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RESEARCH ARTICLE

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Precarious work, job stress, and health-related quality of life

Anasua Bhattacharya PhD | Tapas Ray PhD

Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Cincinnati, Ohio, USA

Correspondence
Anasua Bhattacharya, National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, 1150 Tusculum Ave, MS C-15, Cincinnati, OH 45226, USA.
Email: ABhattacharya1@cdc.gov

Abstract

Objectives: Recent technological and work organization changes have resulted in an increased prevalence of nonstandard work arrangement types. One of the consequences has been an increased prevalence of precarious work. Our objective was to generate a scale to measure work precariousness in the United States and examine the associations between this study precariousness scale with job stress, unhealthy days, and days with activity limitations among US workers from 2002 to 2014, to determine if precarious work adversely affects worker health.

Methods: Our scale was inspired by the Employment Precariousness Scale that measures work precariousness reported by salaried workers and developed for the US workforce. We used pooled cross-sectional data from 22 representative items from the General Social Survey, Quality of Work Life survey for the years 2002, 2006, 2010, and 2014. These data included 4534 observations for analysis. We used regression models to examine associations between work precariousness and job stress, unhealthy days, and days with activity limitations.

Results: Statistically significant positive association existed between job stress and work precariousness. Workers reporting work precariousness were more likely to experience more days in poor physical and mental health and more days with activity limitations due to health problems.

Conclusions: The results of our study provide support for our precariousness scale and its suitability for assessing the health-related quality of life of workers in different work arrangements.

KEYWORDS

health-related quality of life, job stress, nonstandard employment, precarious work, precariousness scale

1 | INTRODUCTION

There are no universal, standardized definitions of precarious work, making it difficult to capture its characteristics and compare studies that assessed it across countries.[1–4] Precarious work has been broadly defined by some as uncertain, unstable, and insecure work in which workers, as opposed to businesses or the government, bear the risks of work and receive limited social benefits and statutory protections.[5–9]

Similar to precarious work, related concepts, for example, contingent work and nonstandard work arrangements, also lack standardized definitions. According to one of the definitions for contingent workers by the US Bureau of Labor Statistics (BLS), they are workers who do not expect their jobs to last.[10] Definitions vary significantly among sources for nonstandard work arrangements, also referred to as alternative work or employment arrangements. To address this gap, the National Institute for Occupational Safety and Health (NIOSH) uses the following work arrangement definitions (NIOSH Strategic Plan: FYs 2019–2023, Version 4: October 2019 https://www.cdc.gov/niosh/about/strategicplan/pdf/NIOSH-Strategic-Plan_V4_Oct-2019_1.pdf). A standard work arrangement is secure or permanent.

Workers in such an arrangement have employee status; stable and adequate pay; access to fringe benefits including health insurance, paid leave, and retirement benefits; a regular, full-time work schedule; and the ability to negotiate their schedule and take time-off. A nonstandard work arrangement differs in some ways from the standard arrangement. While efforts are currently underway to improve data collection, currently available surveys use similar and very limited types of work arrangement for classifying workers. The concepts of precarious work, contingent workers, and work arrangements are not mutually exclusive; for example, some workers in standard arrangements may experience unfair treatment, a characteristic of precarious work.

Over the past few decades, employment relations in many countries have changed and led to greater employment flexibility in developing and developed economies.[11–14] A major consequence of employment flexibility is the proliferation of various nonstandard, nonpermanent work arrangements.[11] In turn, one of the implications of the increased prevalence of nonstandard work arrangement types is that it resulted in an increased prevalence of precarious work across the world.[15] The International Labor Rights Forum reports that workers doing precarious work increasingly fill permanent job needs but are frequently denied permanent employee rights.[16] Workers engaging in precarious work often work under temporary contracts, earn lower wages, and are subject to more dangerous working conditions than other workers.[2,16,17] Women, minorities, migrants, and young workers are more likely to engage in such work.[18]

Focusing on US data, analyses of the General Social Survey (GSS) data from 1972 to 2006 found an upward trend in perceived job insecurity, a characteristic of precarious work.[19,20] Analyzing GSS data, Ray et al.[3] reported that from 2002 to 2014, the percentage of workers increased from merely from 19% to 21% in nonstandard arrangements. One of their major findings was that there was no monotonic rise in nonstandard work arrangements, and the changes are cyclical. The recent BLS contingent worker survey (CWS) showed a marginal decline in the overall proportion of workers in alternative employment arrangements, from 10.7% of the workforce in 2005 to 10.1% in 2017.[10] However, these studies are based on different data sets and different time periods.

Research on nonstandard work arrangements and similar concepts rarely addresses concerns regarding precarious work in the United States.[21,22] Overall, measures of precarious work have been slow to evolve and have failed to accurately capture the factors affecting the workers in these jobs. To better understand the determinants and effects of precarious work, carefully calibrated and disaggregated metrics are needed. Various precarious work constructs and models have been proposed, mostly by non-US researchers. For example, Amable et al.[23] and Lewchuk et al.[24] considered precarious work as a multidimensional construct, defined across four dimensions of continuity (i.e., temporality), vulnerability (i.e., powerlessness), protection (i.e., limited fringe benefits), and income insufficiency (i.e., low level of earnings). In another study, Benach et al.[13] classified precariousness based on employment insecurity, individualized bargaining relations between workers and employers, low wages and economic deprivation, limited workplace rights and social protection, and powerlessness to exercise workplace rights. Besides these challenges in understanding its determinants, understanding the health consequences of precarious work is also challenging. Three main pathways link precarious work to adverse health consequences and to poor quality of life.[13] First, workers in precarious jobs experience higher exposures to working conditions with harmful health consequences. Second, precarious jobs may limit workers' control over their professional and personal lives, leading to psychosocial stress. Finally, some of the most important consequences of precarious work relate to social and material consequences.

Because measuring the dimensions of precarious work is complicated, few studies have attempted to do so. Amable et al.[23] conceptualized and operationalized work precariousness as a multidimensional construct based on Rodgers sociological construct of precarious work.[5] Many studies have documented the health consequences of precarious work, and most of these research works attributed job insecurity and temporariness as major components of precariousness.[2,25,26] Most of them reported that job insecurity and temporariness has adverse effects on workers' health, particularly mental health.[2,27–29]

Our study constructed a work precariousness scale based upon the Employment Precariousness Scale (EPRES) developed by Amable et al.[23] and Amable[30] and revised by Vives et al.[11,24] EPRES is a theory-based questionnaire developed to measure precarious work in epidemiological research.[11] A recent study has adapted the same scale, explored the psychometric properties, and concluded that the scale exhibited good psychometric properties and reliability.[31] We used elements similar to those included in this scale to measure the prevalence of precarious work in the United States and to examine whether precarious work was associated with elevated job stress, and two health-related quality of life metrics including unhealthy days (measured by days in poor physical and mental health) and reduced productive functioning (measured by days with activity limitations).

2 | DATA AND METHODOLOGY

We used data from the NIOSH-sponsored Quality of Work Life module of General Social Survey (GSS-QWL) for each of the years 2002, 2006, 2010, and 2014 (for details, see https://www.cdc.gov/niosh/topics/stress/qwlquest.html). Unless otherwise mentioned, we used pooled cross-sectional data from GSS-QWL for 2002, 2006, 2010, and 2014. A joint project between NIOSH and the National Science Foundation, GSS-QWL, with an approximately 70% response rate each survey year, is administered every 4 years and includes GSS respondents currently working full-time, part-time, or temporarily not working. Since 2002, GSS-QWL has captured how work life and work experience have changed. It includes questions on hours of work, workload, worker autonomy, layoffs, job security, job satisfaction, job stress, and worker well-being. Since 2002, the module has grown to include 90 different variables, expanding to include more specific health and safety measures, questions about the use of technology at work, and additional items on supervisory roles. The combined years of data had 5911 to start with. We used

weights provided by GSS-QWL so that the data represent the US working population. Because these data are publicly available and do not contain any personal identifiers, we did not require any human subjects' institutional review and/or approval, to access the data. Therefore, any ethics review, approval and/or informed consent was not required or relevant for this study.

We conducted descriptive analyses to understand how work precariousness has changed over the years and how various work arrangements and industries differ in their share of precarious work. All the independent variables we used were categorical in nature. We classified workers aged 18 years and above into five groups: (i) 18–24 years, (ii) 25–34 years, (iii) 35–44 years, (iv) 45–54 years, and (v) 55 and over. We used the following combined race and ethnicity categories, as provided by GSS-QWL: (i) White, (ii) Black, (iii) American Indian, (iv) Asian, (v) multi-racial, and (vi) Hispanic. We classified workers according to their education level into the following four groups: (i) did not complete middle school, (ii) completed high school, (iii) completed college, and (iv) completed postgraduate degree. We assessed the health status of workers based on their self-reported health, which included poor, fair, good, very good, and excellent; we categorized them into two groups, (i) excellent, very good, or good, (ii) fair or poor. We used the work arrangement categories provided by GSS-QWL that included the following: (i) on-call workers, (ii) workers paid by temporary help agencies, (iii) those working for a contractor, (iv) independent contractors, consultants, or freelance workers, and (v) regular, permanent employees (i.e., those in standard arrangements). GSS-QWL classifies job satisfaction into four categories: (i) very much satisfied, (ii) somewhat satisfied, (iii) not too satisfied, and (iv) not at all satisfied.

We used 22 GSS-QWL survey items to construct four different components of our precariousness scale (described in Table 1) and applied factor analysis to attribute a score for each of the four components. We combined the individual component scores to construct an overall precariousness score. We used responses to survey items inquiring about job stress, the number of days during which workers were in poor mental and physical health, and the number of days during which workers experienced activity limitations to measure health-related outcomes of interest. The job stress question was, "*How often do you find your work stressful?*," with several response options. We converted the responses into bivariate as follows: the worker was considered as stressed at work if the response was, always or often; and the worker was considered as not stressed at work if the response was, hardly ever or never. The number of days workers were in poor mental and physical heath were counted as the sum of days from responses to two questions, "Now thinking about your physical health, which includes physical illness and injury, for how many days during the past 30 days was your physical health not good?," and "Now thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days was your mental health not good?" The total number of days was truncated at a maximum of 30 when it exceeded 30. Finally, the number of days during which workers experienced activity limitations was used from the response to the question, "During the past 30 days, for about how many days did your poor physical or mental health keep you from doing your usual activities, such as self-care, work, or recreation?" We separately estimated the association among the obtained precariousness score and each of these health outcomes (job stress, unhealthy days, and days with activity limitations) after controlling for age, sex, race and ethnicity, education, health status, work arrangement, and job satisfaction.

Table 1 shows the four different components of the precariousness scale we constructed: (i) temporariness, (ii) disempowerment, (iii) vulnerability, and (iv) wages. It also lists the individual survey items we used to build these components of our precariousness scale. In addition, the table lists the components and variables used in the EPRES scale. We included the survey questions in Table 1 and have provided the questions and the answer options for each, along with the values associated with each response option in constructing the scale in the supplementary information document (S-1 represents our precariousness scale and S-2 represents EPRES scale).

The EPRES scale included two more components than our scale, access to rights, and exercise of rights. We included satisfaction with leave as one of the fringe benefits within our "wages" component. Though we did not include worker empowerment as a separate component because GSS-QWL does not include related information, our scale incorporated a similar variable on worker representation in decision-making ("*In your job, how often do you take part with others in making decisions that affect you?*"). We assessed each variable in the different components of the scale using a range of 1–4, with 1 representing the best situation and 4 the worst situation for the workers (see supplementary information, S-1 for details on the response options). We applied factor analysis using the group of variables in each of the components of the precariousness scale.

We conducted factor analysis for each of the four components separately. Factor analysis is used to describe variability among observed, correlated variables with respect to a potentially lower number of unobserved variables called factors. We used a principal component factor method to analyze the correlation matrix and load the factors. Factor loadings are the weights and correlations between each variable and the factor, and the higher a factor's load, the more relevant is the factor. Some of the components of our scale included one factor and some of them included up to three factors. We used variables with rotated values of 0.6 or more to estimate the components of the scale. There are many methods on factor analysis and factor loading values. We have followed Hair et al.[32] Depending on the rotated values of the variables in each factor (reported in supplementary information, S-3), we estimated the mean value of all the variables that define a factor. Therefore, each factor was the mean value of all the variables that had values 0.6 or more. When a component of the scale had only one factor, the mean value of the factor was similar to the value of the scale component itself. When a component of the scale had more than one factor, we used the mean value of all those factors as the value of the component. Thus, the procedure we used generated a mean value for each of the four different components (temporariness, disempowerment, vulnerability, and wages) of the precariousness scale for each worker. Then, we constructed the

TABLE 1 Components and variables of our precariousness scale and the EPRES scale

Components	Our precariousness scale	EPRES Scale (Amable et al.[23])
Temporariness	Job security: *The job security is good.*	Contract duration
	Salaried or wage earner: *In your main job, are you salaried or paid by the hour?*	Temporary contract (in last 12 months)
	Job tenure: *How long have you worked in your present job for your current employer?*	
Disempowerment	Decision-making: *In your job, how often do you take part with others in making decisions that affect you?*	Decision taker in scheduling
	Job schedule: *How often are you allowed to change your starting and quitting times on a daily basis?*	Decision taker in work hours
	Union membership: *Do you or your spouse belong to any union?*	Decision taker in wage and salary (collective or top-down)
	Employer and employer relation: *In general, how would you describe relation in your work place between management and employees?*	
	Help with equipment: *I receive enough help and equipment to get the job done.*	
	Must work: *When you work extra hours on your main job, is it mandatory (required by your employer)?*	
	Developing opportunity: *I have an opportunity to develop my own special abilities.*	
Vulnerability	Respect at workplace: *At work, people are treated with respect.*	Afraid to demand better work condition
	Trust towards management: *I trust the management at the place where I work.*	Defenseless towards mistreatment
	Productive: *Conditions on my job allow me to be about as productive as I could be.*	Afraid of being fired
	Age discrimination: *Do you feel in any way discriminated against on your job because of your age?*	Discriminatory treatment
	Race discrimination: *Do you feel in any way discriminated against on your job because of your race or ethnic origin?*	Authoritative treatment
	Safe team: *Where I work, employees and management work together to ensure the safest possible working conditions.*	Feet easily replaceable
Wages	Financial situation: *So far as you and your family are concerned, how would you say your financial situation is.*	Meet basic needs
	Personal income: *Inflation-adjusted personal income in constant dollars.*	Meet unexpected expenses
	Family income satisfaction: *Compared with American families in general, would you say your family income is comparable.*	Take home monthly wage
	Fringe benefits: *My fringe benefits are good.*	
	Chances of promotion: *The chances for promotion are good.*	
Rights	----------	Right to paid vacation
		Right to paid pension
		Right to paid severance pay
		Right to paid maternity leave
		Right to paid day off for personal reasons
		Right to paid holidays
		Right to paid unemployment benefit
Exercise of Rights	----------	Weekly holidays
		Sick leave
		Vacation
		Personal day off

Abbreviation: EPRES: Employment Precariousness Scale.

precariousness score using the mean value of the four different components of the scale. In the process of generating the precariousness score, due to missing values of some of the variables, we could come up with a precariousness score for 4534 individuals. Based on this precariousness score, we classified precarious work as low, moderate, or high using tercile distribution. We used these three similar categories, low, medium, and high, for ranking the four individual components of the scale using tercile distribution.

We assessed the individual relationships between precarious work and job stress, precarious work and days in poor health, and precarious work and days with activity limitations separately. We conducted similar assessments for the different components of the precariousness scale. We used a logistic model to measure the association among precarious work and job stress and also among different components of precarious work and job stress, controlling for covariates that included age, sex, race and ethnicity, education,

TABLE 2 Distribution of worker characteristics, health, work arrangement, job satisfaction, and job stress by the level of precariousness (GSS-QWL, 2002–2014, *N* = 4534)

Variables		Population (%)	Precariousness (%)	
			Moderate	High
Age	18–24 years	9.72	32.78	15.45
	25–34 years	23.58	35.96	39.38
	35–44 years	23.16	34.25	31.49
	45–54 years	23.63	33.20	28.12
	55 years and over	19.90	27.72	24.14
Sex	Male	49.35	31.60	32.64
	Female	50.65	34.29	33.65
Race and ethnicity	White	67.82	33.02	27.55
	Black	11.70	36.36	46.02
	Hispanic	10.55	29.35	44.76
	American Indian	0.43	34.39	39.02
	Asian	3.03	45.41	23.71
	Multi-racial	6.47	26.37	52.34
Education	Did not complete middle school	9.53	31.66	51.11
	Completed high school	56.52	34.68	37.53
	Completed college	18.59	31.17	20.95
	Completed postgraduate degree	15.36	29.94	19.23
Health status	Excellent, very good, or good	86.75	33.72	30.83
	Fair or poor	13.25	28.06	48.38
Work arrangement	Independent contractors, contractors, consultants, or freelance workers	13.77	33.95	22.46
	On-call workers	2.77	37	46.38
	Workers paid by temporary help agencies	0.86	21.41	62.6
	Working for a contractor	2.99	34	43.65
	Regular, permanent employees	79.61	32.86	33.51
Job satisfaction	Very satisfied	49.93	33.31	19.7
	Somewhat satisfied	38.18	35.8	40.25
	Not too satisfied	8.39	25.2	62.48
	Not at all satisfied	3.50	15.65	75.7
Job stress	No	67.87	32.78	15.45
	Yes	32.13	35.96	39.38

Abbreviation: GSS-QWL, General Social Survey, Quality of Work Life.

health status, work arrangement type, and job satisfaction. A total of 15 regression models were run, three sets of models for precariousness, and for each component (four components) of the scale with three of the outcome variables separately. We used linear regression models to measure the association between the level of precariousness and (i) days in poor physical and mental health and (ii) days with activity limitations, controlling for the same covariates mentioned earlier. For each of the three different regression models, the reference group included workers engaging in non-precarious work (low precarious level), who were white males, in the age group of 18–34 years, who did not complete middle school, in excellent health status, working as an independent contractor, consultant, or freelance worker, and completely satisfied with the job.

3 | RESULTS

Tables 2 and 3 demonstrate the results of the study. Based on the tercile distribution, we categorized work precariousness as low (score 1.67 to ≤1.79), moderate (>1.79 to ≤1.993), and high (>1.99).

Table 2 shows the distribution of the workers in our sample across the variables of interest. About 51% of the survey respondents were female, and 24% were in each of the age groups of 25–34 years, and 45–54 years. About 68% of the respondents were white, and 57% had completed high school. 87% of the respondents reported their health status as excellent or very good, and 80% worked as regular, permanent employees. Approximately 50% of the respondents reported a high level of job satisfaction, and 32% reported experiencing job stress.

The last two columns of Table 2 show the percentages of workers employed in moderate and high precarious work classified by each row variable. It shows that a higher percentage of workers in the age group of 25–34 years (39.4%) were engaged in precarious work, and a higher percentage of workers in precarious work were female (33.7%). Precarious work was more common among workers of Multi-racial origin (52.3%), followed by Black (46.0%), Hispanic (44.8%), and American Indian workers (39.0). The percentage of workers engaged in precarious work was highest among those who reported the lowest levels of completed education. It was 51.1% for

TABLE 3 Associations between precarious work and job stress, unhealthy days, and days with activity limitations (GSS-QWL, 2002–2014)

Variables	Job stress OR (95% confidence interval)	Unhealthy days Coefficients (95% confidence interval)	Days with activity limitations Coefficients (95% confidence interval)
Crude Model (Precarious work)			
Moderate	0.95 (0.81–1.12)	0.05 (−0.24 to 0.33)	0.35 (−0.25 to 0.96)
High	1.73** (1.49–2.01)	0.82** (0.54–1.11)	3.02** (2.41–3.62)
Adjusted Model			
Precarious work			
Moderate	0.95 (0.81–1.13)	−0.07 (−0.36 to 0.23)	−0.24 (−0.83 to 0.35)
High	1.57** (1.32–1.88)	0.39** (0.07–0.72)	1.16** (0.52–1.8)
Age group			
25 to 34 years	1.01 (0.79–1.3)	0.11 (−0.34 to 0.55)	−0.42 (−1.31 to −0.47)
35 to 44 years	1.13 (0.88–1.45)	0.1 (−0.35 to 0.55)	−0.98** (−1.88 to −0.08)
45 to 54 years	0.98 (0.77–1.27)	0.09 (−0.36 to 0.54)	−1.26** (−2.16 to −0.36)
55 years and over	0.86 (0.66–1.12)	−0.03 (−0.5 to 0.44)	−0.99** (−1.93 to −0.05)
Sex			
Female	1.11 (0.97–1.26)	0.22** (0.01–0.43)	1.74** (1.27–2.21)
Race and ethnicity			
Black	0.55** (0.44–0.68)	−0.25 (−0.62 to 0.13)	−2.02** (−2.77 to −1.27)
Hispanic	0.77** (0.61–0.96)	−0.61** (−1 to −0.21)	−1.18** (−1.97 to −0.39)
American Indian	0.89 (0.34–2.3)	−0.14 (−1.81 to 1.52)	−1.53 (−4.86 to 1.81)
Asian	0.84 (0.58–1.24)	−0.08 (−0.77 to 0.6)	−1.15 (−2.53 to 0.22)
Multi-racial	0.81 (0.62–1.05)	0.16 (−0.31 to 0.63)	1.15** (0.2–2.09)
Education			
Completed high school	1.34** (1.05–1.71)	−0.03 (−0.44 to 0.38)	−0.43 (−1.25 to 0.39)
Completed college	1.65** (1.25–2.18)	−0.19 (−0.66 to 0.29)	−1.39** (−2.35 to −0.43)
Completed post-graduate degree	1.97** (1.48–2.62)	−0.1 (−0.6 to 0.4)	−1.07** (−2.07 to −0.07)
Health status			
Fair or poor	1.32** (1.09–1.6)	2.25** (1.9–2.6)	7.19** (6.49–7.89)
Work arrangement			
On-call workers	0.56** (0.34–0.92)	−0.06 (−0.85 to 0.73)	−0.65 (−2.23 to 0.93)
Workers paid by temporary help agencies	1.05 (0.51–2.17)	1.01 (−0.3 to 2.32)	2.09 (−0.54 to 4.72)
Working for a contractor	1.41 (0.94–2.11)	0.37 (−0.37 to 1.1)	0.98 (−0.49 to 2.46)
Regular, permanent employees	1.08 (0.87–1.33)	−0.41** (−0.78 to −0.03)	−0.27 (−1.02 to 0.47)
Job satisfaction			
Somewhat satisfied	1.32** (1.14–1.53)	0.26** (0.02–0.50)	1** (0.48–1.52)
Not too satisfied	2.08** (1.64–2.64)	0.05 (−0.4 to 0.5)	2.53** (1.63–3.43)
Not at all satisfied	5.3** (3.68–7.64)	1.88** (1.21–2.56)	3.96** (2.62–5.3)
Constant	0.21** (0.14–0.31)	0.94** (0.25–1.62)	4.31** (2.94–5.69)

Note: Reference Group: Workers in nonprecarious work, who were white males, in the age group of 18–24 years, who did not complete middle school, in excellent or very good health status, working as an independent contractor, consultant, or freelance worker, and completely satisfied with the job.

Abbreviation: GSS-QWL, General Social Survey, Quality of Work Life.

**Estimates were statistically significant at $\alpha = 0.05$ or lower.

those who did not complete middle school, followed by those who completed high school (37.5%). Also, health seems to be negatively associated with precariousness. Of those who reported fair or poor health status, 48.4% were engaged in highly precarious work. Within different categories of work arrangement, precariousness was high among those who were hired by temporary agencies (62.6%), those on-call (46.4%), and those working under contractors (44%). Also, a higher percentage of workers engaged in precarious work reported job stress (42.1%) and not being satisfied at work (75.7%).

Table 3 shows the results from our three fitted statistical regression models for the univariate models and the models controlling for all variables. Results from multivariate models show that workers in the top 33% of the precarious scale were 57% more likely to report experiencing job stress than those in the bottom 33% of the precarious scale. The odds ratios obtained for different covariates reflect that workers 55 years or older were 14% less likely to report experiencing job stress compared with the reference group and women were 11% more likely to report experiencing job stress than men. Also, the likelihood of reporting job stress for those who had completed a postgraduate degree was almost twice that of those who had not completed middle school. White workers were more stressed at work, 45% more likely to be stressed at work than Black workers, and 23% more likely than the Hispanic workers. Workers who reported good, fair, or poor health status were 32% more likely to experience job stress, and workers who were not at all satisfied at their job were five times more likely to experience job stress compared to those who were very satisfied.

From the associations between unhealthy days and work precariousness, we found that individuals in highly precarious work (precarious score > 1.99) reported more unhealthy days (0.4 days more within 30 days) than those in the lowest tercile and not engaging in precarious work. According to the results, women experienced 0.2 more unhealthy days than men. Those with fair or poor health status experienced 2.25 more unhealthy days. Those not at all satisfied at work reported a higher number (1.9) of unhealthy days than workers in the reference group.

Individuals doing highly precarious work reported experiencing a higher number of days of activity limitation (1.2 more days within 30 days period) than those in low precarious work. Females experienced 1.7 days more of activity limitations, multi-racial workers experienced 1.2 days more of activity limitations, those with fair or poor health status experienced 7.2 days more of activity limitations, and those who reported being not at all satisfied at work experienced 4 more days of activity limitations than those in the reference group.

Table 4 shows the percentage of workers engaged in precarious work over the years and the corresponding confidence intervals in parentheses, from 2002 to 2014. These numbers show that the percentages of highly precarious work have increased from 2002 (32.12%) to 2010 (35.37%) and then dropped in 2014 (30.96%).

We present the results of the rest of the statistical models using the four different components of the precariousness scale in Supplementary Information S-4 (a, b, and c) separately. S-4a shows the odds ratios of experiencing job stress for the different components of the precariousness scale. Odds ratios were highest for vulnerability (2.19) and lowest for temporariness (0.93) for those employed in high precarious work.

Supplementary Information, S-4b, illustrates the associations among unhealthy days and the different work precariousness scale components. The values of the coefficients of the different components of the scale show that workers engaged in high precarious work reported experiencing more unhealthy days. The coefficient was highest for vulnerability (0.54) and lowest for temporariness (0.05).

Supplementary Information, S-4c, shows the results of the linear regression model assessing the associations among the number of days with activity limitations and the different work precariousness scale components. The values of the coefficients show that workers in high precarious work reported more days with activity limitations than those in low precarious work. It was highest for the vulnerability (1.69) and lowest for the wage component (0.6).

4 | DISCUSSION

We developed a work precariousness scale inspired by EPRES, using nationally representative US data; to our knowledge, this is the first attempt to develop a scale and measure precarious work in the United States. Our scale has four components: vulnerability, disempowerment, wages, and temporariness.

Utilizing a nationally representative and heterogeneous sample that incorporated a wide range of socioeconomic and demographic variables, our results show that the percentage of workers engaged in highly precarious work increased from 2002 to 2010, and then decreased, with 2010 as the peak. Other studies focusing on nonstandard employment arrangements in the United States have found similar outcomes.[3,10] This can be attributed to the economic recession that United States was going through during this period.[33] Temporariness and wages were the major sources of precariousness among US workers during the study period. This is intuitive given the macroeconomic conditions of the years in study and the existing lag in wage growth in the United States.[33,34] Also, the income inequity in

TABLE 4 Percentage and confidence intervals of precarious workers across the years

Precarious work	2002	2006	2010	2014
Low (%)	32.47 (29.04–36.15)	33.23 (30.73–36.11)	32.16 (29.24–35.64)	35.62 (32.19–39.23)
Moderate (%)	35.40 (32.17–39.16)	32.40 (29.40–35.50)	32.46 (29.15–36.07)	33.42 (30.94–36.34)
High (%)	32.12 (29.58–35.16)	34.37 (31.89–37.15)	35.37 (31.71–39.2)	30.96 (27.10–34.98)

the United States was on the rise, making workers in the lower-income strata more and more precarious. Our findings show that workers working for temporary help agencies, on-call workers, are more precarious than other types of employment arrangements. These are in support of other studies concluding that in comparison to independent contractors and standard workers, workers paid by temporary agencies have lower wages and have higher job insecurity or temporariness.[3,12] Even regular, permanent employees reported work precariousness, albeit at a lower proportion. Our finding that temporariness is a major source of precariousness is similar to that reported by other studies.[4,12] Workers working under contracts and in temporary agencies either work part-time or do not have permanent jobs, which can be the cause of their precarity.

Our findings underline the negative health consequences of precarious work. Numerous studies have established job stress as a contributor to ill health.[3,35,36] We controlled for job satisfaction, which is a job-related contributor to stress but not to work precariousness. This biases our results downward because certain components of precariousness, especially vulnerability and empowerment, do affect job satisfaction and, indirectly job stress. Job satisfaction can be considered a mediator, and controlling for it reduces the net effect of work precariousness on job stress. Apart from the toll of stress on the physical health of the worker, we also found a positive association between work precariousness and the number of days with poor physical and mental health. This might indicate the hidden costs of precarious work in terms of lost productivity, such as presenteeism, as we found a strong association between days with activity limitations and precarious work. Our results were statistically significant even after controlling for the overall perceived health status of workers and are in support of existing evidence on the association between work precariousness and higher risk for injuries and illnesses.[13,37,38] Our results also support what Benach et al.[13] reported as the first pathway that links precarious work to adverse health consequences and leads to poor quality of life. Another study has also reported a similar association between precarious work and health.[1] Our findings that precarious work implies less control and insufficient reward are also consistent with Karasek's demand-control model and Siegrist's effort-reward model.[39–41]

Compared with men, women, and workers in the age group of 35–44 years experienced more work precariousness. Our findings are similar to what Krepashj et al.[17] reported but not consistent with Kalleberg's conclusions.[19] The reason behind this difference can be attributed to what Kiersztyn's[42] mentioned, that is, the data used by Kalleberg[19] did not have well defined disaggregated measures of precarious work. Julia et al.[43] also reported that younger workers are more employed in precarious work.

5 | LIMITATIONS

GSS-QWL data were available for 2002, 2006, 2010, and 2014 and not for the in-between years. Access to additional potentially essential variables such as the number of days of sick leave, paid vacation, and paternity or maternity leave available to workers, and variables that capture rights and the ability to exercise them might improve our scale. Each component of the scale contained uneven numbers of variables but was weighted equally, which may produce biased results. Finally, regarding the relationship between precarious work and job stress and satisfaction, we could not assess causality because we used pooled cross-sectional data.

6 | IMPLICATIONS AND CONCLUSION

Work precariousness is associated with job stress, which in turn affects the health and well-being of workers and their families. Developing and systematically tracking metrics of work precariousness and linking them to metrics of health and well-being for workers and their families can improve our understanding of how work precariousness affects health and well-being. This understanding can help us develop effective interventions to reduce work precariousness. Our findings indicate the suitability of the designed precarious scale in assessing the health and health-related quality of life of workers in different work arrangements. The precarious scale developed here requires validation. Ongoing assessment of the scale's validity with other data sets capturing both similar and additional variables and components of the scale will allow for further development and exploration of our scale. Future research should examine the psychometric properties of the scale and apply it to other national-level data to explore the robustness of the scale.

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CONFLICTS OF INTERESTS

The authors declare that there are no conflicts of interest.

DISCLOSURE BY AJIM EDITOR OF RECORD

Paul A. Landsbergis declares that he has no conflict of interest in the review and publication decision regarding this article.

AUTHOR CONTRIBUTIONS

The concept of this study was developed by Dr. Ray. All data cleaning, running regression models, analyzing results and drafting of the manuscript was done by Dr. Bhattacharya which were then reviewed and revised by Dr. Ray. Finally, comments by other researchers in the agency were addressed by both authors. The current version of the manuscript was approved by both authors, who agree to be responsible for all aspects of the work, and we ensure that questions related to the accuracy or integrity of any part of the work were appropriately investigated and resolved.

DATA ACCESSIBILITY STATEMENT

These data are publicly available (GSS General Social Survey | NORC) and do not contain any personal identifiers; no human subjects' institutional review or approval was required to access the data. The public-domain data that support the findings of this study are available at the General Social Survey website http://gss.norc.org/Get-The-Data.

ETHICS APPROVAL AND INFORMED CONSENT

This study was conducted at NIOSH (Cincinnati) and the data used in this study study are de-indentified and publicly available. Human subjects protection or institutional review and approval were not required for access or research use of these data.

DISCLAIMER

The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the National Institute for Occupational Safety and Health.

ORCID

Anasua Bhattacharya http://orcid.org/0000-0002-4986-5895

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SUPPORTING INFORMATION

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

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