more untenable financial situation for drivers.

Informants discussed insufficiencies of, or skepticism around, government, employer, and union support. For instance, informants discussed a lack of information being provided by apps and the government about financial support, training, and access to PPE. Two informants talked extensively about inadequacies in the unemployment process, with one noting that drivers had to wait up to 6 months to receive unemployment benefits at the level they applied for. Additionally, two informants discussed skepticism around union support, with one informant mentioning that union distrust was influenced by company scare tactics.

Informants also discussed particular challenges in accessing data from ride-share companies about who and where other drivers are, making it more difficult to build community among drivers and coordinate efforts to promote safety. One such informant talked about the isolation and loneliness within the driver community which has been amplified by an inability to connect driver groups, stating: "Well, one of the biggest things, I think is just not being able to talk with other drivers that you just don't happen to see. And in this line of work, you're very insular. I mean, I'm in my own little universe... so finding a way to bridge that gap has been the biggest challenge."

Informants addressed an overall lack of empowerment in the driver community, driver mistreatment, and "exploitation," including through their company's deactivation policies and unfair wages. Additionally, poor treatment of drivers was reported as common due to a lack of understanding among passengers about what drivers go through. One informant discussed pressure put on drivers to enforce passenger mask use which could lead to passenger retribution against drivers through false

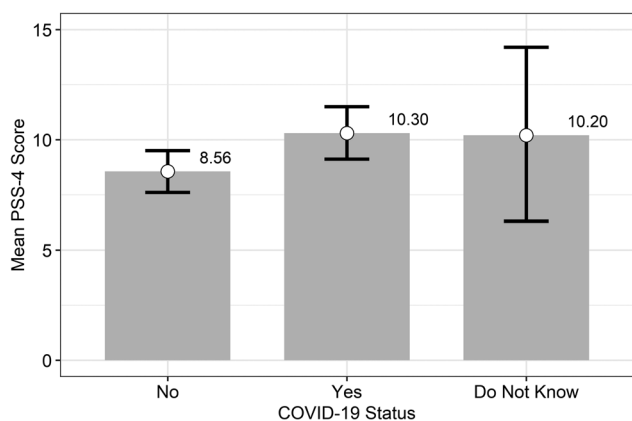


FIGURE 1 Perceived Stress Score by self-reported COVID status. The white point on each bar denotes the mean PSS-4 score by COVID-19 status, and the black bars denote the upper and lower 95% confidence interval of the mean

TABLE 4 Workplace controls implemented in response to COVID-19

Control type	COVID-19 controls implemented
Administrative	<ul style="list-style-type: none"> • Union support to drivers to access unemployment benefits and other government resources, including the development of a step-by-step guide for drivers to provide one-on-one technical assistance in different languages. <ul style="list-style-type: none"> ◦ Use of driver outreach field workers to provide one-on-one technical assistance in different languages, and phone-based outreach to provide public health guidance regarding the pandemic. ◦ Sharing information through online meetings and while distributing cleaning supplies. • Union-led policy advocacy or organizing in support of worker protections like sick leave, higher wages, and protection from unfair deactivation • Information and resources shared through driver leaders, with cascading effects through the driver network
Engineering	<ul style="list-style-type: none"> • Installation of dash cams in vehicles to protect drivers against potential deactivation from false claims by passengers • Mask enforcement programs implemented by apps to make it easier for passengers and drivers to prove they are wearing masks, involving passengers taking "selfies" wearing a mask before getting into the vehicle and confirming that drivers are wearing masks
PPE	<ul style="list-style-type: none"> • Driver purchasing of PPE and cleaning supplies, including face masks, gloves, and sanitizing products, out of pocket • Distribution of PPE at culturally appropriate staging locations, including lots, airports, and mosques, with driver leaders taking an active role in collection and distribution

claims of harassment. This same informant mentioned xenophobia potentially playing a role in passenger mistreatment. Another informant discussed their perceptions of drivers as an unprotected class of workers, many of whom are also from marginalized and vulnerable populations.

3.2 | Facilitators

A majority of informants identified forms of social cohesion as a solution to the challenges of app-based driving in a pandemic. One informant noted that one-on-one communication with a trusted peer is the “most valuable communication mechanism” and provides drivers an opportunity to unite over efforts to improve working conditions. Another informant described driver leader meetings that provide a space for drivers to discuss strategies for meeting driver needs. Informants discussed the importance of collaboration among driver leaders and Teamsters to organize and advocate for driver rights to local political leaders, help organize resources, and provide legal and communication support. As one shared, “The unity we want motivated us to show support for our fellow drivers. Then they know, if we are united, we can achieve a lot. We would be looking after each other.” Teamsters also provided a platform for drivers to speak directly to municipal policymakers with the power to create better working conditions.

4 | DISCUSSION

This is one of few studies to investigate workplace health and safety of app-based drivers, and the first of our knowledge to characterize how the COVID-19 pandemic has affected this worker population. Given that app-based drivers are part of a labor model that is increasing in the United States but is weakly regulated, this study is an important step toward characterizing the concerns and needs of these workers. The findings presented here could inform policies and practices that can protect these workers and reduce concerns related to COVID-19 or other infectious diseases going forward.

Findings indicate that this is a worker population with high levels of concerns around exposure to COVID-19, and the health and economic effects associated with the virus. As they indicated in interviews, workers experienced untenable financial situations early in the pandemic due to decreases in ridership, out-of-pocket PPE and sanitation costs, and difficulties accessing unemployment. These concerns may have been exacerbated by the lack of protective controls provided by the company that employed them, changes in hours or the ability to work during the pandemic, and self-reported pay, which did not keep up with the cost of living. The lack of power these drivers had at work due to their low pay, minority status, and lack of a traditional employee–employer relationship (a relationship that may carry benefits and be subject to state and federal occupational safety and health regulations) may also have increased feelings of concern and fear around COVID-19, and influenced the distrust drivers tended to express in the company they drove for. Despite the above, drivers tended to take pride in their work, like their job, and recognize the importance of their work in society.

Thirty-percent of respondents reported they thought they had COVID-19 at some point, though we were not able to confirm infection or assess whether or not the probable COVID-19 cases originated in their vehicle. This is similar to the percent of app-based drivers in New York City that reported that they or a family member had been infected with COVID-19 (38%).²³ Washington State Department of Labor & Industries (L&I) published a report looking at confirmed COVID-19 cases in Washington by industry for the time period January 2020–June 2020, which overlaps with the time period covered in our survey.²⁴ L&I reported that the transportation and warehousing industry had a polymerase chain reaction (PCR)-positivity rate of 52.4 per 100,000 workers (0.05%), which is much lower than the cumulative incidence self-reported by the app-based drivers in our survey, though the L&I report only counts Department of Health confirmed cases (indicated by a positive PCR test) for which industry is known, while our survey relies on self-reported presumption of infection. On the closing date of our survey (September 7, 2020) there had been a total of 20,417 PCR-confirmed COVID-19 cases in King County, which is equivalent to nearly 1% of residents. Based on these measures, it seems likely that the rate of COVID-19 in app-based drivers in King County was elevated above the community and industry-specific rate. This finding also points to the need for increased surveillance in occupational populations and the use of more refined and standardized measures to quantify the burden of both exposure and infection in occupational populations.²⁵

It is important to understand the burden of COVID-19 infection in app-based drivers because as a working population without a traditional employer–employee relationship, this could mean that these drivers had decreased access to paid sick leave, medical benefits, and the worker's compensation system, as compared to those with traditional employer–employee relationships. The lack of these safety nets and benefits may have increased the likelihood that a driver, if they were driving at all, may have practiced “presenteeism” by going to work even when they were ill, as staying home could have come at economic cost. As app-based drivers share air with members of the public in indoor close quarters, often for sustained periods of time, the health of app-based drivers is linked to the health of the community, and reducing the burden of infectious disease in these essential workers would help to decrease community transmission, and therefore should be an important priority for public health.²⁶ However, our qualitative findings indicate that few controls were implemented by the company's drivers work for, underscoring the relative lower priority of driver health and safety among employers.

Understanding which exposure controls were available to drivers, and the barriers and facilitators to enacting more protective controls is very important to decreasing SARS-CoV-2 in this population, leading to a decreased risk of COVID-19 infection while driving, which can positively influence feelings of perceived stress and job satisfaction, as supported by our regression analyses. These qualitative findings help enable us to act on the findings from the survey, and prioritize potential interventions. Based on our modified perceived stress scale, drivers indicated they were experiencing stress, with more than half of respondents (58%) indicating they felt unable to control the important things in life “often,” and 42% of respondents reporting that they “often” felt difficulties were piling up so

high that they could not overcome them. The COVID-19 pandemic has exacerbated many stressors, including worry about one's own health and the health of family members, social isolation, financial insecurity, and resource scarcity, all which were found to be independently related to psychological distress and depressive symptoms in a survey of North Americans during the pandemic, and were increased in those with a lower income and experiencing additional stresses related to the sociocultural and socioeconomic implications of the pandemic.²⁷ Even outside of a pandemic, stress and work have a complex relationship, with work factors such as pay, job demands, and job control contributing to stress,^{17,18,28,29} but stress also influencing aspects such as job satisfaction.^{19-21,30-32} We saw a significant association between job satisfaction and PSS-4, as well as COVID-19 infection status and PSS-4. However, the cross-sectional design of our study impedes determination of the directionality of these associations. Regardless, workplaces taking steps to decrease employee stress, improve employee job satisfaction, and protect workers from infectious disease would decrease the burden of chronic disease outcomes and mental health outcomes in their employees, and decrease associated healthcare costs.^{22,23,33,34}

As this is the first work to characterize stress in app-based drivers, the COVID-19 pandemic likely influenced stress levels in all people, there is limited occupational health literature utilizing the PSS-4, and the response scale we used with the PSS-4 was modified for our population, it is challenging to compare the PSS-4 scores in the app-based drivers to other occupational cohorts, both before and during the pandemic. A study of healthcare workers in New York City undertaken during the COVID-19 pandemic found PSS-4 scores lower than the app-based drivers at baseline (5.3 ± 3.1)³⁵ and a study of migrant Filipino workers in Hong Kong administered in July 2020 had PSS-4 scores higher than the app-based drivers (10.67 ± 3.24).³⁶ Population norms for the PSS-4 have not been updated in the United States since 1983, when the overall mean PSS-4 in males was 4.2 ± 2.8 , with higher PSS-4 scores in individuals that were female, younger, lower income, non-White, and with lower educational attainment.³⁷ Updated PSS-4 norms in the UK pre-COVID reported a mean PSS-4 score of 5.56 ± 3.04 in males.³⁸ We hypothesize that the app-based drivers have PSS-4 scores above the population norms, though additional work to characterize PSS-4 scores in worker populations, both during and after COVID-19, is needed.

Uber administered a user experience survey in October 2020 to which nearly 100,000 drivers across the United States responded.³⁹ Like in our survey, there were high levels of worry around finances (65% of respondents), physical health (41%), health of family/friends due to the COVID-19 pandemic (40%), and mental health (31%). Forty percent of respondents said that Uber had only done "OK" or "Poor" in protecting the health and well-being of drivers during COVID-19. In the survey, Uber outlined some of their COVID-19-specific programs, and while 70% of respondents recognized that Uber is requiring riders to wear masks, less than half of respondents (49%) were aware that Uber was distributing cleaning supplies and PPE. All other listed COVID-19 services were fairly unknown to drivers—only 23% of respondents were aware of COVID-19 financial assistance available from Uber, and only 13% of respondents were aware of Uber-provided access to telemedicine. Ten percent of

respondents were unaware of any COVID-19 programs offered by Uber, pointing to a need for increased communication between the company and the drivers, and high levels of worry about economic and health outcomes in drivers, themes which were also apparent in our survey.

Limitations of this study must be noted. Results from this study may or may not be generalizable outside of the sampled population, as drivers were identified from their union affiliation and overwhelmingly identified as male and Black or African. App-based drivers who voluntarily align with a union may have different concerns, needs, and risk perceptions than those who do not align with a union. However, working with the union allowed us access to a worker population that would otherwise have been challenging to reach. Our survey employed a convenience sample, which allowed us to collect ample data in a relatively short amount of time and gave flexibility for the community liaisons in finding willing participants. However, this type of sampling can also induce sampling bias, decreasing the generalizability of these findings. Moreover, our mixed methods design provided context-rich information about the study setting, which may promote determinations of transferability to other communities. Subsequent work should strive to reach drivers who are not affiliated with the union and include drivers with similar duties who do not rely on apps (such as taxi drivers or chauffeurs) to not only decrease the homogeneity of the respondents and increase the external validity of the findings but also understand how the experiences, needs, and barriers of app-based drivers differ from those of other drivers. Similarly, conducting interviews with appropriate representatives of the companies that employ app-based drivers would enable us to understand their perception of supports provided by the company during this time, and barriers there may be to enacting additional supports.

In many of our measures there was a lack of variability, making it difficult to do more involved statistical analysis of these data. This could be due to the relatively homogenous nature of the survey respondents, and to three-point response scales used in this study, which inherently reduced variability compared to five- to seven-point response scales. However, the lack of variability may also be a true representation of high levels of concerns around exposures and health in this population, and the lack of employer-provided protections and supports. The survey was purposively designed to be accessible to the population of interest, and the simplified answer scales were a deliberate choice to ensure accessibility and ease of response. As drivers surveyed other drivers, trust would be increased.

This survey was developed in May 2020 and distributed in August–September 2020, and as such the survey reflects understanding of COVID-19 exposure and transmission at the time of survey development. At that time in the COVID-19 pandemic there was still an emphasis on fomite transmission and control through cleaning, so many questions were around cleaning and disinfection, and questions were not asked about things like the use of ventilation in the vehicle, which is now known to be an important COVID-19 control. However, vehicle hygiene is also important for other infectious diseases that circulate, so having access to cleaning supplies and hand sanitizer for both driver and passenger use remains an

important control for general public health, even if it represents a negligible route of transmission for COVID-19.

Our qualitative analyses are limited by a small sample size, resulting from a small sampling frame and occupational-based inclusion criteria focused on a population without workplace access to or need for offices or computers. While the themes summarized herein offer context-rich information, additional research is necessary to ensure credibility and promote transferability. Also due to the fact that most interviewees did not work in an office or on a computer, providing written summaries of interview interpretation for participant validation (i.e., member checking) was determined not to be feasible. However, two union organizers, who also participated in interviews, reviewed final analysis memos to ensure they were grounded in practical realities. Moreover, the study team cross-checked analysis memos against qualitative data to ensure confirmability of findings.

Despite these limitations, the novelty and importance of this study for public health must be emphasized. This is one of few studies that has characterized the health, safety and risk perceptions of app-based drivers—a vulnerable worker population consisting of a high population of immigrant and refugee workers. This study was done in partnership with drivers and we sought input from them at all steps of study design and survey delivery to ensure it was appropriate, applicable, and accessible. The mixed methods design we utilized added depth to the quantitative data to better understand the concerns of these workers, and identify potential areas for intervention to help better support these workers. Future work will seek to characterize changes in drivers' experiences and perceptions over time, particularly as COVID-19 restrictions wane and pandemic-specific safety nets are relaxed. The COVID-19 pandemic has highlighted how the health of workers and the community are interconnected, and the need for increased health-protective policies and controls for workers during the pandemic and beyond. Work presented here amplifies the voices and needs of workers who have been heavily impacted by the COVID-19 pandemic, yet lack access to many of the workplace protections that employees in a standard employment relationship have,^{24,40} underscoring the urgent need for increased attention to app-based drivers, and the growing app-based economy, in public health research and policy.

ACKNOWLEDGEMENTS

The authors are grateful for the support of Teamsters Local 117 and the app-based drivers who made this study possible. Funding for this study was from the University of Washington Population Health Initiative, Economic Recovery Grant.

CONFLICTS OF INTEREST

Marissa G. Baker had a consulting relationship with Mercer Total Health Management to assist Sony TV with their COVID-19 return to set. No other authors declare any conflicts of interest.

AUTHOR CONTRIBUTIONS

Author contributions are as follows: Marissa G. Baker, Ann Bostrom, and Nicole A. Errett conceived of the work, Marissa G. Baker, Ann Bostrom,

Nicole A. Errett, and Lily M. Monsey designed the study protocol and study instruments. Lily M. Monsey, Megan M. Archer, Nicole A. Errett, and Marissa G. Baker contributed to the acquisition of data. Kerry L. Beckman and Marissa G. Baker analyzed the survey data, and Lily M. Monsey, Megan M. Archer, and Nicole A. Errett analyzed the qualitative data. All authors contributed to interpretation of the data. Marissa G. Baker, Lily M. Monsey, Kerry L. Beckman, Nicole A. Errett, and Megan M. Archer all drafted the work, and all authors helped critically revise the manuscript for important intellectual content. All authors have provided final approval of this version and are in agreement to be accountable for all aspects of the work and ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

DISCLOSURE BY AJIM EDITOR OF RECORD

John Meyer declares that he has no conflict of interest in the review and publication decision regarding this article.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ETHICS APPROVAL AND INFORMED CONSENT

The University of Washington Human Subjects Division reviewed the protocol for this study and determined this project to be exempt as no identifying information was being collected by researchers.

ORCID

Kerry L. Beckman  <http://orcid.org/0000-0002-6014-2735>

Lily M. Monsey  <http://orcid.org/0000-0003-3565-7646>

Nicole A. Errett  <http://orcid.org/0000-0002-8247-8336>

Ann Bostrom  <http://orcid.org/0000-0002-6399-3404>

Marissa G. Baker  <http://orcid.org/0000-0003-3136-0490>

REFERENCES

1. Baker MG. Nonrelocatable occupations at increased risk during pandemics: United States, 2018. *Am J Public Health.* 2020;110(8):1126-1132.
2. De Stefano V. The rise of the "just-in time workforce": on demand work, crowdwork, and labor protection in the "gig economy". *Comparative Labor Law Policy J.* 2016;37(3):461-471.
3. Karpman M, Acs G. *Unemployment Insurance and Economic Impact Payments Associated with Reduced Hardship Following CARES Act.* Urban Institute; 2020. Accessed August 9, 2021. <https://www.urban.org/sites/default/files/publication/102486/unemployment-insurance-and-economic-impact-payments-associated-with-reduced-hardship-following-car-es-act.pdf>
4. The CARES Act and Its Impact on Independent Contractors and Gig Workers. Accessed June 16, 2021. <https://www.natlawreview.com/article/cares-act-and-its-impact-independent-contractors-and-gig-workers>
5. Prather KA, Marr LC, Schooley RT, McDiarmid MA, Wilson ME, Milton DK. Airborne transmission of SARS-CoV-2. *Science.* 2016;370(6514):303-304.
6. Greenhalgh T, Jimenez JL, Prather KA, Tufekci Z, Fisman D, Schooley R. Ten scientific reasons in support of airborne transmission of SARS-CoV-2. *Lancet.* 2021;397(10285):1603-1605.

7. Benner C. On Demand and on the Edge: Ride Hailing And Delivery Workers In San Francisco. Accessed June 16, 2021. https://transform.ucsc.edu/wp-content/uploads/2020/05/OnDemandOntheEdge_ExecSum.pdf
8. Berry M. How Many Uber Drivers Are There? [Internet]. 2021 [cited 2021 Jun 16]. <https://therideshareguy.com/how-many-uber-drivers-are-there/>
9. Fare Share Plan. Accessed June 16, 2021. <https://www.seattle.gov/mayor/fareshare>
10. Council Connection: Council Passes Premium Pay for Frontline Gig Workers During COVID Crisis. Accessed June 16, 2021. <https://council.seattle.gov/2020/06/15/council-passes-premium-pay-for-frontline-gig-workers-during-covid-crisis/>
11. Kerr D Lyft pulls bait-and-switch on promised coronavirus sick pay, drivers say. Accessed Aug 9, 2021. <https://www.cnet.com/tech/mobile/lyft-quietly-adjusts-its-coronavirus-sick-pay-policy-for-drivers/>
12. Text of Proposed Laws: Proposition 22. <https://vig.cdn.sos.ca.gov/2020/general/pdf/topl-prop22.pdf>
13. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. *J Health Soc Behav.* 1983;24(4):385-396.
14. Lee E-H. Review of the psychometric evidence of the perceived stress scale. *Asian Nurs Res.* 2012;6(4):121-127.
15. Spector PE. Measurement of human service staff satisfaction: development of the Job Satisfaction Survey. *Am J Community Psychol.* 1985;13(6):693-713.
16. Sparks K, Cooper C, Fried Y, Shirom A. The effects of hours of work on health: A meta-analytic review. *J Occup Organ Psychol.* 1997; 70(4):391-408.
17. Nixon AE, Mazzola JJ, Bauer J, Krueger JR, Spector PE. Can work make you sick? A meta-analysis of the relationships between job stressors and physical symptoms. *Work & Stress.* 2011;25(1):1-22.
18. Storseth F. Changes at work and employee reactions: organizational elements, job insecurity, and short-term stress as predictors for employee health and safety. *Scand J Psychol.* 2006;47(6):541-550.
19. Ma C-C, Samuels ME, Alexander JW. Factors that influence nurses' job satisfaction. *J Nurs Adm.* 2003;33(5):293-299.
20. Heaney CA, Israel BA, House JS. Chronic job insecurity among automobile workers: effects on job satisfaction and health. *Soc Sci Med.* 1994;38(10):1431-1437.
21. Hierarchy of Controls. 2020. Accessed February 10, 2021. <https://www.cdc.gov/niosh/topics/hierarchy/default.html>
22. Korstjens I, Moser A. Series: practical guidance to qualitative research. Part 4: trustworthiness and publishing. *Eur J Gen Pract.* 2018;24(1): 120-124.
23. Lew I, Chatterjee D & Torres E The gig is up: an overview of New York City's app-based gig workforce during COVID-19. 2021. Accessed August 9, 2021. https://smhttp-ssl-58547.nexcesscdn.net/nycss/images/uploads/pubs/Gig_Workers_V10.pdf
24. Wuellner S Washington COVID-19 cases by industry, January 2020-June 2020. 2021. Report No.: SHARP Technical Report 103-06-2021. Accessed August 9, 2021. https://lni.wa.gov/safety-health/safety-research/files/2021/103_06_2021_COVID_Industry_Report.pdf
25. Baker MG. Occupational health surveillance as a tool for COVID-19 prevention. *Am J Public Health.* 2021;111(6):999-1001.
26. Danon L, Read JM, House TA, Vernon MC, Keeling MJ. Social encounter networks: characterizing Great Britain. *Proc Biol Sci.* 2013; 280(1765):20131037.
27. Zheng J, Morstead T, Sin N, et al. Psychological distress in North America during COVID-19: the role of pandemic-related stressors. *Soc Sci Med.* 2021;270:113687.
28. Karasek RA. Job demands, job decision latitude, and mental strain: implications for job redesign. *Adm Sci Q.* 1979;24(2):285-308.
29. Landsbergis PA, Grzywacz JG, LaMontagne AD. Work organization, job insecurity, and occupational health disparities. *Am J Ind Med.* 2014;57(5):495-515.
30. Hoboubi N, Choobineh A, Kamari Ghanavati F, Keshavarzi S, Akbar, Hosseini A. The impact of job stress and job satisfaction on work-force productivity in an iranian petrochemical industry. *Saf Health Work.* 2017;8(1):67-71.
31. Hünefeld L, Gerstenberg S, Hüffmeier J. Job satisfaction and mental health of temporary agency workers in Europe: a systematic review and research agenda. *Work Stress.* 2020;34(1):82-110.
32. Johnsen TL, Eriksen HR, Indahl A, Tveito TH. Directive and non-directive social support in the workplace—is this social support distinction important for subjective health complaints, job satisfaction, and perception of job demands and job control? *Scand J Public Health.* 2018;46(3):358-367.
33. Hassard J, Teoh KRH, Visockaite G, Dewe P, Cox T. The cost of work-related stress to society: a systematic review. *J Occup Health Psychol.* 2018;23(1):1-17.
34. Goetzl RZ, Roemer EC, Holingue C, et al. Mental health in the workplace: a call to action proceedings from the mental health in the workplace-public health summit. *J Occup Environ Med.* 2018;60(4): 322-330.
35. Hirten RP, Danieletto M, Tomalin L, et al. Factors associated with longitudinal psychological and physiological stress in health care workers during the COVID-19 pandemic: observational study using apple watch data. *J Med Internet Res.* 2021. Preprint. <http://doi.org/10.2196/31295>
36. Li DCY, Leung L. Psychometric data on knowledge and fear of coronavirus disease 2019 and perceived stress among workers of filipino origin in Hong Kong. *Data Brief.* 2020;33:106395.
37. Cohen S. Perceived stress in a probability sample of the United States. In: Spacapan S, Oskamp S, eds. *The Social Psychology of Health.* Vol 251. Sage Publications, Inc.; 1988:31-67.
38. Warrtig SL, Forshaw MJ, South J, White AK. New normative, English-sample data for the Short Form Perceived Stress Scale (PSS-4). *J Health Psychol.* 2013;18(12):1617-1628.
39. Uber User Experience Survey Results. Accessed August 9, 2021. <https://uber.app.box.com/s/ilxsiqy0bkfhgum8o15n6k6bqi2rqn9c>
40. Peckham T, Fujishiro K, Hajat A, Flaherty BP, Seixas N. Evaluating employment quality as a determinant of health in a changing labor market. *RSF* 2019;5(4):258-281.

SUPPORTING INFORMATION

Additional Supporting Information may be found online in the supporting information tab for this article.

How to cite this article: Beckman KL, Monsey LM, Archer MM, Errett NA, Bostrom A, Baker MG.. Health and safety risk perceptions and needs of app-based drivers during COVID-19. *Am J Ind Med.* 2021;64:941-951. <https://doi.org/10.1002/ajim.23295>