# Precarious employment and mental health in the United States: Results from the Medical Expenditure Panel Survey (MEPS), 2008–2021

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A B S T R A C T

*Objectives:* To measure associations between employment precarity and mental health among United States (US) workers.
*Methods:* This study used data from the US Medical Expenditure Panel Survey for 2008–2021. Multivariable generalized estimating equations were used to measure associations between employment precarity (operationalized as a multi-dimensional exposure) and self-rated mental health after adjusting for relevant confounders. Marginal effects analysis was used to assess potential dose-response relationships between precarity and mental health.
*Results:* Our sample ($n = 57,529$) was representative of >106 million US workers employed throughout 2008–2021. Compared to those with low levels of employment precarity, those with medium and high levels of precarity had an increased odds of reporting poor/fair mental health (aOR = 1.21; 95% CI = 1.11, 1.32 and 1.51; 95% CI = 1.36, 1.68, respectively). Marginal effects analysis indicated that increasing levels of precarity were associated with an increased probability of reporting poor/fair mental health.
*Conclusions:* Increasing levels of employment precarity were associated with poor/fair self-rated mental health, findings potentially indicative of a dose-response relationship between the two. These nationally representative findings suggest employment precarity is an important social determinant of mental health. Future research could investigate how best to mitigate the negative effects of precarity on workers' lives and well-being, particularly regarding mental health.

## 1. Introduction

The prevalence of standard, full-time employment in the United States (US) has been decreasing since the 1970s (Kalleberg, 2011). This trend was exacerbated by the 2008 Financial Crisis and COVID-19 Pandemic, both of which were associated with increases in part-time employment in the US (Cowan, 2020; Kalleberg and von Wachter, 2017). While some aspects of non-standard employment may be seen as beneficial (e.g., increased scheduling flexibility), decreases in standard employment have generally been associated with rising precarious employment (PE) in the US (Kalleberg, 2011). While there is no single, accepted definition of PE, one systematic review of definitions and operationalizations identified three core dimensions of the concept:

employment insecurity, income inadequacy, and lack of workplace rights/protections (Kreshpaj et al., 2020). Moreover, recent literature has highlighted the importance of measuring PE's components in a single, multi-dimensional operationalization to capture the full breadth of its effects on worker health (Hajat et al., 2023; Vives et al., 2020).

Mounting evidence suggests PE contributes to poor health (Hajat et al., 2023). In addition to increasing risk of disease, such as myocardial infarction (Matilla-Santander et al., 2022b), PE has a measurable effect on workers' quality of life (Bhattacharya and Ray, 2021), potentially resulting in poor mental health (Vives et al., 2013). Results from European studies suggest a causal relationship between PE and poor mental health, including one cohort study (Canivet et al., 2016) and a cross-sectional study finding a dose-response relationship between the two

(Vives et al., 2013). While fewer PE studies have been conducted in the US, published research indicates that workers in PE arrangements are more likely to report depression and poor mental health than those in standard employment relationships (Andrea et al., 2022; Peckham et al., 2019).

PE is theorized to lead to poor mental health through various pathways. For example, low control over one's job and working schedule are associated with poor mental health (Dalgard et al., 2009; Lee and Kawachi, 2021). Other psychosocial occupation hazards experienced by workers in PE arrangements include workplace bullying and discrimination (Kvart et al., 2021). Outside of the workplace, the economic and social uncertainties inherent to precarious work can divert workers' time and energy away from other meaningful social interactions (e.g., time spent with family or in one's community), resulting in feelings of social isolation (Irvine and Rose, 2022).

Decades of worsening employment quality in the US have drawn attention to PE's ramifications for worker health (Howard, 2017). However, few US studies have investigated associations between PE and mental health. For example, a recent review by Hajat et al. identified only four US studies examining PE's relationship to mental health (Hajat et al., 2023). Of these, three used a typological approach towards measuring precarity (Andrea et al., 2022; Eisenberg-Guyot et al., 2020; Peckham et al., 2019), in which qualitatively distinct employment classes are identified within an analytic sample. Only one study (Bhattacharya and Ray, 2021) identified by Hajat et al. used a summative score approach, in which PE is measured as a continuum, allowing for the measurement of mental health outcomes at increasing levels of precarity. Other US studies have used a summative approach to measure associations with perceived stress during the COVID-19 pandemic (Oddo et al., 2023a) or have measured associations between individual PE measures, such as insecure income, with psychological stress (Thomas et al., 2022). To expand on these previous studies, we examined associations between PE, operationalized as a summative, multi-dimensional exposure, and self-rated mental health using 2008–2021 data from the US Medical Expenditure Panel Survey (MEPS), a nationally representative survey that collects data on health, employment, healthcare utilization, and health insurance coverage in the US.

## 2. Methods

This study used data from US MEPS (U.S. Department of Health and Human Services Agency for Healthcare Research and Quality, 2024). MEPS data are collected from a nationally representative sample of respondents in five rounds over a two-year period, or panel, during which information is collected on participants' demographics, healthcare utilization, employment arrangements, and health insurance coverage. A new panel is selected each year. To increase sample size, we pooled data from MEPS panels 13–25, corresponding to years 2008–2021. This timeframe includes the 2008 financial crisis and its aftermath, during which the US experienced several labor market changes, such as increases in non-voluntary part-time work (Kalleberg and von Wachter, 2017). MEPS Panel 25, which includes data collected in 2020–2021, was the most recent panel for which five rounds of data were available at the time of analysis. To allow for analysis across five rounds of data collection, the longitudinal MEPS files for each panel were used. Information pertaining to how a participant was paid (i.e., salaried or not) and the year participants started their current main job was extracted from MEPS Jobs data files. This activity was reviewed by CDC, deemed research not involving human subjects, and was conducted consistent with applicable federal law and CDC policy.

To maintain consistency with previous literature, our PE operationalization included MEPS variables broadly representing three domains identified in a previous systematic review of PE definitions and operationalizations: employment security, income inadequacy, and lack of rights/protections (Kreshpaj et al., 2020). Variable selection was also informed by previous studies creating multi-dimensional measures of PE

(Baek et al., 2023; Bhattacharya and Ray, 2021; Oddo et al., 2023a; Vives et al., 2010), as well as consideration of what information was available in our sample. For example, while some definitions of PE included measures related to disempowerment and education/training opportunities (Oddo et al., 2021), variables related to these concepts were not identified in MEPS. Ultimately, thirteen variables were selected for inclusion in our PE measure (Table 1). For each variable, participants were assigned a score of "1" if they reported the value of that variable associated with PE (e.g., an individual whose current main job is temporary would receive a score of "1" for that measure, while a non-temporary employee would receive "0"). While previous research using a summative, multi-dimensional PE measure to study associations with mental health have weighted individual employment variables to creating equal influence of each PE domains, these used formal scale validation approaches (Bhattacharya and Ray, 2021) or measured precarity using previous-validated precarity scales (Vives et al., 2013). As no formal validation of our PE measure was performed in this study, these variables were weighted equally and summed, resulting in a scale ranging from 0 to 13; a higher value was indicative of higher PE.

The outcome of this study was self-rated mental health. MEPS participants are asked to rate their mental health at each of five rounds using a Likert Scale with levels of "poor", "fair", "good", "very good", and "excellent"; we dichotomized this measure into a binary outcome with "poor/fair" and "good/very good/excellent" strata (McAlpine et al., 2018). Data were also collected on age, sex, race/ethnicity, nativity status, education, family size, marital status, region, and occupational group; each of these variables were also self-reported. As published research suggests that PE is differentially distributed among these factors (Hajat et al., 2023; Peckham et al., 2019; Thomas et al., 2022), these were considered potential confounders of the association

**Table 1**

Dimensions of the main exposure, employment precarity, as operationalized in this study using United States Medical Expenditure Panel Survey (MEPS) data, 2008–2021.

| Precarity domain | Measure[a] | Value |
|---|---|---|
| Employment stability | Is current main job temporary? | 1 = job is temporary |
| | Is current main job seasonal? | 1 = job is seasonal |
| | Length of time at current main job. | 1 = less than or equal to one year |
| | Does worker currently hold more than one job? | 1 = holds more than one job |
| | How many hours a week spent working? | $1 \leq 35$ h/week[b] |
| Income inadequacy | How is worker paid (e.g., salaried, hourly, commission, etc.)? | 1 = non-salaried |
| | How much is worker paid relative to federal poverty line? | 1 = annual wage income is <145% of federal poverty level[c] |
| Workplace rights/ protections | Does current main job provide paid vacation? | 1 = does not provide paid vacation |
| | Does current main job provide paid leave to see a doctor? | 1 = no paid leave to see doctor |
| | Is health insurance offered at current main job? | 1 = health insurance not offered |
| | Does current main job provide paid sick leave? | 1 = does not provide paid sick leave |
| | Pension plan at current main job? | 1 = no pension plan |
| | Is current main job unionized? | 1 = job is not unionized |

[a] These variables were selected based on a previous literature, including a systematic review of definitions of precarious employment (Kreshpaj et al., 2020), as well as consideration of what variables were/were not available in the data used (US medical expenditure panel survey).

[b] This value (35 h/week) was selected based on the U.S. Bureau of Labor Statistics definition of parttime employment (Bureau of Labor Statistics, 2024).

[c] Based on a previously published study using US MEPS data to study psychological distress relating to insecure income (Thomas et al., 2022).

between PE and poor mental health.

## 2.1. Statistical analysis

All MEPS files were downloaded in R version 4.4.0 using the package 'MEPS' (Harel et al., 2018; R Development Core Team, 2010). Of approximately 195,213 participants in MEPS rounds 13–25, we excluded those aged <18 years ($n = 57,747$), those missing data on the primary outcome of interest ($n = 8910$), those in military occupations ($n = 288$) or industries ($n = 291$), those who were unemployed ($n = 128,122$), and those for whom a proxy responded to the MEPS survey ($n = 8726$). Similar to previous research on PE (Oddo et al., 2021; Oddo et al., 2023b), we excluded self-employed participants ($n = 12,443$) as they did not have information on several PE-related variables.

Descriptive statistics were calculated using the R package 'survey' (Lumley, 2023). To measure between PE and poor mental health across five rounds of data, we constructed generalized estimating equations (GEEs) with an exchangeable correlation structure and logit link. This approach is useful for longitudinal data, such as MEPS, as it accounts for the correlation of individual participant's answers across each round of data collection (Thomas et al., 2022). GEEs were constructed in STATA version 17 (StataCorp, 2021).

Bivariate GEEs were used to measure the association of self-rated mental health with our PE measure, which was divided into three strata with a relatively equal number of PE variables: low (0–3 employment variables demonstrating precarity), medium (4–7), and high (8–13) levels of PE. We allowed the highest stratum, high PE, to have two more variables than the low and medium PE strata since a low proportion of our sample had 12 or 13 employment variables demonstrating precarity. This trichotomization allowed for the measurement of poor/fair mental at increasing levels of precarity while also allowing for an adequate sample size to be included in each stratum. Multivariable analyses using the trichotomized PE measure included a GEE with all potential confounders and MEPS panel number included as covariates. Sensitivity analyses included a multivariable GEE with only time-varying covariates and a multivariable GEE excluding participants with outcome or covariate missingness.

Marginal effects were used to estimate the probability of a MEPS participant reporting poor/fair mental health within each individual stratum (i.e., without the aforementioned trichotomization) of the PE measure. For this analysis, those with zero or one of the individual PE measures were pooled due to small cell sizes; similarly, those with 11, 12, or 13 PE measures were pooled. For comparison, the unadjusted proportion of participants reporting poor/fair mental health at each exposure strata were calculated.

Missing values were imputed using multiple imputations with chained equations (MICE) via the RStudio package `mice` (Buuren et al., 2023). The longitudinal structure of each MEPS panel was incorporated into the MICE procedure using a two-level structure, in which MEPS round number was clustered around each unique participant and allowed to have a random intercept. All covariates and employment-related variables relating to PE, as well as self-rated mental health status, were used in the imputation process (Harel et al., 2018). Individuals missing data on self-rated mental health in our initial sample were excluded after imputation but before further analyses (Austin et al., 2021; von Hippel, 2007). A total of 15 datasets were generated using MICE; descriptives statistics were reported according to guidelines for reporting imputed data in epidemiological studies (Hayes-Larson et al., 2019) and modeling results from each imputed dataset were pooled using Rubin's Rules (Buuren et al., 2023; Harel et al., 2018).

## 3. Results

Our sample included 57,529 participants from MEPS panels 13–25, corresponding to 287,516 survey responses across five rounds of data collection. The weighted total for this sample was 106,990,169 US

workers employed throughout the years 2008–2021 (Table 2). Of these, 60.5%, 26.1%, and 13.8% were in the low, medium, and high PE strata, respectively. Compared to the low PE strata, participants with high PE tended to be younger (mean = 38.7; SD = 16.6) and were more frequently female (56.3%), Hispanic (23.2%), foreign-born (22.4%), single (as opposed to married or divorced; 46.5%), non-college-educated (46.4%), and employed in service occupations (33.3%). Regarding PE-related variables, those with high PE frequently reported not belonging to a union (98.7%), not having leave to see a doctor (98.7%), not having paid sick leave (97.4%), not having a pension plan (96.2%), not having paid vacation (95.2%), and being paid though a non-salaried pay schedule (92.5%). Conversely, working temporary or seasonal jobs were the PE variables reported least-frequently by participants regardless of PE strata. Weighted descriptive statistics by self-reported mental health strata are reported in Supplemental Table 1.

The proportion of participants reporting poor/fair self-rated mental health was 3.2%, 4.2%, and 5.8% in the low, medium, and high PE strata, respectively (Table 3). Adjusted for potential confounders, those with medium and high PE values had 1.21 (95% CI = 1.11, 1.32) and 1.51 (95% CI = 1.36, 1.68) times the odds of reporting poor/fair mental health, respectively, compared to those with low PE values. Sensitivity analyses containing only time-varying covariates or using a complete case sample did not differ significantly from our main results (Supplementary Table 2).

Marginal effects analysis showed evidence of a dose response relationship between PE and poor self-rated mental health (Fig. 1), with an overall positive relationship between the two. The covariate-adjusted probability of reporting poor/fair self-rated mental health ranged from a low of 2.80% (95% CI = 2.56, 3.05) in those with PE measure of zero or one, to 5.28% (95% CI = 4.21, 6.63) in those with a precarity value of 11–13.

## 4. Discussion

To the authors' knowledge, this is the largest study of PE and mental health in the US. Our analysis represented >106 million US workers employed throughout the years 2008–2021, a timeframe including the 2008 Financial Crisis and emergence of COVID-19 pandemic, events which likely increased the prevalence of PE in the U.S. (Cowan, 2020; Kalleberg and von Wachter, 2017; Oddo et al., 2023a). After controlling for potential confounders using multivariable GEEs, we detected significant associations between PE, operationalized as a summative multi-dimensional exposure, and self-rated mental health (Table 3). Furthermore, marginal effects analyses were suggestive of a positive dose-response relationship between our PE measure and the covariate-adjusted probability of reporting poor/fair mental health (Fig. 1).

Few recent US studies of employment quality and mental health have measured PE using a summative approach, which operationalizes precarity as a numeric exposure and can measure health outcomes at increasing levels of PE. One example from Oddo et al. (2023a) surveyed >600 US adults and found significant positive associations between PE and self-perceived stress (Oddo et al., 2023a). Similarly, a study using the Quality of Work Life module of the General Social Survey (GSS) found that participants with high levels of precarity had increased odds of job-related stress (Bhattacharya and Ray, 2021). Outside of the US, evidence of a dose-response relationship between PE and poor mental health was observed in a sample of Spanish workers, a trend also observed in the study's sex-stratified analysis (Vives et al., 2013). Congruence between our results and these studies, each of which used slightly different summative operationalizations of precarity, supports a causal relationship between PE and poor mental health.

In contrast to studies using a summative PE measure, others have operationalized precarity using a typological approach, in which employed persons are grouped using statistical techniques such as structural equation modeling. While typological PE operationalizations are not designed to detect detection dose-response relationships – a

**Table 2**

Descriptive statistics of employed persons (weighted *n* = 106,990,169) included for analysis from the United States Medical Expenditure Panel Survey (MEPS), 2008–2021.[a]

| Sample characteristic | Initial sample | Complete case sample | Imputed sample | | | |
|---|---|---|---|---|---|---|
| | | | Total | Employment precarity[b] | | |
| | | | | Low | Medium | High |
| | (Weighted n = 106,990,169) | (Weighted n = 82,144,374) | (Weighted n = 106,990,169) | (Weighted n = 64,241,834) | (Weighted n = 27,963,164) | (Weighted n = 14,785,171) |
| **Demographic variables** | | | | | | |
| Sex, % | | | | | | |
| Female | 48.4 | 48.5 | 48.4 | 47.6 | 46.0 | 56.3 |
| Male | 51.6 | 51.5 | 51.6 | 52.4 | 54.0 | 43.7 |
| Age, mean (SD) | 42.4 (13.1) | 42.5 (13.0) | 42.4 (13.1) | 43.7 (11.7) | 41.5 (13.6) | 38.7 (16.6) |
| Race/ethnicity, % | | | | | | |
| Asian only, non-Hispanic | 6.0 | 5.6 | 6.0 | 6.5 | 5.2 | 4.7 |
| Black/African-American only, non-Hispanic | 11.4 | 10.7 | 11.4 | 11.3 | 11.5 | 11.2 |
| Hispanic | 16.1 | 15.3 | 16.1 | 11.9 | 22.3 | 23.2 |
| Other race, non-Hispanic | 2.4 | 2.4 | 2.4 | 2.3 | 2.4 | 2.7 |
| White only, non-Hispanic | 64.1 | 66.0 | 64.1 | 68.0 | 58.5 | 58.1 |
| Nativity status, % | | | | | | |
| Born in United States | 82.2 | 83.1 | 82.1 | 85.2 | 77.4 | 77.6 |
| Foreign-born | 17.8 | 16.9 | 17.9 | 14.8 | 22.6 | 22.4 |
| Education, % | | | | | | |
| High school or less | 32.6 | 31.4 | 32.7 | 23.3 | 46.9 | 46.4 |
| Some college | 67.4 | 68.6 | 67.3 | 76.7 | 53.1 | 53.6 |
| Family size, mean (SD) | 2.84 (1.45) | 2.78 (1.43) | 2.84 (1.45) | 2.79 (1.38) | 2.92 (1.53) | 2.91 (1.56) |
| Marital status, % | | | | | | |
| Single | 27.9 | 27.6 | 27.9 | 22.2 | 31.2 | 46.5 |
| Married | 57.1 | 56.7 | 57.1 | 63.0 | 53.0 | 39.3 |
| Divorced/separated/widowed | 15.0 | 15.7 | 15.0 | 14.8 | 15.8 | 14.2 |
| Region, % | | | | | | |
| Northeast | 18.0 | 17.5 | 18.0 | 19.4 | 16.1 | 15.9 |
| Midwest | 22.5 | 23.1 | 22.5 | 21.8 | 24.0 | 23.1 |
| South | 36.8 | 36.9 | 36.8 | 36.1 | 37.8 | 37.7 |
| West | 22.6 | 22.5 | 22.6 | 22.7 | 22.1 | 23.3 |
| Occupational group, % | | | | | | |
| Management, business, and financial operations | 16.3 | 17.0 | 16.3 | 22.3 | 8.5 | 4.8 |
| Professional and related occupations | 26.9 | 28.0 | 26.9 | 33.3 | 18.0 | 16.2 |
| Service occupations | 14.7 | 14.0 | 14.7 | 8.6 | 19.1 | 33.3 |
| Sales and related occupations | 8.0 | 7.7 | 8.0 | 6.5 | 9.0 | 12.4 |
| Office and administrative support | 13.1 | 13.1 | 13.1 | 13.6 | 12.6 | 12.0 |
| Farming, fishing, and forestry | 0.5 | 0.5 | 0.5 | 0.2 | 0.9 | 1.4 |
| Construction, extraction, and maintenance | 7.2 | 7.1 | 7.2 | 5.2 | 11.5 | 7.4 |
| Production, transportation, material moving | 12.0 | 11.9 | 12.0 | 9.2 | 18.7 | 11.4 |
| Unclassifiable occupation | 1.2 | 0.6 | 1.2 | 1.1 | 1.7 | 1.2 |
| | | | | | | |
| **Employment precarity variables** | | | | | | |
| Is current main job temporary?, % | | | | | | |
| Not temporary | 96.1 | 96.1 | 96.1 | 98.9 | 96.0 | 84.1 |
| Temporary | 3.9 | 3.9 | 3.9 | 1.1 | 4.0 | 15.9 |
| Is current main job seasonal or year round?, % | | | | | | |
| Not seasonal | 96.6 | 96.6 | 96.6 | 98.7 | 96.5 | 87.7 |
| Seasonal | 3.4 | 3.4 | 3.4 | 1.3 | 3.5 | 12.3 |
| Length of time at current main job., % | | | | | | |
| Greater than one year | 80.8 | 81.3 | 80.8 | 89.3 | 74.5 | 55.8 |
| Less than or equal to one year | 19.2 | 18.7 | 19.2 | 10.7 | 25.5 | 44.2 |
| Does worker currently hold more than one job?, % | | | | | | |
| Not more than one current job | 91.7 | 91.5 | 91.7 | 94.3 | 89.5 | 84.8 |
| More than one current job | 8.3 | 8.5 | 8.3 | 5.7 | 10.5 | 15.2 |
| How many hours a week spent working?, % | | | | | | |
| ≥35 | 83.4 | 83.5 | 83.4 | 97.0 | 80.0 | 30.9 |
| <35 | 16.6 | 16.5 | 16.6 | 3.0 | 20.0 | 69.1 |
| How is worker paid?, % | | | | | | |
| Salaried | 39.8 | 41.3 | 39.4 | 57.5 | 16.2 | 4.8 |
| Hourly, commission, or other | 60.2 | 58.7 | 60.6 | 42.5 | 83.8 | 95.2 |
| How much is worker paid relative to federal poverty line?, % | | | | | | |

**Table 2** (*continued*)

| Sample characteristic | Initial sample | Complete case sample | Imputed sample | | | |
|---|---|---|---|---|---|---|
| | | | Total | Employment precarity[b] | | |
| | | | | Low | Medium | High |
| | (Weighted n = 106,990,169) | (Weighted *n* = 82,144,374) | (Weighted n = 106,990,169) | (Weighted *n* = 64,241,834) | (Weighted *n* = 27,963,164) | (Weighted *n* = 14,785,171) |
| ≥145% federal poverty level | 82.0 | 82.9 | 82.0 | 97.1 | 76.1 | 27.9 |
| <145% federal poverty level | 18.0 | 17.1 | 18.0 | 2.9 | 23.9 | 72.1 |
| Does current main job provide paid vacation?, % | | | | | | |
| Yes | 75.3 | 75.4 | 75.2 | 96.4 | 63.7 | 4.8 |
| No | 24.7 | 24.6 | 24.8 | 3.6 | 36.3 | 95.2 |
| Does current main job provide paid leave to see a doctor?, % | | | | | | |
| Yes | 64.7 | 65.4 | 64.5 | 92.9 | 32.7 | 1.3 |
| No | 35.3 | 34.6 | 35.5 | 7.1 | 67.3 | 98.7 |
| Is health insurance offered at current main job?, % | | | | | | |
| Yes | 77.8 | 78.4 | 77.4 | 96.7 | 66.2 | 15.1 |
| No | 22.2 | 21.6 | 22.6 | 3.3 | 33.8 | 84.9 |
| Does current main job provide paid sick leave?, % | | | | | | |
| Yes | 70.3 | 70.7 | 70.2 | 97.8 | 42.6 | 2.6 |
| No | 29.7 | 29.3 | 29.8 | 2.2 | 57.4 | 97.4 |
| Pension plan at current main job?, % | | | | | | |
| Yes | 62.2 | 63.6 | 62.0 | 87.2 | 34.9 | 3.8 |
| No | 37.8 | 36.4 | 38.0 | 12.8 | 65.1 | 96.2 |
| Is current main job unionized?, % | | | | | | |
| Yes | 12.6 | 13.2 | 12.6 | 17.8 | 6.8 | 1.3 |
| No | 87.4 | 86.8 | 87.4 | 82.2 | 93.2 | 98.7 |

[a] Descriptive statistics are reported as column percent unless otherwise noted.

[b] Trichotomized by the number of measures displayed in Table 1 for which each participant reported the "precarious" level of the variable; low = 0–3, medium = 4–7, high = 8–13.

**Table 3**

Crude and covariate-adjusted associations between employment precarity and poor/fair self-rated mental health in a sample of employed persons (weighted n = 106,990,169) from the United States Medical Expenditure Panel Survey (MEPS), 2008–2021.[a]

| Employment precarity[b] | Weighted n (%) | Prevalence of poor/fair mental health[c] | Crude odds ratio (95% CI) | Adjusted[d] odds ratio (95% CI) |
|---|---|---|---|---|
| Low | 64,241,834 (60%) | 3.2% | 1.00 (ref) | 1.00 (ref) |
| Medium | 27,963,164 (26.1%) | 4.2% | 1.29 (1.19, 1.40) | 1.21 (1.11, 1.32) |
| High | 14,785,171 (13.8%) | 5.8% | 1.72 (1.56, 1.89) | 1.51 (1.36, 1.68) |

[a] Measured using generalized estimating equations (GEEs) with an exchangeable correlation structure and logit link. GEEs were nationally representative via incorporation of the MEPS data's survey weights.

[b] Trichotomized by the number of measures displayed in Table 1 for which each participant reported the "precarious" level of the variable; low = 0–3, medium = 4–7, high = 8–13.

[c] Defined as a binary variable ("poor/fair" or "excellent/very good/good") by dichotomizing a Likert scale MEPS variable asking participants to rate their mental health at each round of data collection.

[d] Adjusted for age, sex, race/ethnicity, nativity status, education, family size, marital status, region, occupational group, and MEPS panel number.

strength of summative approaches – they benefit in their ability to identify taxonomically distinct clusters of employment relationships (Hajat et al., 2023). One such study from Peckham et al. used latent class analysis to group GSS participants into distinct employment clusters, including a "precarious" group of workers which had a high probability of part-time work or nonpermanent contracts, low wages, and low probability of union representation (Peckham et al., 2019). This precarious group was found to have higher probability of reporting poor general and mental health when compared to a "Standard Employment Relationship" group. Another study from Andrea et al. used data from the Health and Retirement Study identified distinct employment quality trajectories (Andrea et al., 2022). One trajectory, "Poor EQ to Delayed and Poor Retirement", was similar to Peckham's "precarious" cluster and had the highest prevalence of depression of any group attached to (i. e., participating in) the labor force. While these studies used a typological as opposed to summative approach, their results support our finding that workers with high levels of PE have high rates of poor mental health.

Regarding causal mechanisms, research suggests that the uncertainty, unpredictability, and variability intrinsic to PE contributes to increased job-related stress and, therefore, poor mental health (Bhattacharya and Ray, 2021; Irvine and Rose, 2022). This hypothesis is congruent with findings that workers with low control over their working conditions report higher levels of psychological distress, especially when paired with high demands within the workplace (Dalgard et al., 2009). Similarly, workers with high job insecurity have been found to have increased levels of stress-related hormones, findings which add biological plausibility to this association (Herr et al., 2017).

PE may also affects workers' mental health by interfering with their life outside of work. A 2023 advisory from the US Surgeon General, titled "Our Epidemic of Loneliness and Isolation", noted that one's employment situation may play a role in generating feelings of loneliness (Office of the U.S. Surgeon General, 2023). For example, multiple job holding due to financial insecurity may result in less time spent with one's family; preoccupation with work may distract an individual from engaging with their community and forming meaningful social connections; and so forth. In fact, research outside of the US has noted associations between PE and "social precarity", or constraints in working life, social activities, or financial difficulties (Matilla-Santander et al., 2022a). In this context, it is possible that our results are partially mediated by the social isolation produced by precarious work.
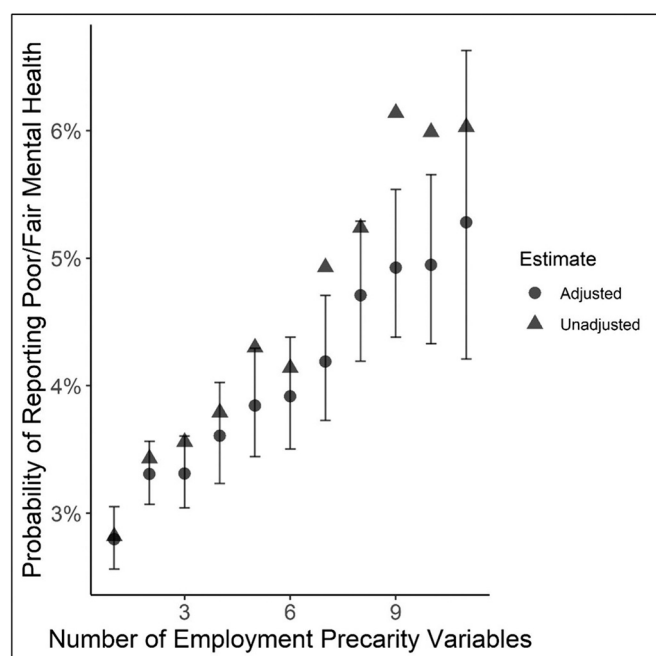
**Fig. 1.** Probability of reporting poor/fair self-rated mental health at each level of this study's employment precarity exposure, shown both unadjusted[a] and adjusted[b] for covariates of interest, in a sample of employed persons (weighted $n = 106,990,169$) from the United States Medical Expenditure Panel Survey (MEPS), 2008–2021.

[a] Unadjusted values are the proportion of participants reporting poor/fair mental health at each exposure strata.

[b] Adjusted for age, sex, race/ethnicity, nativity status, education, family size, marital status, region, occupation, and MEPS panel number using multivariable generalized estimating equations with an exchangeable correlation structure and logit link. GEEs were nationally representative via incorporation of the MEPS data's survey weights. Due to small cell sizes, exposure levels 0 and 1, as well as levels 11, 12, and 13, are pooled.

## 5. Limitations

In addition to its strengths, including use of a nationally representative survey, this study also has limitations. First, although we observed evidence suggestive of a dose-response relationship between PE and poor mental health, we cannot draw conclusions regarding the temporal relationship between the two given our cross-sectional study design. However, research outside of the US using a cohort study design (Canivet et al., 2016), which can more rigorously investigate casual relationships, has found associations between PE and poor mental health. Second, since MEPS data are self-reported, our outcome, self-rated mental health, is inherently subjective and not necessarily indicative of a diagnosable mental health condition. However, previous research indicates that self-rated measures of mental health are correlated with validated mental health scales (Ahmad et al., 2014). Third, by excluding self-employed and unemployed individuals, we cannot generalize these findings to workers in the gig economy (e.g., rideshare drivers and digital couriers) or individuals who gained/lost employment throughout the study period. Previous studies have assigned temporarily unemployed participants their highest numeric value of a summative PE measure (Oddo et al., 2023a; Oddo et al., 2023b) and other published research has found that loss of employment is associated with increased rates of poor mental health (Guerin et al., 2021). Thus, by excluding unemployed MEPS participants, we may have excluded some workers most at risk for both PE and poor mental health. Regarding self-employed individuals, several recent US studies of precarity have omitted self-employed workers (Oddo et al., 2021; Oddo et al., 2023b) and this remains an area in which future research is needed. Fourth, we

did not assess associations between PE and mental health stratified by sociodemographic factors which were noted to have differential levels of PE, such as gender, education, or occupation. Given recent advances in mediation analysis within occupational health research (Eisenberg-Guyot et al., 2023), future research may examine the role of these factors as determinants and/or mediators of the association between PE and poor mental health.

We should also acknowledge our PE measure's inherent limitations. Specifically, we did not weight our measure based on pre-identified domains of precarity (i.e., employment instability, inadequate wages, and lack of workplace rights or protections (Kreshpaj et al., 2020)) or use validation procedures to confirm that our sample's patterns of PE conform to these domains. Thus, our measure may weight one of these domains more than others, potentially reducing our ability to accurately measure a dose-response relationships between PE and poor mental health. Future PE research using MEPS could examine how to measure, group, and weight the dataset's employment-related variables to capture PE most accurately as a multi-dimensional construct. Similarly, due to limitations in what information is collected in MEPS, our PE measure did not include several precarity indicators used in previous studies. For example, previous studies have included measures related to a worker's ability to exercise rights in the workplace (e.g., ability to demand fair treatment or better working conditions). While including these indicators may have improved our PE measure's validity, their omission highlights the limitations of using previously collected data for assessing PE.

Finally, our study cannot speak to how PE, as an occupational health exposure, is generated. Several interconnected social, economic, and legal factors produce employment relationships associated with negative health outcomes. Few studies have investigated these factors as causes of PE and this remains an area in which future research is needed (Fujishiro et al., 2022).

## 6. Conclusions

The results of this study are suggestive of a dose-response relationship between PE and poor/fair mental health in the US. These findings are concerning given evidence that employment quality and institutional protections for US workers have been decreasing for decades (Kalleberg, 2011). Despite growing evidence of PE's negative ramifications for workers' well-being, few studies have assessed interventions aiming to reduce precarity's impact on workers (Gunn et al., 2022). Future research is needed to understand how best to ameliorate the negative effects of precarity on workers' mental health, including workplace interventions and broader policy changes related to employment quality.

### Ethics statement

This activity was reviewed by CDC, deemed research not involving human subjects, and was conducted consistent with applicable federal law and CDC policy.

### Author contributions

EWL downloaded data, cleaned it, and drafted the manuscript for submission. Analyses were performed by EWL and AA. AA, ALS, AB, and MG provided expert opinion regarding occupational health and working conditions. All authors were involved in the conceptualization of the study and reviewed/approved the final manuscript before submission.

## CRediT authorship contribution statement

**Eric W. Lundstrom:** Writing – review & editing, Writing – original draft, Visualization, Validation, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Abay Asfaw:** Writing – review & editing, Methodology, Investigation, Formal analysis. **Andrea L. Steege:** Writing – review & editing, Conceptualization. **Anasua Bhattacharya:** Writing – review & editing, Methodology, Conceptualization. **Matthew Groenewold:** Writing – review & editing, Supervision, Conceptualization.

## Declaration of competing interest

The authors have no conflicts of interest or funding sources to disclose.

## Data availability

The data used in this study are publicly available.

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ypmed.2024.108090.

## References

Ahmad, F., Jhajj, A.K., Stewart, D.E., Burghardt, M., Bierman, A.S., 2014. Single item measures of self-rated mental health: a scoping review. BMC Health Serv. Res. 14.

Andrea, S.B., Eisenberg-Guyot, J., Oddo, V.M., Peckham, T., Jacoby, D., Hajat, A., 2022. Beyond hours worked and dollars earned: multidimensional EQ, retirement trajectories and health in later life. Work Aging Retire. 8, 51–73.

Austin, P.C., White, I.R., Lee, D.S., van Buuren, S., 2021. Missing data in clinical research: a tutorial on multiple imputation. Can. J. Cardiol. 37, 1322–1331.

Baek, S.U., Won, J.U., Yoon, J.H., 2023. Multidimensional typologies of precarious employment and their relationships with mental well-being in Korean wageworkers: a latent class analysis based on the Korean working conditions survey (2020-2021). Prev. Med. 177, 107787.

Bhattacharya, A., Ray, T., 2021. Precarious work, job stress, and health-related quality of life. Am. J. Ind. Med. 64, 310–319.

Bureau of Labor Statistics, 2024. U.S. Bureau of Labor Statistics Glossary, U.S. Bureau of Labor Statistics Glossary, U.S. Bureau of Labor Statistics Handbook of Methods.

Buuren, S.V., Groothuis-Oudshoorn, K., Vink, G., Schouten, R., Robitzsch, A., Rockenschaub, P., Doove, L., Jolani, S., Moreno-Betancur, M., et al., 2023. Package 'Mice', 3.16.0 ed.

Canivet, C., Bodin, T., Emmelin, M., Toivanen, S., Moghaddassi, M., Östergren, P.-O., 2016. Precarious employment is a risk factor for poor mental health in young individuals in Sweden: a cohort study with multiple follow-ups. BMC Public Health 16.

Cowan, B.W., 2020. Working paper 27315: short-run effects of COVID-19 on U.S. worker transitions. In: Research, N.B.O.E (Ed.), NBER Working Paper Series.

Dalgard, O.S., Sørensen, T., Sandanger, I., Nygård, J.F., Svensson, E., Reas, D.L., 2009. Job demands, job control, and mental health in an 11-year follow-up study: normal and reversed relationships. Work Stress 23, 284–296.

Eisenberg-Guyot, J., Peckham, T., Andrea, S.B., Oddo, V., Seixas, N., Hajat, A., 2020. Life-course trajectories of employment quality and health in the U.S.: a multichannel sequence analysis. Soc. Sci. Med. 264, 113327.

Eisenberg-Guyot, J., Blaikie, K., Andrea, S.B., Oddo, V., Peckham, T., Minh, A., Owens, S., Hajat, A., 2023. A tutorial on a marginal structural modeling approach to mediation analysis in occupational health research: investigating education, employment quality, and mortality. Am. J. Ind. Med. 66, 472–483.

Fujishiro, K., Ahonen, E.Q., Winkler, M., 2022. Investigating employment quality for population health and health equity: a perspective of power. Int. J. Environ. Res. Public Health 19.

Guerin, R.J., Barile, J.P., Thompson, W.W., McKnight-Eily, L., Okun, A.H., 2021. Investigating the impact of job loss and decreased work hours on physical and mental health outcomes among US adults during the COVID-19 pandemic. J. Occup. Environ. Med. 63, e571–e579.

Gunn, V., Kreshpaj, B., Matilla-Santander, N., Vignola, E.F., Wegman, D.H., Hogstedt, C., Ahonen, E.Q., Bodin, T., Orellana, C., et al., 2022. Initiatives addressing precarious employment and its effects on workers' health and well-being: a systematic review. Int. J. Environ. Res. Public Health 19.

Hajat, A., Andrea, S.B., Oddo, V.M., Winkler, M.R., Ahonen, E.Q., 2023. Ramifications of precarious employment for health and health inequity: emerging trends from the Americas. Annu. Rev. Public Health. 45 (1), 235–251.

Harel, O., Mitchell, E.M., Perkins, N.J., Cole, S.R., Tchetgen Tchetgen, E.J., Sun, B., Schisterman, E.F., 2018. Multiple imputation for incomplete data in epidemiologic studies. Am. J. Epidemiol. 187, 576–584.

Hayes-Larson, E., Kezios, K.L., Mooney, S.J., Lovasi, G., 2019. Who is in this study, anyway? Guidelines for a useful Table 1. J. Clin. Epidemiol. 114, 125–132.

Herr, R.M., Barrech, A., Gundel, H., Lang, J., Quinete, N.S., Angerer, P., Li, J., 2017. Effects of psychosocial work characteristics on hair cortisol - findings from a post-trial study. Stress 20, 363–370.

Howard, J., 2017. Nonstandard work arrangements and worker health and safety. Am. J. Ind. Med. 60, 1–10.

Irvine, A., Rose, N., 2022. How Does Precarious Employment Affect Mental Health? A Scoping Review and Thematic Synthesis of Qualitative Evidence from Western Economies. Work, Employment and Society.

Kalleberg, A.L., 2011. Good Jobs, Bad Jobs: The Rise of Polarized and Precarious Employment Systems in the United States, 1970s to 2000s, 1st pbk. ed. Russell Sage Foundation, New York.

Kalleberg, A.L., von Wachter, T.M., 2017. The U.S. labor market during and after the great recession: continuities and transformations. RSF: The Russell Sage Foundation J. Soc. Sci. 3.

Kreshpaj, B., Orellana, C., Burstrom, B., Davis, L., Hemmingsson, T., Johansson, G., Kjellberg, K., Jonsson, J., Wegman, D.H., Bodin, T., 2020. What is precarious employment? A systematic review of definitions and operationalizations from quantitative and qualitative studies. Scand. J. Work Environ. Health 46, 235–247.

Kvart, S., Jonsson, J., Bodin, T., Hakansta, C., Kreshpaj, B., Orellana, C., Ostergren, P.O., Nylen, L., Matilla-Santander, N., 2021. Precarious employment and psychosocial hazards: a cross-sectional study in Stockholm County. Int. J. Environ. Res. Public Health 18.

Lee, H.E., Kawachi, I., 2021. Association between unpredictable work schedules and depressive symptoms in Korea. Saf. Health Work 12, 351–358.

Lumley, T., 2023. Package 'Survey', 4.2-1 ed.

Matilla-Santander, N., Jonsson, J., Kreshpaj, B., Orellana, C., Benach, J., Badarin, K., Burstrom, B., Vives, A., Kjellberg, K., et al., 2022a. The relation between precarious employment arrangements and social precarity: findings from the PREMIS study in Stockholm, Sweden. Int. J. Health Serv. 52, 201–211.

Matilla-Santander, N., Muntaner, C., Kreshpaj, B., Gunn, V., Jonsson, J., Kokkinen, L., Selander, J., Baron, S.L., Orellana, C., et al., 2022b. Trajectories of precarious employment and the risk of myocardial infarction and stroke among middle-aged workers in Sweden: a register-based cohort study. Lancet Reg. Health Eur. 15, 100314.

McAlpine, D.D., McCreedy, E., Alang, S., 2018. The meaning and predictive value of self-rated mental health among persons with a mental health problem. J. Health Soc. Behav. 59, 200–214.

Oddo, V.M., Zhuang, C.C., Andrea, S.B., Eisenberg-Guyot, J., Peckham, T., Jacoby, D., Hajat, A., 2021. Changes in precarious employment in the United States: a longitudinal analysis. Scand. J. Work Environ. Health 47, 171–180.

Oddo, V.M., Jones-Smith, J.C., Knox, M.A., 2023a. Changes in precarious employment and health in the United States amidst the COVID-19 pandemic. Prev. Med. Rep. 31, 102113.

Oddo, V.M., Zhuang, C.C., Dugan, J.A., Andrea, S.B., Hajat, A., Peckham, T., Jones-Smith, J.C., 2023b. Association between precarious employment and BMI in the United States. Obesity (Silver Spring) 31, 234–242.

Office of the U.S. Surgeon General, 2023. Our Epidemic of Loneliness and Isolation.

Peckham, Fujishiro, Hajat, Flaherty, Seixas, 2019. Evaluating employment quality as a determinant of health in a changing labor market. RSF: The Russell Sage Foundation J. Soc. Sci. 5.

R Development Core Team, 2010. R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing.

StataCorp, 2021. Stata Statistical Software: Release 17. StataCorp LLC.

Thomas, R.D., Davis, J.W., Cuccaro, P.M., Gemeinhardt, G.L., 2022. Assessing associations between insecure income and US workers' health: an IPUMS-MEPS analysis. Soc. Sci. Med. 309, 115240.

U.S. Department of Health & Human Services Agency for Healthcare Research and Quality, 2024. Medical Expenditure Panel Survey (MEPS).

Vives, A., Amable, M., Ferrer, M., Moncada, S., Llorens, C., Muntaner, C., Benavides, F. G., Benach, J., 2010. The employment precariousness scale (EPRES): psychometric properties of a new tool for epidemiological studies among waged and salaried workers. Occup. Environ. Med. 67, 548–555.

Vives, A., Amable, M., Ferrer, M., Moncada, S., Llorens, C., Muntaner, C., Benavides, F. G., Benach, J., 2013. Employment precariousness and poor mental health: evidence from Spain on a new social determinant of health. J. Environ. Public Health 2013, 978656.

Vives, A., Benmarhnia, T., Gonzalez, F., Benach, J., 2020. The importance of using a multi-dimensional scale to capture the various impacts of precarious employment on health: results from a national survey of Chilean workers. PLoS One 15, e0238401.

von Hippel, P.T., 2007. Regression with missing Ys: an improved strategy for analyzing multiply imputed data. Sociol. Methodol. 37, 83–117.