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ARTICLE

Uncertainty Stress and Its Correlates among Platform Delivery Riders in China

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ABSTRACT: Background: As social development accelerates and workforce competition intensifies, uncertainty is increasingly recognized as a core component of contemporary stress, particularly in the rapidly expanding platform (gig) economy. Platform delivery riders operate under algorithmic control, unstable income, and opaque evaluation systems, yet the magnitude and correlates of their uncertainty stress remain under-investigated. This study aimed to quantify the level of uncertainty stress among platform delivery riders and to identify work- and lifestyle-related factors associated with it. **Methods:** A cross-sectional correlational design was used. Between August and December 2022, platform delivery riders in Shenzhen and Guangzhou (two megacities in southern China) were recruited via street-intercept and snowball sampling. Of 1976 riders who consented, 1949 completed the online self-administered questionnaire, and 1879 valid responses were retained for analysis. Uncertainty stress (assessed with the 4-item Uncertainty Stress Scale), work conflict, work pace, job insecurity, sociodemographic characteristics, structural job characteristics, and lifestyle behaviors were measured. Data were analyzed using independent-samples t-tests, one-way ANOVA, Pearson correlations, and hierarchical multiple linear regression. **Results:** Uncertainty stress was elevated overall (total summed score: Mean = 11.88, SD = 4.34; mean item score = 2.97), and 40.2% of riders reported severe uncertainty stress (defined as a total score > 12). In the fully adjusted multivariate model, higher uncertainty stress was independently associated with being divorced or widowed ($\beta = 0.053$, $p = 0.015$), higher work conflict ($\beta = 0.290$, $p < 0.001$), faster work pace ($\beta = 0.078$, $p < 0.001$), and higher job insecurity ($\beta = 0.153$, $p < 0.001$); conversely, higher monthly income ($\beta = -0.107$, $p < 0.001$), longer working years ($\beta = -0.048$, $p = 0.037$), and regular exercise ($\beta = -0.107$, $p < 0.001$) were associated with lower uncertainty stress. **Conclusion:** Platform delivery riders bear a disproportionately high burden of uncertainty stress. Psychosocial job demands—particularly customer-driven work conflict—were the most potent correlates, while regular exercise appeared protective. Given the continued growth of platform delivery, longitudinal and intervention studies are needed to develop and evaluate programs that address uncertainty stress in this workforce.

KEYWORDS: Uncertainty stress; platform delivery riders; work conflict; work pace; job insecurity; lifestyle

1 Introduction

The rapid expansion of the gig economy has fundamentally transformed the global labor landscape. Since the outbreak of the COVID-19 pandemic in 2020, reliance on platform-mediated food delivery services

has surged, intensifying both the workload and the visibility of platform delivery riders [1]. The pandemic, together with subsequent macroeconomic pressures such as economic slowdowns, has spotlighted the precarious nature of gig economy work. Unlike traditional employment with fixed schedules and stable incomes, platform delivery riders operate in a hyper-flexible environment characterized by algorithmic control and systemic instability [2–4]. Although early studies focused on physical risks and immediate workload surges during the pandemic [3,5], a critical theoretical gap remains regarding the psychological toll of this precariousness—specifically, how the inherent unpredictability of platform work translates into psychological distress for these workers.

Existing research on platform delivery riders has focused predominantly on quantitative job demands, including time pressure, physical exhaustion, and traffic safety [6–8]. Strict delivery deadlines and penalty mechanisms for delays are well-documented sources of job intensification [7]. However, focusing on workload alone fails to capture a defining stressor of the gig economy: uncertainty. As the gig economy matures, riders' stress increasingly hinges not on how much work they have, but on whether and when work will arrive and on how their performance will be evaluated by opaque algorithms. Uncertainty stress—distinct from general job stress—may therefore be the central psychological mechanism linking gig-work characteristics to adverse health outcomes [9,10].

Theoretically, uncertainty stress refers to perceived stress arising from situations in which an individual lacks the information needed to predict outcomes or plan future actions [11,12]. Rapid socioeconomic transformation, intensified work competition, value confusion, and a sense of societal dysfunction have been identified as major sources of uncertainty stress [13,14]. Empirical studies have linked uncertainty stress to a range of adverse health outcomes, including negative affect, problem drinking, suicidal ideation, poor sleep quality, and lower self-rated health [15–18]. Identifying the risk and protective factors of uncertainty stress among platform delivery riders is therefore both clinically and practically important.

In the gig economy, uncertainty stress is rooted in what recent scholars have termed "algorithmic insecurity" [4]. Compared with traditional workers, platform delivery riders contend with heightened job-related uncertainty across multiple domains [2]: the absence of a fixed workplace, the capricious nature of customer demands and feedback, opaque job-assignment algorithms, fluctuating order volumes and income, underdeveloped social security protections, and unclear long-term career prospects. According to the Job Demands-Resources (JD-R) model and Social Safety Theory [19,20], chronic uncertainty of this kind depletes psychological resources by sustaining vigilance and threat monitoring, ultimately producing exhaustion [16,18]. Despite its theoretical relevance, few empirical studies have systematically examined the antecedents of uncertainty stress in this workforce.

To address these gaps, this study draws on the JD-R model to examine three critical but under-researched sources of uncertainty in platform delivery work: structural job characteristics, psychosocial job demands, and personal resources [19]. First, objective working conditions (e.g., platform type, working hours, insurance status, employment type, tenure) define the precarious nature of the work environment and may act as structural antecedents that predispose riders to uncertainty stress. Second, work conflict, work pace, and job insecurity represent the proximal psychosocial demands experienced by riders daily: work pace reflects task-level algorithmic time pressure [21], work conflict captures interpersonal-level tension with customers and merchants [22], and job insecurity reflects career-level concerns about income volatility and employment instability [23]. Interpersonal conflict has long been recognized as a major source of job stress [24], but it takes on particular potency in the gig economy: in rating-based systems, a single negative interaction (e.g., a late delivery, a complaint, or customer incivility) can trigger algorithm-driven penalties or account deactivation, directly amplifying uncertainty about income and career continuity [25]. Third,

beyond these work-related factors, Stress Coping Theory holds that healthy lifestyle behaviors function as personal resources for managing stress [26]. Unhealthy lifestyles (e.g., substance use, sedentary behavior) may therefore exacerbate vulnerability to uncertainty stress [27], yet how lifestyle interacts with gig-work stressors remains rarely explored.

Based on this framework, three hypotheses were proposed. Hypothesis 1: Riders exposed to more precarious structural working conditions (e.g., longer daily working hours, lack of social insurance, part-time status) report higher levels of uncertainty stress. Hypothesis 2: Higher psychosocial job demands (work conflict, work pace, and job insecurity) are the primary correlates of uncertainty stress. Hypothesis 3: Unhealthy lifestyles (e.g., smoking, drinking) are associated with higher uncertainty stress, whereas positive behaviors (e.g., regular physical exercise) are protective. Theoretically, this study extends the application of uncertainty stress theory to the digital platform economy. Empirically, it quantifies the level of uncertainty stress in this workforce and identifies its key correlates, providing an evidence base for targeted policies and interventions to improve rider well-being.

2 Methods

2.1 Study Design

A cross-sectional correlational design was utilized in this study. The survey was designed and administered using the Wenjuanxing Platform (https://www.wjx.cn/app/survey.aspx) and was conducted between August and December 2022 in Shenzhen and Guangzhou, two major metropolitan cities in southern China. Shenzhen is a special economic zone with a population of 17.66 million and a GDP of ¥3.24 trillion, while Guangzhou is the capital city of Guangdong province with a population of 18.73 million and a GDP of ¥2.88 trillion.

2.2 Sampling and Recruitment Process

A combined street-intercept (convenience) and snowball sampling strategy was used. To assist with data collection, ten research assistants were selected from psychology students and received a half-day survey training. They conducted street-intercept recruitment in five main urban districts of Shenzhen and Guangzhou, targeting public locations where platform delivery riders aggregate (e.g., commercial centers, residential complexes, restaurant clusters, and rider waiting points outside merchants). Data were collected at varied time slots throughout the day and across weekdays and weekends to capture temporal variation in rider availability. At each site, research assistants approached riders during non-peak waiting periods, briefly explained the study purpose and content, and showed the rider a printed card displaying the survey QR code. Riders who agreed to participate scanned the QR code with their smartphones and completed the questionnaire on-site (approximately 15 min); upon completion, they received a small gift (worth approximately 15 RMB—riders could choose two items from a raincoat, a smartphone waterproof case, and a sports towel) or an equivalent monetary compensation of 15 RMB delivered via WeChat transfer. To extend reach to riders who were difficult to access on-site, snowball sampling was additionally used. Participating riders were invited to forward the survey QR code to their colleagues and riders' work WeChat groups. Riders who shared the QR code via WeChat and completed the questionnaire online received the equivalent monetary compensation through WeChat transfer. The first page of the online questionnaire presented the research objectives, the voluntary nature of participation, confidentiality and anonymity assurances, and the principal investigator's contact information. Participants were required to actively check an "I agree to participate" option before being permitted to proceed to the survey items. This study received ethical

approval from the Ethics Committee of Shenzhen University (Approval No. 202200044). All the participants provided informed consent. All procedures were performed in accordance with relevant guidelines.

To ensure data quality and guard against fraudulent responses, multi-layered quality control measures were implemented. At the platform level, the Wenjuanxing system enforced mandatory responses on every item, built-in range checks on numerical inputs, and IP address tracking to detect and block duplicate submissions from the same device or network. Three attention/lie-detection items (e.g., "Please select 'strongly disagree' for this item") were embedded throughout the questionnaire, together with cross-item logical consistency checks. For identity screening, on-site research assistants approached only individuals who could be reliably identified as active platform delivery riders based on contextual cues (e.g., presence at rider waiting points, branded delivery equipment), and confirmed rider status through a screening question before sharing the QR code. For online snowball-recruited respondents specifically, an additional manual verification step was implemented before disbursing the monetary compensation: the research team manually reviewed each submitted response and verified the participant's identity as an active platform delivery rider by requesting a screenshot of their most recent delivery record from the platform app (with customer and order details redacted to protect privacy). Monetary compensation was disbursed only to respondents who passed both the identity verification and the response-quality screening.

2.3 Participants

A total of 1976 participants consented to participate in the survey, and 1949 of them completed the survey (959 in Shenzhen and 990 in Guangzhou, completion rate among consenters = 98.6%). Given that on-site riders who declined participation due to time constraints could not be reliably tracked, a precise response rate based on initial contacts could not be computed. It was applied the following predefined criteria to identify and exclude invalid responses: (a) completion time below 250 s (the lower 5th percentile), considered unrealistically short for thorough reading; (b) straight-line or patterned responding (e.g., selecting the same option for all items in a scale); (c) failed embedded attention/lie-detection items; and (d) cross-item logical inconsistencies. After data cleaning, 1879 valid questionnaires were retained for analysis (valid retention rate = 96.4%). Participants' platform affiliations were assessed by a multi-select question covering 22 platforms; some riders worked across multiple platforms simultaneously. The sample was predominantly composed of food-delivery riders—73.0% were affiliated with Meituan and 31.2% with Ele.me (multiple selections allowed)—with the remainder coming from fresh-grocery and on-demand errand platforms, including Hema (4.5%), Dingdong Maicai (3.8%), Shansong (3.8%), Pupu Maicai (3.2%), JD Daojia (2.7%), and Paotui errand services (2.2%), among others. Conventional parcel-courier workers were not included, as their employment structure, dispatch logic, and labor-relations status differ fundamentally from platform-mediated on-demand delivery.

2.4 Measures

2.4.1 Dependent Variable (Uncertainty Stress)

Uncertainty stress was measured by the 4-item Uncertainty Stress Scale (USS), initially developed by Yang [13]. This scale has demonstrated robust reliability and validity in diverse populations, including college students, community residents, and healthcare professionals [14,28,29]. The USS comprises four items gauging different facets of uncertainty, encompassing current life uncertainty, goal uncertainty, social values uncertainty, and uncertainty about social change. Sample items included statements like "life is impalpable, and fate is unpredictable" and "social values seem chaotic, leading to a sense of confusion". Participants rated each item on a 5-point Likert-type scale, ranging from 1 (very little stress) to 5 (extremely

stressful). To derive a comprehensive score, item responses were summed, yielding a total scale score ranging from 4 to 20, with higher scores indicating a higher level of uncertainty stress. Following prior practice, a mean item score above 3 (corresponding to a total score > 12) signified severe stress [14,17,30]. In this sample, the Cronbach's α coefficient for the USS-4 was 0.92.

2.4.2 Independent Variables

Demographic Characteristics

Age, gender, residence, educational attainment, and marital status were assessed.

Personal Lifestyle

Participants were asked whether they currently smoke (Yes/No), drink alcohol (Yes/No), and engage in regular physical exercise (Yes/No). The "regular exercise" item referred to leisure-time exercise only (e.g., jogging, ball sports, fitness training). Riders were explicitly instructed that work-related physical activity should not be considered as regular physical exercise, considering such movements are obligatory and work-imposed rather than undertaken for fitness.

Structural Job Characteristics

Work platform, employment type, social insurance, monthly delivery income, working years, and daily working hours were assessed.

Psychosocial Job Demands

Work conflict was measured using an adapted version of the Incivility from Customers Scale proposed by Wilson and Holmvall [31]. The original scale consists of 10 items. During the pilot stage of this study, preliminary interviews with 15 platform delivery riders indicated that two items did not correspond to any work scenario they had encountered. Based on this rider feedback and the research team's professional judgment, two items were removed: "Grumbled to you that there were too few employees working" (because riders work independently rather than within a co-located service team) and "Made inappropriate gestures to get your attention (e.g., snapping fingers)" (because customer–rider interactions occur primarily through app-mediated communication and brief doorstep handoffs rather than extended in-person service settings). The final adapted scale consisted of 8 items. Sample retained items from this scale included instances where customers "continued to complain despite your efforts to assist them", "complained to you about the value of goods and services", and "grumbled to you about slow service during busy times". Participants provided their responses on a 7-point scale with labels of: never, once or twice, monthly, weekly, daily, 2–3 times per day, and more than 3 times per day. Item responses were summed to create a total work conflict score (range 8–56), with higher scores indicating higher levels of work conflict from customers. Higher scores on this scale were indicative of higher levels of work conflict, and the scale exhibited strong internal consistency, as indicated by a Cronbach's alpha coefficient of 0.97.

Work pace was measured by the three-item sub-scale of the Copenhagen psychosocial questionnaire [32]. The items included "do you have to work very fast", "do you work at a high pace throughout the day", and "is it necessary to keep working at a high pace". Participants expressed their agreement with these statements on a 5-point scale, ranging from "strongly disagree" to "strongly agree". Elevated scores on this scale indicated a fast work pace, and it demonstrated acceptable internal consistency, with a Cronbach's alpha coefficient of 0.73. Item responses were summed to create a total work pace score (range 3–15).

Job insecurity was assessed by the three-item subscale of the Copenhagen psychosocial questionnaire [32]. The items probed participants' concerns regarding unemployment, technological obsolescence, and the difficulty of finding another job if they became unemployed. Responses were recorded on a 5-point scale, extending from "strongly disagree" to "strongly agree". Higher scores on this scale denoted higher levels of job insecurity, and it displayed a satisfactory level of internal consistency, with a Cronbach's alpha coefficient of 0.91. Item responses were summed to create a total job insecurity score (range 3–15).

2.5 Data Analysis

Independent-samples *t*-tests and one-way analysis of variance (ANOVA) were used to examine variations in uncertainty stress across basic demographic groups, personal lifestyles, and job-related characteristics. Pearson correlation analyses were conducted to explore bivariate associations between uncertainty stress and the continuous psychosocial job-demand variables (work conflict, work pace, job insecurity). Subsequently, hierarchical multiple linear regression was then employed to identify independent predictors of uncertainty stress.

The model-building followed a three-stage variable selection process. First, guided by the Job Demands-Resources (JD-R) framework, three substantive predictor blocks were theoretically specified. Second, within each theoretical block, only variables that showed a statistically significant association with uncertainty stress in univariate analyses (*t*-tests/ANOVA) or bivariate correlations were retained for entry into the multivariate model to ensure model parsimony. Third, demographic variables (e.g., marital status) that reached univariate significance were additionally entered as covariates to adjust for potential confounding. Accordingly, the retained variables were entered in four hierarchical blocks: Model 1 (base model) included the demographic covariate (the marital status dummy variables); Model 2 added structural job characteristics (monthly delivery income and working years); Model 3 added the personal lifestyle block (smoking and regular exercise); Model 4 (full model) further added the psychosocial job-demands block (work conflict, work pace, and job insecurity). Marital status was dummy-coded with "unmarried" as the reference category (Married_d:1 = Married, 0 = otherwise; Divorced/widowed_d:1 = Divorced or widowed, 0 = otherwise). Monthly delivery income and working years were entered as ordinal variables coded in ascending order; this specification assumes an approximately linear trend in uncertainty stress across ordered categories. Smoking and regular exercise were entered as dichotomous variables (0 = No, 1 = Yes).

The standardized coefficients (β) were used to assess the relative strength of these predictors. Regression assumptions were evaluated for the full model: normality of residuals was assessed via histogram and normal P-P plot inspection; homoscedasticity was evaluated by plotting standardized residuals against standardized predicted values; and multicollinearity was examined using Variance Inflation Factor (VIF) values. No serious violations were detected. All analyses were conducted in SPSS Statistics 26.0 (IBM Corp., Armonk, NY, USA).

3 Results

In the present sample, 90.8% of the participants were male riders, and 68.0% were unmarried. The mean age was 27.5 years (SD = 6.4), with an age range spanning from 18 to 56 years. The majority of the participants hailed from rural areas (77.5%) and had an educational attainment of high school or below (69.0%). The mean total score for uncertainty stress was 11.88 (SD = 4.34; mean item score = 2.97, SD = 1.09). Notably, 40.2% of platform delivery riders in our sample had severe uncertainty stress (defined as total score > 12).

Table 1 presents uncertainty stress scores disaggregated by demographic, job-related, and lifestyle characteristics. Marital status, monthly delivery income, working years, smoking, and regular exercise were found to be associated with uncertainty stress.

Table 1: Total uncertainty stress scores by demographic, structural job, and lifestyle characteristics among platform delivery riders (N = 1879).

Participant Characteristics	Frequency (%) (All Participants, N = 1879)	Uncertainty Stress Score			
		Mean	SD	*t*/*F*	*p*
Total	**1879**	**11.88**	**4.34**		
Demographics					
Age (years)					
<19	165 (8.8)	11.99	4.78		
20–24	556 (29.6)	12.00	4.23		
25–29	521 (27.7)	12.02	4.19	$F = 1.489$	0.203
30–34	374 (19.9)	11.39	4.36		
>35	263 (14.0)	12.00	4.57		
Gender					
Male	1707 (90.8)	11.94	4.32	$t = 1.658$	0.099
Female	172 (9.2)	11.33	4.61		
Registered permanent residence					
Rural	1457 (77.5)	11.84	4.42	$t = -0.864$	0.388
Urban	422 (22.5)	12.04	4.10		
Educational attainment					
Junior high school and below	538 (28.6)	12.00	4.68		
High school	758 (40.3)	11.94	4.17	$F = 0.523$	0.666
Junior college and university	547 (29.1)	11.70	4.20		
Postgraduate and above	36 (1.9)	11.72	4.97		
Marital status					
Unmarried	1277 (68.0)	11.80	4.27		
Married	525 (27.9)	11.88	4.47	$F = 4.418$	0.012*
Divorced and widowed	77 (4.1)	13.31	4.62		
Monthly delivery income (yuan)					
<3999	274 (14.6)	12.24	4.37		
4000–7999	835 (44.4)	12.21	4.27	$F = 13.570$	<0.001***
8000–11,999	622 (33.1)	11.78	4.15		
>12,000	148 (7.9)	9.83	4.99		
Structural/Objective job characteristics					
Work platform					
Platform-affiliated rider	550 (29.3)	11.83	4.52		
Third agency-affiliated rider	1035 (55.1)	11.89	4.24	$F = 0.091$	0.913
Self-employed rider	294 (15.6)	11.97	4.42		
Employment type					
Part-time	420 (22.4)	12.21	4.49	$t = 1.720$	0.086
Full-time	1459 (77.6)	11.79	4.30		
Social insurance					
Paid	1384 (73.7)	11.81	4.36	$t = -1.153$	0.249
Unpaid	495 (26.3)	12.08	4.31		

Table 1: *Cont.*

Participant Characteristics	Frequency (%) (All Participants, N = 1879)	Uncertainty Stress Score			
		Mean	SD	*t*/*F*	*p*
Total	**1879**	**11.88**	**4.34**		
Working years					
<1	1015 (54.0)	12.02	4.32		
1–2	357 (19.0)	12.10	4.12		
2–3	226 (12.0)	11.92	4.41	F = 2.807	0.024*
3–4	126 (6.7)	10.79	4.55		
>4	155 (8.2)	11.49	4.67		
Daily working hours					
<4	139 (7.4)	11.84	4.58		
4–8	176 (9.4)	12.03	4.06	F = 0.233	0.873
8–12	1226 (65.2)	11.91	4.19		
>12	338 (18.0)	11.73	4.95		
Personal lifestyle					
Smoking					
Yes	1231 (65.5)	12.04	4.45	t = 2.207	0.027*
No	648 (34.5)	11.58	4.12		
Drinking					
Yes	884 (47.0)	11.92	4.37	t = 0.330	0.742
No	995 (53.0)	11.85	4.33		
Regular exercise					
Yes	690 (36.7)	11.27	4.62	t = −4.655	<0.001***
No	1189 (63.3)	12.24	4.14		

Note: Values represent total summed scores on the 4-item Uncertainty Stress Scale (USS-4; possible range 4–20; Cronbach's α = 0.92 in this sample). Group differences in uncertainty stress were tested using independent-samples t-tests for two-group variables and one-way ANOVA for variables with three or more groups; t or F values and p-values are reported. *p < 0.05, ***p < 0.001.

Table 2 illustrates that work conflict, work pace, and job insecurity were all correlated with uncertainty stress.

Table 2: Pearson correlations among psychosocial job-demand variables and uncertainty stress (N = 1879).

Variables	Mean ± SD	Uncertainty Stress	Work Conflict	Work Pace	Job Insecurity
Uncertainty stress	11.88 ± 4.34	1.00			
Work conflict	20.51 ± 11.47	0.304**	1.00		
Work pace	11.45 ± 2.43	0.133**	0.150**	1.00	
Job insecurity	8.18 ± 3.71	0.162**	−0.030	0.102**	1.00

Note: Values are Pearson correlation coefficients. **p < 0.01.

Results from hierarchical multiple linear regression analysis are presented in Table 3. In Model 1, marital status alone accounted for 0.5% of the variance in uncertainty stress (R^2 = 0.005, p = 0.012). Adding structural job characteristics in Model 2 significantly increased the explained variance (R^2 = 0.020, ΔR^2 = 0.016, F-change = 14.996, p < 0.001). The lifestyle block in Model 3 further contributed (R^2 = 0.036, ΔR^2 = 0.016, F-change = 15.204, p < 0.001). The addition of the psychosocial job-demands block in Model 4 yielded the largest increment, substantially raising the explained variance to 15.5% (R^2 = 0.155, ΔR^2 = 0.119, F-change = 87.485, p < 0.001), confirming that work conflict, work pace, and job insecurity were the most substantial contributors. In the full model, work conflict (β = 0.290), job insecurity (β = 0.153), regular exercise (β = −0.107), and monthly delivery income (β = −0.107) were the strongest independent

correlates. Among the marital status dummies, only the "Divorced/widowed vs. Unmarried" contrast remained significant (β = 0.053, p = 0.015), while the "Married vs. Unmarried" contrast was non-significant (β = 0.030, p = 0.187). All VIF values in Model 4 ranged from 1.021 to 1.196, confirming the absence of multicollinearity.

Table 3: Hierarchical multiple linear regression models predicting uncertainty stress (N = 1879).

Variables	Model 1 (Demographic Model)		Model 2 (Structural Job Characteristic Model)		Model 3 (Lifestyle Model)		Model 4 (Psychosocial Job-Demand Model)		
	Standardized β	p	Standardized β	p	Standardized β	p	Standardized β	p	VIF
Married (vs. Unmarried)	0.009	0.709	0.036	0.132	0.028	0.238	0.030	0.187	1.130
Divorced/widowed (vs. Unmarried)	0.069	0.003**	0.080	0.001**	0.077	0.001**	0.053	0.015*	1.044
Monthly delivery income	/	/	−0.112	<0.001***	−0.120	<0.001***	−0.107	<0.001***	1.164
Working years	/	/	−0.036	0.143	−0.040	0.111	−0.048	0.037*	1.196
Smoking	/	/	/	/	0.053	0.019*	0.026	0.222	1.021
Regular exercise	/	/	/	/	−0.112	<0.001***	−0.107	<0.001***	1.021
Work conflict	/	/	/	/	/	/	0.290	<0.001***	1.039
Work pace	/	/	/	/	/	/	0.078	<0.001***	1.101
Job insecurity	/	/	/	/	/	/	0.153	<0.001***	1.036
R^2	0.005		0.020		0.036		0.155		
ΔR^2	0.005		0.016		0.016		0.119		
F-change	4.418*		14.996***		15.204***		87.485***		

Note: Values are standardized β coefficients with corresponding p-values. Reference category for marital status dummy variables is "Unmarried". Coding: Smoking (0 = No, 1 = Yes); Regular exercise (0 = No, 1 = Yes); Monthly delivery income and Working years entered as ordinal variables in ascending order (this specification assumes an approximately linear trend across ordered categories). Model 1 (base model) includes the marital status dummy variables. Model 2 adds structural job characteristics: monthly delivery income and working years. Model 3 adds the personal lifestyle block: smoking and regular exercise. Model 4 (full model) further adds psychosocial job demands: work conflict, work pace, and job insecurity. VIF, Variance Inflation Factor; *p < 0.05, **p < 0.01, ***p < 0.001.

4 Discussion

Before discussing the findings, we note that the cross-sectional design precludes causal inferences; all associations reported below should be interpreted accordingly. To our knowledge, this is the first study to characterize uncertainty stress among platform delivery riders. As a distinct occupational group within the rapidly expanding gig economy, riders face elevated uncertainty compared with workers in more traditional roles. In this large sample drawn from Guangzhou and Shenzhen, the average level of uncertainty stress was elevated; higher levels were associated with greater work conflict, faster work pace, and higher job insecurity, whereas regular exercise, higher monthly income, and longer working years were associated with lower uncertainty stress.

The mean item score for uncertainty stress was 2.97 (SD = 1.09), substantially higher than scores previously reported among Chinese community residents in 2002 (2.04 ± 0.85) and 2020 (2.73 ± 0.97) and among college students in 2013 (2.33 ± 0.92) and 2016 (2.74 ± 0.74) [14,18,30,31]. The prevalence of severe uncertainty stress in our sample (40.2%) also markedly exceeded that observed among college students (19.6%) and community residents (34.4%) [17,18]. Together, these comparisons indicate that platform delivery riders in Guangzhou and Shenzhen bear a disproportionately heavy burden of uncertainty stress, underscoring the urgency of addressing this issue within the gig-economy workforce.

4.1 Demographics and Uncertainty Stress

Divorced or widowed riders reported higher levels of uncertainty stress than married or unmarried riders. The loss of a long-term partner typically removes a primary source of emotional, financial, and social support [33], and the resulting loneliness and insecurity may contribute to heightened uncertainty stress.

Lower monthly delivery income was associated with higher uncertainty stress, consistent with prior findings linking lower family income to severe uncertainty stress in college students [34]. Higher income may buffer against uncertainty by enhancing economic security and access to social resources, whereas lower-income workers are more exposed to market fluctuations and employment instability [35], both of which can amplify perceived uncertainty and stress.

Working years was negatively associated with uncertainty stress in the full model, suggesting that experience may buffer against perceived uncertainty. As riders accumulate experience, they develop familiarity with platform algorithms, delivery routes, and customer interactions, which can reduce perceived unpredictability [36]. The non-significant descriptive fluctuation at >4 years warrants further longitudinal investigation, since prolonged exposure to precarious work may eventually erode this protective effect [37]. Overall, Hypothesis 1 was only partially supported: among structural job characteristics, only lower monthly income and shorter working years were significantly associated with higher uncertainty stress, whereas platform type, employment type, social insurance, and daily working hours were not.

4.2 Lifestyle and Uncertainty Stress

Smoking and regular exercise were both associated with uncertainty stress in univariate analyses, but only regular exercise remained significant in multivariate models—riders who exercised regularly reported lower uncertainty stress. This finding aligns with prior evidence that physical activity buffers stress [38,39] through both physiological mechanisms (e.g., reduced cortisol reactivity [40]) and psychological mechanisms (e.g., enhanced self-efficacy and perceived control [41]), which are particularly relevant to coping with unpredictable work environments. Exercise has also been shown to reduce anxiety sensitivity [42,43], a construct closely linked to intolerance of uncertainty [44,45]. Hypothesis 3 was therefore partially supported: regular exercise was independently protective, whereas smoking and alcohol use were not independently associated with uncertainty stress in the multivariate model.

4.3 Psychosocial Job Demands and Uncertainty Stress

Work conflict, fast work pace, and job insecurity were each independently associated with uncertainty stress. Job insecurity is widely conceptualized as a subjectively experienced stressor [46], and platform delivery riders—often working under temporary or contract-based arrangements [2]—face acute insecurity about job continuity, valued job features, and career prospects, which lies at the core of uncertainty perceptions. A fast work pace likely compounds these effects, as constant time pressure and worry about meeting delivery deadlines fuel anxiety and a sense of loss of control.

Work conflict emerged as the strongest psychosocial correlate of uncertainty stress. Customer incivility—through negative feedback, verbal aggression, or unfair complaints—can trigger immediate algorithmic penalties and damage to platform ratings, threatening riders' social-evaluative standing and economic stability in unpredictable ways [47]. By contrast, a fast work pace, although demanding, may become routinized over time as riders develop time-management strategies. The unpredictable and interpersonal nature of work conflict likely poses a greater challenge to one's sense of control, a core element of uncertainty stress [48].

The structure of platform work itself may amplify these stressors. Opaque algorithmic management—dynamic order assignment, punitive systems for delays or low ratings—creates an environment of low controllability and high unpredictability [47]. Capricious customer demands compounded by inflexible platform rules may trap riders in a cycle of uncertainty, where performance and livelihood depend on factors beyond their control. Taken together, Hypothesis 2 was fully supported: work conflict, work pace, and job insecurity were all independently and positively associated with uncertainty stress, with work conflict emerging as the strongest correlate.

4.4 Policy Implications and Practice Recommendations

Several potential implications for mitigating uncertainty stress among platform delivery riders are discussed below. Because the present study used a cross-sectional correlational design, the associations identified above do not support causal inference. The suggestions that follow should therefore be interpreted as hypothesis-generating directions rather than evidence-based policy prescriptions, and they warrant rigorous testing in longitudinal or intervention research before adoption. First, at the policy and regulatory level, our finding that lower income and higher job insecurity were each associated with greater uncertainty stress points to possible directions for strengthening labor protections for gig workers, such as establishing frameworks for minimum earnings guarantees and mandating access to social insurance schemes (e.g., for injury or unemployment) to reduce financial precarity [49]. Clarifying riders' employment status may be a critical step in this direction.

Secondly, at the platform and organizational level, our finding that work conflict was the strongest correlate of uncertainty stress points to a potential role for platforms to reform their management systems to enhance transparency and fairness. This may include creating transparent and appealing rating systems to protect riders from unfair customer feedback, and designing algorithms that incorporate realistic delivery timelines and adequate rest periods [50]. Platforms could also consider instituting training programs for customers to promote respectful interactions and provide riders with de-escalation training for handling conflicts.

Thirdly, given the observed protective association between regular exercise and lower uncertainty stress, it may be beneficial for platforms and rider associations to actively promote physical well-being. This could involve subsidized gym memberships, organized sports events, or digital health challenges. Furthermore, mental well-being programs, such as stress management workshops and access to confidential counseling services, tailored to the flexible schedules of gig workers, may also warrant consideration.

4.5 Limitations

Several limitations should be noted. First, this study was a cross-sectional survey, which inherently precludes the establishment of causal relationships. All reported associations should be interpreted as correlational, and the directionality of relationships cannot be determined from the present data. In the future study, a longitudinal study for exploring how work conflict, work pace, and job insecurity are associated with sustained uncertainty stress over time should be conducted. Second, it is important to acknowledge the potential presence of selection bias. The street-intercept and snowball sampling strategy may overrepresent riders active in high-traffic urban locations and those with stronger social-network connections (e.g., active in rider WeChat groups), while underrepresenting riders in suburban or peri-urban areas or those less digitally connected. Additionally, riders who declined participation due to time pressures during peak delivery hours may systematically differ in workload and stress levels from those who participated. However, our sampling strategy covered diverse locations across five major urban districts in each city, including

streets and communities in commercial, residential, and mixed-use areas where delivery riders are typically active. Data were collected at various time slots throughout the day to account for temporal variations. While conducting research on delivery riders presents significant logistical challenges, the total sample size of this study is substantial compared to prior research in this field. We believe these efforts enhance the representativeness of our findings, despite potential limitations in sampling bias. Third, it is important to acknowledge that our study sample was drawn exclusively from two megacities. Consequently, the findings regarding uncertainty stress may not be fully generalizable to platform delivery riders operating in smaller cities, rural areas, or other geographical regions, where distinct socioeconomic contexts and working conditions could lead to different experiences of uncertainty stress. Therefore, caution should be exercised when attempting to generalize the study's conclusions. Fourth, regular physical exercise was assessed using a single dichotomous item. Future studies should employ validated instruments such as the International Physical Activity Questionnaire (IPAQ) to obtain more granular estimates of physical activity. Fifth, data collection coincided with a period of intermittent COVID-19 control measures in southern China; pandemic-driven reliance on platform delivery substantially elevated demand for riders during this period, while occasional local restrictions affected on-site recruitment in some districts and time slots. Elevated workload during outbreak waves, sporadic mobility restrictions, and broader macroeconomic volatility likely contributed to the elevated uncertainty stress levels reported here, limiting direct comparison with non-pandemic periods. Caution is therefore warranted when generalizing the present findings to non-pandemic contexts.

5 Conclusions

Platform delivery riders in Guangzhou and Shenzhen reported experiencing a higher level of perceived uncertainty stress, with 40.2% exceeding the severe threshold. Psychosocial job demands—particularly work conflict—emerged as the strongest correlates, followed by job insecurity and fast work pace, underscoring the central role of interpersonal tensions in this workforce. Among personal resources, regular exercise was independently associated with lower uncertainty stress, suggesting its potential as a modifiable protective factor. Demographic and structural vulnerabilities were also observed: divorced or widowed riders and those with lower delivery income reported higher uncertainty stress, while longer working years were associated with lower levels. Special attention should be paid to these specific subpopulations.

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