Journal of Occupational and Environmental Medicine, Publish Ahead of Print

DOI: 10.1097/JOM.0000000000003692

No Worker is an Island: Physical and Social Isolation at Work in the United States

Kenneth A. Scott, PhD[1] ORCiD: 0000-0002-2192-5526, Chandran Achutan, PhD[2]ORCiD: 0000-0003-1512-0868, Ryan Hill, MPH[1] ORCiD: 0000-0001-9479-0004

[1]NIOSH Western States Division, [2]NIOSH Division of Science Integration

Corresponding Author: Kenneth A. Scott, PhD, MPH NIOSH Western States Division W 6th Avenue/Kipling Street, Lakewood, CO 80225 Phone: 303-565-7993 Email: kscott4@cdc.gov & occinjury@gmail.com

All sources of support relevant to publication: This work was completed by researchers with the National Institute for Occupational Safety and Health (NIOSH) as part of their normal work activities. This work was also supported in part through the NIOSH Nanotechnology Research Center (NTRC) FY25 Emerging Technologies Pilot Project Competition (intramural).

Disclaimer: The findings and conclusions in this report are those of the author(s) and do not necessarily represent the official position of the National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention.

Conflicts of Interest: None declared.

Ethical Considerations: This activity was reviewed by CDC, deemed not research, and was conducted consistent with applicable federal law and CDC policy.[§]

Specific Author Contributions: Obtaining intramural grant support: Dr. Scott; Study conceptualization: Dr. Scott, Dr. Achutan, and Captain Hill; Data management and analysis: Dr.

[§] See e.g., 45 C.F.R. part 46.102(l)(2), 21 C.F.R. part 56; 42 U.S.C. §241(d); 5 U.S.C. §552a; 44 U.S.C. §3501 et seq.

ACCEPTED

Copyright © 2026 American College of Occupational and Environmental Medicine. Unauthorized reproduction of this article is prohibited.

Scott and Dr. Achutan; Manuscript preparation and review: Dr. Scott, Dr. Achutan, and Captain Hill.

Data availability: Data are publicly available. O*NET 28.3 Database, May 2024 release can be downloaded here: https://www.onetcenter.org/db_releases.html. The U.S. Bureau of Labor Statistics Employment Projections data for 2023-2033 can be downloaded here: https://www.bls.gov/emp/data/projections-archive.htm.

Relevant reporting guidelines: In preparing the manuscript, the authors adhered to guidelines recommended by the STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) initiative. A STROBE checklist is included as Supplemental Digital Content.

Artificial Intelligence (AI) Statement: Artificial intelligence programs were not used at any stage during the production of this manuscript, including research design, data collection, data analysis, data interpretation, and manuscript preparation.

Running Head Title: Isolated Work in the United States

ACCEPTED

Copyright © 2026 American College of Occupational and Environmental Medicine. Unauthorized reproduction of this article is prohibited.

1. Abstract

Objective: To estimate the prevalence of physically and socially isolated work in the United States, including by detailed occupation.

Methods: Cross-sectional study linking O*NET isolated work prevalence estimates with Bureau of Labor Statistics' employment estimates to produce numbers and percentages of physically and socially isolated U.S. workers.

Results: Different definitions of physical and social isolation produced a range of prevalence estimates. In 2023, between 6.8 million and 36.1 million U.S. workers were physically isolated (4.0-21.5%; n=167,849,800); and between 2.2 and 9.9 million U.S. workers were socially isolated (1.3-5.9%). Estimates varied by occupation.

Conclusion: Physical and social isolation at work are common and likely distinct conditions with unique risks and solutions. However, neither risks nor solutions have been well-characterized. Evaluating isolated-worker-protection practices and scaling effective interventions could improve isolated workers' health and safety.

2. Keywords

Occupational Health; Accidents, Occupational; Social Isolation; Cardiovascular Diseases; United States Occupational Safety and Health Administration

ACCEPTED

Copyright © 2026 American College of Occupational and Environmental Medicine. Unauthorized reproduction of this article is prohibited.

3. Learning Outcomes

- Estimate the number of U.S. workers who operated in physical or social isolation during 2023
- Identify several occupations with relatively high numbers or proportions of isolated workers
- Explain how physical or social isolation at work might relate to the occurrence of adverse health outcomes
- Describe challenges of assessing physical or social isolation at work
- Summarize existing Occupational Safety and Health Administration (OSHA) standards related to physically isolated work

ACCEPTED

Copyright © 2026 American College of Occupational and Environmental Medicine. Unauthorized reproduction of this article is prohibited.

4. Introduction

It is important to understand the scale of isolation among U.S. workers. Workers can be isolated physically or socially. *Physically isolated work* (aka *lone work*) is a potentially hazardous working condition, in which an individual cannot be seen or heard by co-workers for more than a few minutes.[1] *Socially isolated work* is a pervasive lack of social contact or communication while at work.[2] These working conditions can, but do not necessarily, co-occur. A teleworker may be physically isolated and socially connected, whereas a night janitor may be both physically and socially isolated.

The U.S. Surgeon General's *Advisory on the Healing Effects of Social Connection and Community* brought widespread attention to relationships between social connection and health.[2,3] Various adverse physical, mental, and cognitive outcomes are associated with social isolation and loneliness, including heart disease, stroke, suicide, and mortality, likely manifesting via complex social and biological pathways.[4-6]

Instrumental social support can be especially important during emergencies. A study of 75 cardiac deaths among oil and gas extraction workers reported at least 33% of decedents were working alone at the time of the incident.[7] Rapid initiation of cardiopulmonary resuscitation (CPR) and defibrillation is consistently associated with increased survival of a non-traumatic cardiac arrest.[8,9] Researchers have also reported associations between longer median emergency medical service (EMS) response times and increased injury mortality,[10] a finding which, according to a 2015 systematic review, may vary somewhat by injury type.[11] The assumed benefits of social support during emergencies underpin various safety practices, including the "buddy system",[12] emergency preparedness and response,[13] and confined space measures.[14]

ACCEPTED

Copyright © 2026 American College of Occupational and Environmental Medicine. Unauthorized reproduction of this article is prohibited.

Social isolation, on the other hand – a pervasive lack of social contact or communication[2] - limits opportunities for an individual to reap the health benefits of social support in all its forms.[6]

The prevalence of isolated work, as well as its risks and solutions, may vary by geography. The relative frequency of isolated work in each country is likely influenced by, among other things, its industrial and occupational mix (e.g., the relative shares of farmers, truck drivers, etc.) and its rurality. Policies addressing isolated work are geography-specific,[1,15-17] which may further influence its frequency or risks. Access to trauma care varies geographically,[18] which may increase the severity of isolated workers' health events. A recent study of out of hospital cardiac arrests (OHCAs) found variation in median EMS response time, median treatment time, and likelihood of survival by country, even among countries in the relatively affluent European Union.[19] Jurisdictions with fewer technological and human resources dedicated to EMS may be challenged to provide timely care for isolated workers or even locate their emergencies.[20]

Prior studies have identified employment as an important factor shaping individuals' social connections and health outcomes.[6] Recent experimental research using LinkedIn algorithms corroborates decades-old research on the strength of weak ties for finding jobs and advancing professionally.[21,22] A recent cluster-randomized trial reported improvements in cardiometabolic health among some high-risk workers who were provided job flexibility and supervisor support.[23] A separate cluster-randomized study found supervisor training may help reduce employees' loneliness.[24] Risk mitigation strategies for isolated work likely depend on the nature of workers' isolation. Individuals who were physically isolated during pandemic lockdowns mitigated social isolation through virtual interaction.[25] On the other hand, while

ACCEPTED

Copyright © 2026 American College of Occupational and Environmental Medicine. Unauthorized reproduction of this article is prohibited.

resuscitation assistance technology is advancing,[26] a human remains the primary delivery mechanism for CPR and defibrillation.

It is currently unknown how isolated U.S. workers are while at work or which jobs might be especially isolating. In this paper we analyzed national survey data to estimate the prevalence of physically and socially isolated work in the United States, in 2023 and projected into 2033, overall and by occupation.

5. Methods

Setting and study design

We conducted a cross-sectional analysis of publicly available data to estimate the prevalence of isolated work and the number of isolated workers in the U.S., overall and by occupation. The unit of analysis was occupation, as defined by a 2018 Standard Occupational Classification (SOC) code. We linked U.S. employment estimates with data on occupational characteristics, including the distributions of physical and social isolation for each occupation. We also conducted an exploratory post-hoc analysis to explore temporal trends in occupational prevalence. This activity was reviewed by CDC, deemed not research, and was conducted consistently with applicable federal law and CDC policy. [§] We have uploaded the completed STROBE checklist as Supplementary Digital Content, http://links.lww.com/JOM/C411 (SDC).

Data sources/measurement

We obtained occupation-specific prevalence estimates of isolated work from the Occupational Information Network (O*NET) database (v28.3, released 5/2024),[27] a public database containing detailed descriptions of select U.S. occupations. The estimated number of U.S workers overall and in select occupations during 2023, as well as similar estimates projected for 2033, came from

[§] See e.g., 45 C.F.R. part 46.102(l)(2), 21 C.F.R. part 56; 42 U.S.C. §241(d); 5 U.S.C. §552a; 44 U.S.C. §3501 et seq.

ACCEPTED

Copyright © 2026 American College of Occupational and Environmental Medicine. Unauthorized reproduction of this article is prohibited.

the U.S. Bureau of Labor Statistics Employment Projections (EP) program.[27,28] We assumed that isolation prevalence within each occupation remains relatively stable through 2033. Sampling methods, including sample sizes and data collection methods, were determined by O*NET and the EP program methodologies. Eligibility for the cross-sectional analysis included detailed (six-digit) SOC present in both data sources. Eligibility for the post-hoc analysis included detailed SOC codes present in at least two O*NET data releases from 2012-2023 (v17.0-v28.3).

Variables

To estimate the frequency of physical and social isolation at work we used O*NET questions measuring workers' physical proximity to others and their contact frequency, respectively. Respondents are asked "How physically close to other people are you when you perform your current job?" and provided five mutually-exclusive categorical responses [*I don't work near other people (beyond 100 ft.)*; *I work with others but not closely (e.g., private office)*; *Slightly close (e.g., shared office)*; *Moderately close (at arm's length)*; and *Very close (near touching)*]. Respondents are also asked "How much contact with others (by telephone, face-to-face, or otherwise) is required to perform your current job?" with five mutually exclusive categorical responses [*No contact with others*; *Occasional contact with others*; *Contact with others about half the time*; *Contact with others most of the time*; *Constant contact with others*]. Notably, neither of these questions specify whether workers are isolated from all people or specifically from co-workers.

To explore variation introduced by different definitions of isolated work, we created two dichotomous definitions of physical isolation and two of social isolation. The conservative definitions of work isolation included the percentage of O*NET respondents who reported the lowest category of physical or social interaction, respectively. The liberal definitions also

ACCEPTED

Copyright © 2026 American College of Occupational and Environmental Medicine. Unauthorized reproduction of this article is prohibited.

included respondents who reported the next lowest categories. Our decision to dichotomize the outcome of interest was influenced by several factors. First, so little is known about physical or social isolation at work in the U.S., establishing a baseline for exposure surveillance is worthwhile.[29] Second, prior analyses have explored the frequency of working in close physical proximity to other with these same data,[30-34] and we did not want to duplicate those studies. Finally, while treating these data ordinally may be appropriate in studies of dose-response relationships between isolation and specific outcomes, this study estimates prevalence. Coding data continuously, and thus assuming the difference in each categorical response corresponds to a quantitatively equivalent degree of isolation, may be problematic.

Statistical Methods

We merged O*NET data and employment estimates by detailed SOC code and suppressed prevalence values recommended for suppression. We developed box plots to visualize the distribution of categorical responses for each question. We estimated the number of isolated workers in the study population overall and by occupation by multiplying O*NET prevalence estimates of isolated work by the number of workers in each occupation. The total numbers of isolated workers in the U.S. were estimated by applying aggregate prevalence estimates from the O*NET population to total U.S. employment estimates for 2023.

Recognizing the influence of COVID-19 on U.S. work arrangements, we explored, in an exploratory post-hoc analysis, whether the mean occupational prevalence of physically- or socially-isolated work changed, on average, from 2012-2019 vs. 2020-2023. We analyzed O*NET data by collection date and release date, which often differed. We used descriptive statistics, data visualization, and generalized linear mixed models to analyze temporal changes in the mean prevalence of isolated work. We developed four models, each one corresponding to a

ACCEPTED

Copyright © 2026 American College of Occupational and Environmental Medicine. Unauthorized reproduction of this article is prohibited.

separate definition of isolated work (see above: physical or social and conservative or liberal). The outcome, modeled as a binomial variable, was the proportion of workers in each occupation meeting the above definitions of work isolation. The numbers of respondents were treated as weights. Year of data collection was modeled continuously as a fixed effect and SOC codes were modeled with random intercepts, to account for different baseline levels of isolation. We also included a fixed effect term to test whether the relationship of interest was different during or after 2020, compared to data collected before 2020. In the post-hoc analysis we followed O*NET suppression recommendations and restricted the analysis to occupations with two or more time points. We specified, *a priori*, statistical significance for model parameters to be $p<0.05$. All data management and statistical analyses were performed in R (v4.5.2) and RStudio (v2025.09.2, build 418), with support from the following packages: tidyverse, lubridate, lme4, ggpubr.

Finally, we conducted a sensitivity analysis of our cross-sectional results by repeating the cross-sectional analysis, albeit including values recommended by O*NET for suppression.

6. Results

Sample coverage

There were 698 SOC codes with data present in both the O*NET v28.3 and EP datasets for the cross-sectional study. Of the 715 SOC-O*NET codes corresponding to detailed SOC codes, 17 were not present in the EP data (2.4%). Of the 832 SOC codes in the EP dataset, 134 were not present in the O*NET data (16.1%). The O*NET data used in the post-hoc analysis (v17.0-v28.3) included 790 detailed SOC codes with data on social isolation and 788 codes with data on physical isolation. Of these codes, 658 codes had at least two measurements for socially isolated work (83.3%) and 648 codes had two or more measurements for physically isolated work (82.2%).

ACCEPTED

Copyright © 2026 American College of Occupational and Environmental Medicine. Unauthorized reproduction of this article is prohibited.

Distributions of isolation measures

Figure 1 summarizes the distributions of all responses for each of the 698 eligible occupations. Outliers were common, particularly at the lowest levels of isolation. Physical proximity appears to follow a left-skewed distribution with the lower and upper categorical responses having the lowest median percentages. Across occupations respondents indicated constant contact with others was required for the job more than half of the time (median=61.7%). The 25th, 50th and 75th percentile and interquartile range for the lowest level of contact frequency ("No contact with others") were each zero.

[FIGURE 1]

Sample prevalence and occupational differences

The aggregated prevalence of isolated work and the number of isolated workers among eligible occupations are presented in Table 1. In 2023 there were between 5.3 and 28.2 million lone workers in eligible occupations, depending on the definition used, representing between 4% and 21.5% of the study population. These estimate ranges, and the ranges reported below, were the point estimates for the conservative and liberal definitions, respectively. Among workers in these occupations, between 1.7 and 7.8 million people worked in relative social isolation (1.3% or 5.9%, respectively). Assuming the occupation-specific prevalence estimates of isolated work remain unchanged, the number of isolated workers will increase by 2033, in keeping with projected employment growth, and the aggregated prevalence of isolated work will be stable. That said, the percentage of new jobs that are socially isolated may be slightly lower in 2033 than 2023 and the percentage of new jobs that are physically isolated (using the liberal definition only) may be slightly higher.

ACCEPTED

Copyright © 2026 American College of Occupational and Environmental Medicine. Unauthorized reproduction of this article is prohibited.

The prevalence and number of isolated workers for each of the 698 eligible occupations are presented in supplemental files (SDC Tables 1, http://links.lww.com/JOM/C412 and 2, http://links.lww.com/JOM/C413). Occupations with the highest prevalence of conservatively defined physical and social isolation included (tree) fallers (82.2% physically isolated, SOC: 45-4021) and fine artists (81% physically isolated, SOC: 27-1013); and meat, poultry, and fish cutters and trimmers (52.6% socially isolated, SOC: 51-3022) and fast-food cooks (42% socially isolated, SOC: 35-2011). Occupations with the highest numbers of physically and socially isolated workers included common U.S. occupations, such as heavy truck drivers (612,751 physically isolated workers, SOC: 53-3032) and customer service representatives (375,530 physically isolated workers, SOC: 43-4051) and cooks (286,456 socially isolated fast-food cooks, SOC: 35-2011; 276,944 socially isolated restaurant cooks, SOC: 35-2014) and housekeeping workers (135,153 socially isolated workers, SOC: 37-2012).

National estimates

Applying prevalence estimates from Table 1 to total U.S. employment estimates in 2023, we estimated that in 2023, there were approximately 6.8 million physically isolated workers and 2.2 million socially isolated workers in the United States – using the most conservative definition of each (Table 2). Expanding the definitions to include workers alone in their offices and workers who have occasional contact with others increased those totals to 36.1 million and 9.9 million, respectively.

Temporal trends in work isolation

Descriptive statistics of temporal changes are visualized in Figure 2, displaying features relevant for longitudinal analyses. Prevalence data in each O*NET data release included data collected much earlier, as early as 2003 in our study. Figures 2A and 2C display how, when

ACCEPTED

Copyright © 2026 American College of Occupational and Environmental Medicine. Unauthorized reproduction of this article is prohibited.

analyzed by year of data collection, mean prevalence varies from year to year. When analyzed by O*NET release date, mean occupational prevalence appeared stable over time (Figures 2B and 2D). Regression results are summarized in SDC Table 3, http://links.lww.com/JOM/C414. We found evidence of temporal changes in the prevalence of physically isolated work, but only when defined liberally. From 2003-2019, the prevalence of liberally defined physical isolation at work increased modestly (annual change of 0.01 in log odds; OR=1.01, p=0.0018). From 2020-2023 the prevalence decreased (annual change of -0.190 in log odds; OR=0.827, p=0.00074). We did not identify linear relationships between time and either socially isolated work or conservatively defined physical isolation.

[Figure 2]

Sensitivity analysis with values recommended for suppression

There were no missing prevalence estimates for physical proximity or contact frequency. However, there were 96 social isolation values (2.8%, n=3,490) recommended for suppression with at least one suppressed value in 69 of the 698 eligible occupations (9.9%). In the 75 occupations with at least one physical isolation value recommended for suppression (10.7%), 112 values were recommended for suppression (3.2%). In a sensitivity analysis we included values recommended for suppression (SDC Tables 1, http://links.lww.com/JOM/C412 and 2, http://links.lww.com/JOM/C413). Compared with Table 1 data, adding suppressed values increased the conservative and liberal estimates of socially isolated workers in the study population by 341,016 and 453,746 workers (19.8% and 5.8% increases, data not shown). The conservative and liberal estimates of physically isolated workers were increased by 247,534 and 3,011,173 workers (4.7% and 10.7%). Workforce estimates also increased when suppressed

ACCEPTED

Copyright © 2026 American College of Occupational and Environmental Medicine. Unauthorized reproduction of this article is prohibited.

values were included, and the proportions of U.S. workers in social or physical isolation changed slightly (socially isolated: 1.5% & 8.3%; physically isolated: 5.1% & 23.0%).

7. Discussion

This study is, to our knowledge, the first to estimate the prevalence of isolated work among U.S. workers or to address potential similarities and differences between physically and socially isolated work. We are unaware of similar prevalence studies in other countries or jurisdictions. Studies on isolated work have been published recently, both from the U.S.[35,36] and from other countries,[37,38] but comparisons are limited by differing conceptual definitions of isolated work[37,38] and conflicting results on safety risks.[39,40]

We found that substantial numbers of U.S. workers are either physically or socially isolated on the job. Even using the most conservative definitions, millions of U.S. workers operate apart from other people during the workday (6.8 and 2.2 million in physical and social isolation, respectively). Our data also provide supportive evidence that socially isolated work is not equivalent to physically isolated work. There are occupations with a low prevalence of physical isolation and a high prevalence of social isolation (e.g., Cooks, Fast Food, SOC:35-2011, 0% and 42%, respectively) or vice versa (e.g., Fine Artists, Including Painters, Sculptors, and Illustrators, SOC:27-1013, 81% and 0%). Direct comparisons of physical and social isolation prevalence estimates should be undertaken cautiously. The O*NET questions and allowable responses are fundamentally different from each other, and there is no reason to assume any equivalency between categories. Such direct comparisons of physical and social isolation may be irrelevant, as potential health consequences of physical or social isolation may function differently (e.g., access to CPR). We did not find evidence that the frequency of isolated work

ACCEPTED

Copyright © 2026 American College of Occupational and Environmental Medicine. Unauthorized reproduction of this article is prohibited.

changed during the study period, apart from liberally defined physically isolation, which may have increased slightly before 2020 and declined thereafter.

We acknowledge several limitations. We extrapolated the study population's prevalence estimates of isolated work to the total U.S. working population, which may bias our findings. The small samples of respondents at the occupation level may lead to occupational or aggregate prevalence estimates that overestimate or underestimate the true prevalence. Our sensitivity analysis, that included statistically uncertain values, suggest our reported findings may underestimate the actual number of U.S. workers meeting these definitions of isolated work. Validation of the current study's findings and comparisons with similar databases outside the U.S.[41] may be beneficial.

Our post-hoc temporal analyses highlight additional limitations in using O*NET for this study. Each data release includes responses collected several years prior. The apparent stability over time in Figures 2B and 2D is likely due, in part, to previously collected data carried forward from one release to the next. In our statistical analysis we attempted to adjust for this statistically, however we did not allow temporal changes to vary by occupation (e.g., with random slopes) due to limited statistical power. Alternate statistical methods might be worth exploring, but any future temporal analyses would need to address the structure and limitations of O*NET data for this purpose.

Implications for OSH practitioners

Isolated work appears in a wide range of occupational settings, suggesting that our findings may be relevant for a large number of OSH practitioners supporting different employers and industries. Physically isolated work frequently occurs in forests, art studios, oil and gas well sites, tractor trailers, and hotels, among many other settings. Socially isolated workers prepare

ACCEPTED

Copyright © 2026 American College of Occupational and Environmental Medicine. Unauthorized reproduction of this article is prohibited.

food, maintain landscapes, and handle warehoused goods. Fallers (SOC: 45-4021) registered as the most physically isolated occupation by percentage and were among the top five most socially isolated occupations using the liberal definition. Over half of meat, poultry, and fish cutters and trimmers (SOC: 51-3022) reported that their jobs required no contact with others. The variation in isolation prevalence (SDC Tables 1, http://links.lww.com/JOM/C412 and 2, http://links.lww.com/JOM/C413) raises questions regarding the risks – or even potential benefits – associated with physical or social isolation at work.

Physically isolated workers have died from recognized hazards, including workplace violence, being caught and crushed in industrial machinery, chemical exposures, falling overboard commercial fishing vessels, and being entangled in fishing equipment, to name just a few.[42-48] Studies evaluating the effectiveness of interventions to protect physically isolated workers are generally lacking. Indirect lessons may be drawn from studies of OHCAs. A study of 47,685 OHCAs in Sweden found arrests in workplaces were associated with higher survival probability than events occurring in other places.[49] This finding corroborated a 2015 systematic review.[50] Among the study authors' proposed explanations for higher survival in workplaces, many assume co-workers are readily available to administer CPR or defibrillation. Physically isolated workers may not benefit from the potentially protective effect of "the workplace" in surviving an OHCA.

Social isolation has been associated with various chronic health conditions. One systematic review of longitudinal studies reported participants with high versus low social isolation experienced a 29% higher relative risk of new coronary heart disease and a 32% higher relative risk of stroke.[51] A study analyzing data on older adults in the National Social Life, Health, and Aging Project reported a stronger association between social isolation and

ACCEPTED

Copyright © 2026 American College of Occupational and Environmental Medicine. Unauthorized reproduction of this article is prohibited.

hypertension than between diabetes and hypertension.[52] Social isolation has also been recognized as a particularly strong risk factor for suicidal ideation, attempts, and lethal suicide behavior.[5] The frequency of cardiovascular risk factors and suicide also vary considerably by occupation.[53,54] It is currently unknown whether social isolation at work may partially explain occupational variation or contribute to the national burden of chronic diseases and suicide. The workplace may be a place for social support or a place where social relationships can negatively impact psychosocial health.[55] The Work, Family, & Health Network (WFHN), for example, has utilized randomized study designs and reported an intervention to increase supervisor support and scheduling flexibility resulted in improvements to work-family conflict and family time adequacy.[56] Combined with the cluster-randomized trials mentioned above,[23,24] and other studies exploring the potential beneficial role of workplace social support[57] suggests potential for social connection at work and improved health. Workplace conflicts may counteract some of these potential benefits, as might the absence of workplace support. Studies have reported gig workers who are managed algorithmically seek emotional and informational support through online platforms to counteract their occupational social isolation.[58]

There is also likely substantial overlap between physical and social isolation. A report on workplace sexual harassment from the U.S. Equal Opportunity Employment Commission (EEOC) highlighted ways in which social isolation, physical isolation, and loneliness may interact. The authors noted, for example, night-shift janitors, housekeepers in individual hotel rooms, and agricultural workers in the fields may be at a heightened risk of sexual harassment and assault and may have limited opportunities to report incidents or share their concerns.[59] According to our conservative estimates, during 2023 there were 488,876 janitors, maids and cleaners (SOC Codes 37-2011, 37-2012, SDC Table 1, http://links.lww.com/JOM/C412) and

ACCEPTED

Copyright © 2026 American College of Occupational and Environmental Medicine. Unauthorized reproduction of this article is prohibited.

103,488 farmworkers tending to crops, nurseries, or greenhouses (45-2092) who worked in physical isolation. Among these same groups, there were 135,153 maids and housekeeping cleaners (37-2012, SDC Table 2, http://links.lww.com/JOM/C413) and 47,542 farmworkers (45-2092) who reported no contact with others.

Surveillance systems that typically inform U.S. policymaking, such as the Census of Fatal Occupational Injuries, Survey of Occupational Injuries and Illnesses, and OSHA recordkeeping forms do not collect structured data on isolation. To the best of our knowledge, workers' compensation insurance systems and occupational health providers do not systematically document physical or social isolation either. A lack of "near miss" surveillance (e.g., RIDDOR[60]) further limits our ability to understand how often physically isolated workers are protected by buddy systems or other lone work risk mitigation practices. A widespread lack of systematic data collection on isolated work drastically limits what researchers can learn about isolated work risks or risk mitigation. Researchers, practitioners, and public health surveillance experts could develop standardized surveillance definitions for physical or social isolation at work and integrate those definitions into established and/or future "smarter" surveillance systems.[29]

Laws in the United States regulate physically isolated work in specific contexts.[1,14] Employers must provide a trained attendant to monitor a permit-required confined space prior to and during a worker's entry in that space.[14] Shipyard employers must account for physically isolated employees, by sight or by verbal communication (e.g. with a radio), throughout each work shift and at the end of the shift.[1] Employers with grain handling facilities are also required to provide an observer to communicate with and respond to lone workers' needs.[61] When an employer requires a worker to enter an Immediately-Dangerous-for-Life-or-Health (IDLH)

ACCEPTED

Copyright © 2026 American College of Occupational and Environmental Medicine. Unauthorized reproduction of this article is prohibited.

atmosphere they must assign at least one employee outside the IDLH atmosphere to monitor.[62] Interior structural firefighting activities covered by OSHA are expected to assign two employees outside the IDLH atmosphere and two inside.[63] Under the Occupational Safety and Health Act employers must also keep employees informed of their protections and obligations.[64] Training, specific to isolated work or otherwise, is likely critical for individuals who work in isolation.[64] Other countries have policies to protect isolated workers across industries or occupations, prioritizing prompt medical attention,[16] effective communication systems,[15] and technologies specific to isolated work,[65] common OSH practices (e.g., risk assessment),[17] and context-specific requirements (e.g., protections for night-shift retail workers).[17]

Some occupational safety and health practitioners utilize risk mitigation strategies not explicitly required by regulations. For example, a 2018 article by Dr. Fred Straub in *Professional Safety* described an approach to integrate lone work risk mitigation into established safety and health programs, leveraging common tools such as risk assessment, job hazard analysis, periodic check-ins, and audits – among various others.[66] Straub also proposed that job tasks with a high potential for serious injury or fatality (SIF) be prohibited for physically isolated workers.[66] Lone work technologies, which include dedicated hardware and smartphone-compatible software applications, have emerged as technological supplements for lone work risk mitigation programs.[67]

In summary, various risk mitigation strategies for physically isolated work are available to employers, unions, and policymakers at each level of the hierarchy of controls, with little-to-no evidence of effectiveness.

ACCEPTED

Copyright © 2026 American College of Occupational and Environmental Medicine. Unauthorized reproduction of this article is prohibited.

Future research opportunities

Defining and measuring isolated work will be a fundamental challenge to expand the evidence base in this area. When we expanded our definitions to include one additional categorical response the number of isolated workers in each category increased by approximately 5-fold (36.1 and 9.9 million in physical and social isolation). The prevalence of isolated work is dependent on how isolation is conceptualized and measured. Given the paucity of research in this area, additional efforts to improve measurement will help refine the concepts and clarify how isolation does or does not impact worker health and safety. Qualitative methods and mixed-methods approaches may prove especially useful in understanding the perspectives of people involved in isolated work.

Issues to explore regarding the measurement of physical isolation could include the duration of isolation[42] or the distance to others (incl. co-workers, the public, EMS)[7]. Emerging technologies (e.g., sociometric badges)[68,69] may help eliminate potential recall or reporting bias that is a clear limitation of the self-reported data used for this study. Practical and ethical issues related to workplace surveillance could help improve validity and applicability of research findings.[70]

Topics to consider when exploring alternative measurement strategies for social isolation at work may include exploring different types communication including but not limited to what's *required* in a job (i.e., the measure used in this study); the frequency of communication with co-workers vs. members of the public; relationships between objective social isolation measures and subjective measures of loneliness or perceived social support; and the qualities of workplace interactions that are important for health and safety.

ACCEPTED

Copyright © 2026 American College of Occupational and Environmental Medicine. Unauthorized reproduction of this article is prohibited.

More fundamental scientific questions remain, such as whether isolated work *is* a hazard, whether isolation *interacts with* hazards to influence the frequency or severity of outcomes, how isolation at work relates to support from people other than supervisors and co-workers, and/or what the potential benefits of isolation to worker health and safety might be. The limited scope of this study did not investigate etiologic questions directly. This study did not test associations between isolated work and positive or negative health outcomes, but that could be a logical next step for future research.

Conclusion

Millions of U.S. workers are physically or socially isolated at work. Variation in isolation by occupation strongly suggest there are opportunities to understand and mitigate potential risks, while maximizing potential benefits. Examples of mitigation strategies exist in regulations and in occupational safety and health best practices, however rigorous studies examining their effectiveness are lacking. Occupational health and safety risks specific to either form of isolated work are largely uncharacterized. Prior research on social isolation, social support, loneliness, and timely emergency medical response provide a strong foundation to inform future research and interventions specific to physically or socially isolated work.

ACCEPTED

Copyright © 2026 American College of Occupational and Environmental Medicine. Unauthorized reproduction of this article is prohibited.

8. References

1. OSHA. General Working Conditions in Shipyard Employment: Working Alone. 29 CFR § 1915.84. May 2 2011. https://www.govinfo.gov/content/pkg/FR-2011-05-02/pdf/2011-9567.pdf

2. Holt-Lunstad J, Smith TB, Layton JB. Social relationships and mortality risk: a meta-analytic review. *PLoS Med*. Jul 27 2010;7(7):e1000316. DOI:10.1371/journal.pmed.1000316

3. Office of the Surgeon G. Publications and Reports of the Surgeon General. *Our Epidemic of Loneliness and Isolation: The US Surgeon General's Advisory on the Healing Effects of Social Connection and Community*. US Department of Health and Human Services; 2023.

4. Holt-Lunstad J. Social Connection as a Public Health Issue: The Evidence and a Systemic Framework for Prioritizing the "Social" in Social Determinants of Health. *Annu Rev Public Health*. 2022; 43:193-213. DOI:10.1146/annurev-publhealth-052020-110732

5. Van Orden KA, Witte TK, Cukrowicz KC, Braithwaite SR, Selby EA, Joiner TE, Jr. The interpersonal theory of suicide. *Psychol Rev*. 2010;117(2):575-600. DOI:10.1037/a0018697

6. Berkman LF, Glass T, Brissette I, Seeman TE. From social integration to health: Durkheim in the new millennium. *Social Science & Medicine*. Sep 2000;51(6):843-857. DOI:https://doi.org/10.1016/S0277-9536(00)00065-4. This paper is adapted from Berkman, L.F., & Glass, T. Social integration, social networks, social support and health. In L. F. Berkman & I. Kawachi, *Social Epidemiology*. New York: Oxford University Press; and Brissette, I., Cohen S., Seeman, T. Measuring social integration and social networks. In S. Cohen, L. Underwood & B. Gottlieb, *Social Support Measurements and Intervention*. New York: Oxford University Press.

ACCEPTED

Copyright © 2026 American College of Occupational and Environmental Medicine. Unauthorized reproduction of this article is prohibited.

7. Zimmerman SM, Scott KA, Wingate KC, et al. Working Alone and/or in Remote Locations: Opportunities to Prevent the Risk of Fatality from Cardiovascular Events in Oil and Gas Extraction Workers. *J Occup Environ Med*. 2023. DOI:10.1097/jom.0000000000002851

8. De Maio VJ, Stiell IG, Wells GA, Spaite DW. Optimal defibrillation response intervals for maximum out-of-hospital cardiac arrest survival rates. *Ann Emerg Med*. 2003;42(2):242-50. DOI:10.1067/mem.2003.266

9. Eisenberg MS, Bergner L, Hallstrom A. Cardiac resuscitation in the community. Importance of rapid provision and implications for program planning. *JAMA*. 1979;241(18):1905-7. DOI:10.1001/jama.241.18.1905

10. Byrne JP, Mann NC, Dai M, et al. Association Between Emergency Medical Service Response Time and Motor Vehicle Crash Mortality in the United States. *JAMA Surg*. 2019;154(4):286-293. DOI:10.1001/jamasurg.2018.5097

11. Harmsen AM, Giannakopoulos GF, Moerbeek PR, Jansma EP, Bonjer HJ, Bloemers FW. The influence of prehospital time on trauma patients outcome: a systematic review. *Injury*. 2015;46(4):602-9. DOI:10.1016/j.injury.2015.01.008

12. NIOSH [2016]. NIOSH criteria for a recommended standard: occupational exposure to heat and hot environments. By Jacklitsch B, Williams WJ, Musolin K, Coca A, Kim J-H, Turner N. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention,

13. Gershon RR, Qureshi KA, Rubin MS, Raveis VH. Factors associated with high-rise evacuation: qualitative results from the World Trade Center Evacuation Study. *Prehosp Disaster Med*. 2007;22(3):165-73. DOI:10.1017/s1049023x0000460x

ACCEPTED

Copyright © 2026 American College of Occupational and Environmental Medicine. Unauthorized reproduction of this article is prohibited.

14. Occupational Safety and Health Administration, U.S. Department of Labor (OSHA). Permit-Required Confined Spaces. 29 CFR § 1910.146. Jan 1993. https://www.osha.gov/sites/default/files/laws-regs/federalregister/1993-01-14.pdf

15. Australian Government. Remote or isolated work. Regulation 48 in Work Health and Safety Regulations 2011. https://www.legislation.gov.au/F2011L02664/latest/text

16. Republique Francaise. Travail isole. Code du travail. Article R4512-13. Mar 2008. https://www.legifrance.gouv.fr/codes/id/LEGIARTI000018529767/2025-07-24/#LEGIARTI000018529767

17. Keith N. Working Alone: A Look at Legislation in Canada. *Professional Safety*. 2011;56(02):56-59.

18. Newgard CD, Fu R, Bulger E, et al. Evaluation of Rural vs Urban Trauma Patients Served by 9-1-1 Emergency Medical Services. *JAMA Surg*. 2017;152(1):11-18. doi:10.1001/jamasurg.2016.3329

19. Gräsner J-T, Wnent J, Lefering R, et al. European registry of cardiac arrest study THREE (EuReCa- THREE) – EMS response time influence on outcome in Europe. *Resuscitation*. 2025:110704. doi:https://doi.org/10.1016/j.resuscitation.2025.110704

20. Hunt M, Niyonsaba M, Uwitonze JM, et al. Challenges Locating the Scene of Emergency: A Qualitative Study of the EMS System in Rwanda. *Prehosp Emerg Care*. 2024;28(3):501-505. doi:10.1080/10903127.2023.2225195

21. Rajkumar K, Saint-Jacques G, Bojinov I, Brynjolfsson E, Aral S. A causal test of the strength of weak ties. *Science*. Sep 16 2022; 377(6612):1304-1310. doi:10.1126/science.abl4476

22. Podolny JM, Baron JN. Resources and Relationships: Social Networks and Mobility in the Workplace. *American Sociological Review*. 1997;62(5):673-693. DOI:10.2307/2657354

ACCEPTED

Copyright © 2026 American College of Occupational and Environmental Medicine. Unauthorized reproduction of this article is prohibited.

23. Berkman LF, Kelly EL, Hammer LB, et al. Employee Cardiometabolic Risk Following a Cluster-Randomized Workplace Intervention From the Work, Family and Health Network, 2009–2013. *American Journal of Public Health*. 2023; 113(12):1322-1331. DOI:10.2105/ajph.2023.307413

24. Mohr C, Hammer L, Dimoff J, et al. Supportive-leadership training to improve social connection: A cluster-randomized trial demonstrating efficacy in a high-risk occupational context. *J Occup Health Psychol*. 2024;29(5):299-316. DOI:10.1037/ocp0000384

25. Ji JL, Basanovic J, MacLeod C. Social activity promotes resilience against loneliness in depressed individuals: a study over 14-days of physical isolation during the COVID-19 pandemic in Australia. *Sci Rep*. 2022;12(1):7155. doi:10.1038/s41598-022-11315-4

26. Chikatimalla R, Trivedi YV, Chigurupati HD, et al. From prediction to precision: Artificial intelligence and emerging technologies in cardiopulmonary resuscitation. *Progress in Cardiovascular Diseases*. 2025;92:97-107. DOI:https://doi.org/10.1016/j.pcad.2025.09.004

27. Employment and Training Administration, U.S. Department of Labor. Data from: O*NET 28.3 Database. Used under the CC BY 40 license. O*NET® is a trademark of USDOL/ETA. May 2024 Release.

28. Colato J, Ice L. Industry and occupational employment projections overview and highlights, 2022–32. *Monthly Labor Review.* U.S. Bureau of Labor Statistics. 2023. DOI: https://doi.org/10.21916/mlr.2023.24

29. National Academies of Sciences, Engineering, and Medicine; Health and Medicine Division; Board on Health Sciences Policy; *A Smarter National Surveillance System for Occupational Safety and Health in the 21st Century*. Washington (DC): National Academies Press (US); October 9, 2018.

ACCEPTED

Copyright © 2026 American College of Occupational and Environmental Medicine. Unauthorized reproduction of this article is prohibited.

30. Cox-Ganser JM, Henneberger PK. Occupations by Proximity and Indoor/Outdoor Work: Relevance to COVID-19 in All Workers and Black/Hispanic Workers. *American Journal of Preventive Medicine.* 2021;60(5):621-628. DOI:https://doi.org/10.1016/j.amepre.2020.12.016

31. Asfaw A. Racial Disparity in Potential Occupational Exposure to COVID-19. *J Racial Ethn Health Disparities*. 2022;9(5):1726-1739. DOI:10.1007/s40615-021-01110-8

32. Baker MG, Peckham TK, Seixas NS. Estimating the burden of United States workers exposed to infection or disease: A key factor in containing risk of COVID-19 infection. *PLoS One*. 2020;15(4):e0232452. DOI:10.1371/journal.pone.0232452

33. Vergara XP, Gibb K. Close physical proximity on the job—An exposure matrix. *American Journal of Industrial Medicine*. 2022;65(7):537-547. DOI:https://doi.org/10.1002/ajim.23396

34. Yanik EL, Evanoff BA, Dale AM, Ma Y, Walker-Bone KE. Occupational characteristics associated with SARS-CoV-2 infection in the UK Biobank during August-November 2020: a cohort study. *BMC Public Health*. 2022;22(1):1884. DOI:10.1186/s12889-022-14311-5

35. Etienne AJ, Field WE, Ehlers SG, Tormoehlen R, Haslett NJ. The Climate of Working Alone in Agriculture. *J Agric Saf Health*. 2025;31(2):93-108. DOI:10.13031/jash.16102

36. Etienne AJ, Field WE, Haslett N. A Summary of Lone Agricultural Worker Injuries and Fatalities. *J Agric Saf Health*. 2023;29(3):185-201. DOI:10.13031/jash.15523

37. Alroomi AS, Mohamed S. Physical isolation and safety behaviour among oil and gas workers in Kuwait: The mediating role of mental health. *Journal of Loss Prevention in the Process Industries*. 2022;75:104692. DOI:https://doi.org/10.1016/j.jlp.2021.104692

ACCEPTED

Copyright © 2026 American College of Occupational and Environmental Medicine. Unauthorized reproduction of this article is prohibited.

38. Han E, Kim UJ, Lee Y, et al. Association between lone work and self-rated health status: using the 5th Korean Working Conditions Survey. *Ann Occup Environ Med*. 2023;35:e29. DOI:10.35371/aoem.2023.35.e29

39. Amandus HE, Hendricks SA, Zahm D, et al. Convenience Store Robberies in Selected Metropolitan Areas: Risk Factors for Employee Injury. *Journal of Occupational and Environmental Medicine*. 1997;39(5):442-447.

40. Faulkner KA, Landsittel DP, Hendricks SA. Robbery characteristics and employee injuries in convenience stores. *Am J Ind Med*. 2001;40(6):703-9. DOI:10.1002/ajim.10011

41. d'Errico A, Gallo F, Evanoff BA, Descatha A, Dale AM. Reliability of O*NET physical exposures between Italian and US databases. *Am J Ind Med*. 2022;65(10):790-799. DOI:10.1002/ajim.23423

42. Harrison RJ, Retzer K, Kosnett MJ, et al. Sudden Deaths Among Oil and Gas Extraction Workers Resulting from Oxygen Deficiency and Inhalation of Hydrocarbon Gases and Vapors - United States, January 2010-March 2015. *MMWR - Morbidity & Mortality Weekly Report*. 65(1):6-9.

43. Kentucky Fatality Assessment and Control Evaluation Program (KY FACE). Service Technician Working Alone Dies after being Assaulted. 2010. https://stacks.cdc.gov/view/cdc/165247

44. Washington State Fatality Assessment and Control Evaluation Program. Retail Worker Fatality Narrative: Clerk Shot in Robbery of Family Gas Station. 2024. https://www.lni.wa.gov/safety-health/safety-research/files/2024/71_250_2024s_GasStationClerkHomicideSlideshow.pdf

ACCEPTED

Copyright © 2026 American College of Occupational and Environmental Medicine. Unauthorized reproduction of this article is prohibited.

45. NIOSH Fatality Assessment and Control Evaluation Program. Recycling Center Laborer Crushed In Baling Machine– Tennessee. 1996. https://stacks.cdc.gov/view/cdc/167310

46. NIOSH Fatality Assessment and Control Evaluation Program. Sixteen-Year-Old Produce-Market Worker Dies From Crushing Injuries After Being Caught in a Vertical Downstroke Baler – New York. 2000. https://stacks.cdc.gov/view/cdc/167368

47. NIOSH Fatality Assessment and Control Evaluation Program. 36-Year-Old Paper Factory Worker Dies From Crushing Injuries After Being Caught in a Horizontal Baler – Pennsylvania. 2002. FACE Reports. https://stacks.cdc.gov/view/cdc/167338

48. NIOSH Fatality Assessment and Control Evaluation Program. Millwright Killed When Pinned Between the Feed Rolls of a Debarker during Machine Maintenance – South Carolina. 2007. https://stacks.cdc.gov/view/cdc/167277

49. Bylow H, Rawshani A, Claesson A, Lepp M, Herlitz J. Characteristics and outcome after out-of-hospital cardiac arrest with the emphasis on workplaces: an observational study from the Swedish Registry of Cardiopulmonary Resuscitation. *Resuscitation Plus*. 2021;5:100090. DOI:https://doi.org/10.1016/j.resplu.2021.100090

50. Descatha A, Dagrenat C, Cassan P, Jost D, Loeb T, Baer M. Cardiac arrest in the workplace and its outcome: a systematic review and meta-analysis. *Resuscitation*. 2015;96:30-36. DOI:https://doi.org/10.1016/j.resuscitation.2015.07.004

51. Valtorta NK, Kanaan M, Gilbody S, Ronzi S, Hanratty B. Loneliness and social isolation as risk factors for coronary heart disease and stroke: systematic review and meta-analysis of longitudinal observational studies. Heart. 2016;102(13):1009-1016. doi:10.1136/heartjnl-2015-308790

ACCEPTED

Copyright © 2026 American College of Occupational and Environmental Medicine. Unauthorized reproduction of this article is prohibited.

52. Yang YC, Boen C, Gerken K, Li T, Schorpp K, Harris KM. Social relationships and physiological determinants of longevity across the human life span. Proc Natl Acad Sci U S A. 2016;113(3):578-583. doi:10.1073/pnas.1511085112

53. MacDonald LA, Bertke S, Hein MJ, et al. Prevalence of Cardiovascular Health by Occupation: A Cross-Sectional Analysis Among U.S. Workers Aged ≥45 Years. Am J Prev Med. 2017;53(2):152-161. doi:10.1016/j.amepre.2017.02.022

54. Sussell A, Peterson C, Li J, Miniño A, Scott KA, Stone DM. Suicide Rates by Industry and Occupation - National Vital Statistics System, United States, 2021. MMWR Morb Mortal Wkly Rep. 2023;72(50):1346-1350. Published 2023 Dec 15. doi:10.15585/mmwr.mm7250a2

55. Birmingham WC, Holt-Lunstad J, Herr RM, Barth A. Social Connections in the Workplace. Am J Health Promot. Jul 2024;38(6):886-891. doi:10.1177/08901171241255204b

56. Kelly EL, Moen P, Oakes JM, et al. Changing Work and Work-Family Conflict: Evidence from the Work, Family, and Health Network. *American Sociological Review*. 2014;79(3):485-516. DOI:10.1177/0003122414531435

57. Hammer LB, Allen SJ, Leslie JJ. Occupational Stress and Well-Being: Workplace Interventions Involving Managers/Supervisors. In: Lapierre LM, Cooper SC, eds. *Organizational Stress and Well-Being*. Cambridge University Press; 2023:389-417.

58. Cropanzano R, Keplinger K, Lambert BK, Caza B, Ashford SJ. The organizational psychology of gig work: An integrative conceptual review. J Appl Psychol. Mar 2023;108(3):492-519. DOI:10.1037/apl0001029

59. Feldblum CR, Lipnic VA. Select Task Force on the Study of Harassment in the Workplace. U.S. Equal Employment Opportunity Commission. 2016. URL: https://www.eeoc.gov/select-task-force-study-harassment-workplace

ACCEPTED

Copyright © 2026 American College of Occupational and Environmental Medicine. Unauthorized reproduction of this article is prohibited.

60. Health and Safety Executive (UK). Reporting of Injuries, Diseases, and Dangerous Occurrences Regulations (RIDDOR), Schedule 2: Dangerous Occurrences. London, England, United Kingdom. https://www.legislation.gov.uk/uksi/2013/1471/schedule/2/made

61. OSHA. Grain Handling Facilities. 29 CFR § 1910.272. Mar 2003. https://www.govinfo.gov/content/pkg/FR-2003-03-14/pdf/03-6117.pdf

62. OSHA. Respiratory Protection: Procedures for IDLH atmospheres. 29 CFR § 1910. 134(g)(3). Jan 1998. https://www.govinfo.gov/content/pkg/FR-1998-01-08/pdf/97-33843.pdf

63. OSHA. Respiratory Protection: Procedures for interior structural firefighting. 29 CFR § 1910. 134(g)(4). Jan 1998. https://www.govinfo.gov/content/pkg/FR-1998-01-08/pdf/97-33843.pdf

64. OSHA. Occupational Safety and Health: Posting of notices by employer. 29 USC § 657(c)(1)1970. https://uscode.house.gov/view.xhtml?path=/prelim@title29/chapter15&edition=prelim

65. Deutsche Gesetzliche Unfallversicherung. Einsatz von Personen-Notsignal-Anlagen. Regel 112-139. Jan 2012. https://publikationen.dguv.de/regelwerk/dguv-regeln/1004/einsatz-von-personen-notsignal-anlagen

66. Straub F. High Risk, Lone Worker: The Unacceptable Risk. *Professional Safety*. 2018;63(07):30-35.

67. National Safety Council. Using Lone Worker Monitoring Technology to Protect Workers. 2023. https://www.nsc.org/getmedia/c2ab538c-8464-48cd-bf90-e1601f466bd5/wtz-lone-down-worker-monitoring-wp.pdf

ACCEPTED

Copyright © 2026 American College of Occupational and Environmental Medicine. Unauthorized reproduction of this article is prohibited.

68. Kawamoto E, Ito-Masui A, Esumi R, et al. Social Network Analysis of Intensive Care Unit Health Care Professionals Measured by Wearable Sociometric Badges: Longitudinal Observational Study. J Med Internet Res. 2020;22(12):e23184. DOI:10.2196/23184

69. Olguin Olguin D, Waber BN, Kim T, Mohan A, Ara K, Pentland A. Sensible organizations: technology and methodology for automatically measuring organizational behavior. IEEE Trans Syst Man Cybern B Cybern. 2009;39(1):43-55. DOI:10.1109/tsmcb.2008.2006638

70. Ajunwa I. The Quantified Worker: Law and Technology in the Modern Workplace. Cambridge University Press; 2023.

ACCEPTED

Copyright © 2026 American College of Occupational and Environmental Medicine. Unauthorized reproduction of this article is prohibited.

9. Figure Legend

FIGURE 1: The Categorical Distributions of Physical Proximity and Contact Frequency at Work Reported by Survey Respondents; O*NET 28.3 Database, May 2024 Release

FIGURE 2: Temporal Trends in Mean Occupational Prevalence of Socially Isolated Work (SIW) and Physically Isolated Work (PIW) in O*NET Data Releases from 2012-2024, By Collection Date, Release Date, and Liberal or Conservative Definition of Isolation.

ACCEPTED

Copyright © 2026 American College of Occupational and Environmental Medicine. Unauthorized reproduction of this article is prohibited.

Table 1: Estimating changes in the number and percent of U.S. workers reporting physical or social isolation, among 698 of 867 detailed Standard Occupational Code (SOC) occupations (80.5%)

Year	Physical isolation*			Social isolation**		
Conservative	**Isolated workers (n)**	**Total (n)**	**Isolated (%)**	**Isolated workers (n)**	**Total (n)**	**Isolated (%)**
2023	5,296,644	131,317,529	4	1,725,497	132,666,373	1.3
2033	5,458,603	135,592,771	4	1,738,172	137,303,966	1.3
Estimated Change	161,959	4,275,242	3.8	12,675	4,637,593	0.3
Liberal	**Isolated workers (n)**	**Total (n)**	**Isolated (%)**	**Isolated workers (n)**	**Total (n)**	**Isolated (%)**
2023	28,212,977	131,317,529	21.5	7,790,122	132,666,373	5.9
2033	29,275,783	135,592,771	21.6	7,967,878	137,303,966	5.8
Estimated Change	1,062,806	4,275,242	24.9	177,756	4,637,593	3.8

* Conservative definition of physical isolation: individuals who when asked "How physically close to other people are you when you perform your current job?" responded "I don't work near other people (beyond 100 ft)". Liberal definition: also includes individuals who responded "I work with others but not closely (e.g., private office)".

** Conservative definition of social isolation: individuals who when asked "How much contact with others (by telephone, face-to-face, or otherwise) is required to perform your current job?" responded "No contact with others". Liberal definition: also includes individuals who responded "Occasional contact with others".

ACCEPTED

Copyright © 2026 American College of Occupational and Environmental Medicine. Unauthorized reproduction of this article is prohibited.

Table 2: Estimated Number of U.S. Workers Who Are Physically or Socially Isolated at Work, by Isolation Definition, 2023					
Total Employment *	**Definition**	**Physical Isolation**		**Social Isolation**	
		Percent isolated**	**Number of workers**	**Percent isolated****	**Number of workers**
167,849,800	Conservative	4.0%	6,770,160	1.5%	2,183,103
	Liberal	21.5%	36,061,770	5.9%	9,856,080

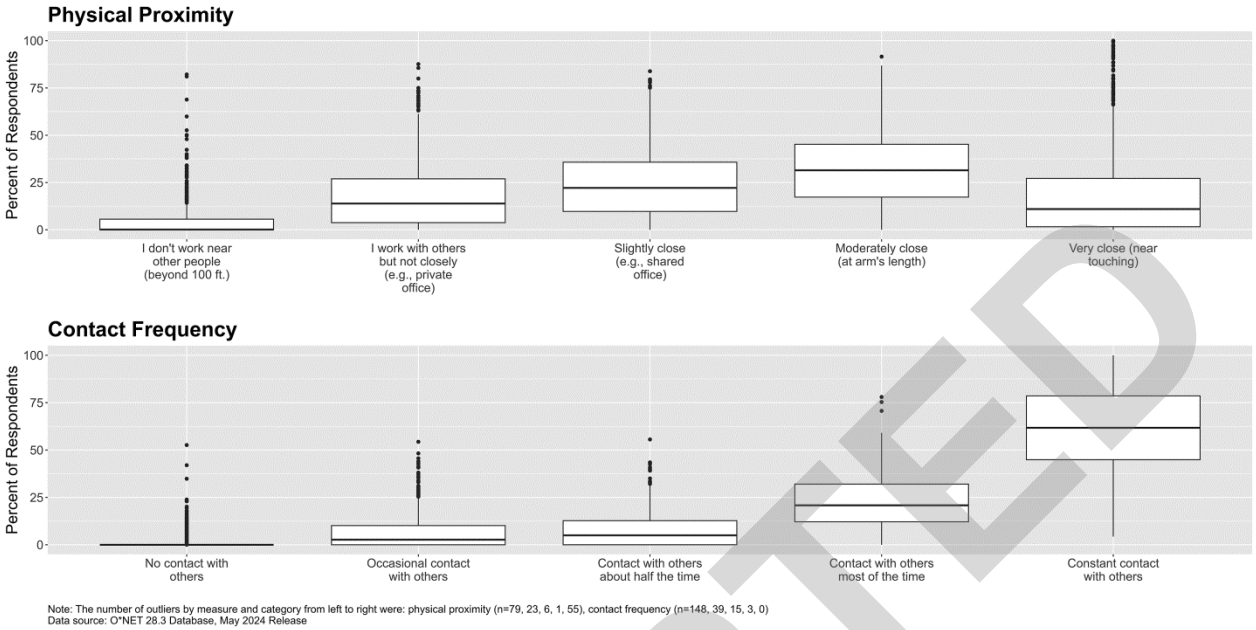
* https://www.bls.gov/opub/mlr/2024/article/industry-and-occupational-employment-projections-overview-and-highlights-2023-33.htm

** Table 1

ACCEPTED

Copyright © 2026 American College of Occupational and Environmental Medicine. Unauthorized reproduction of this article is prohibited.

Figure 1

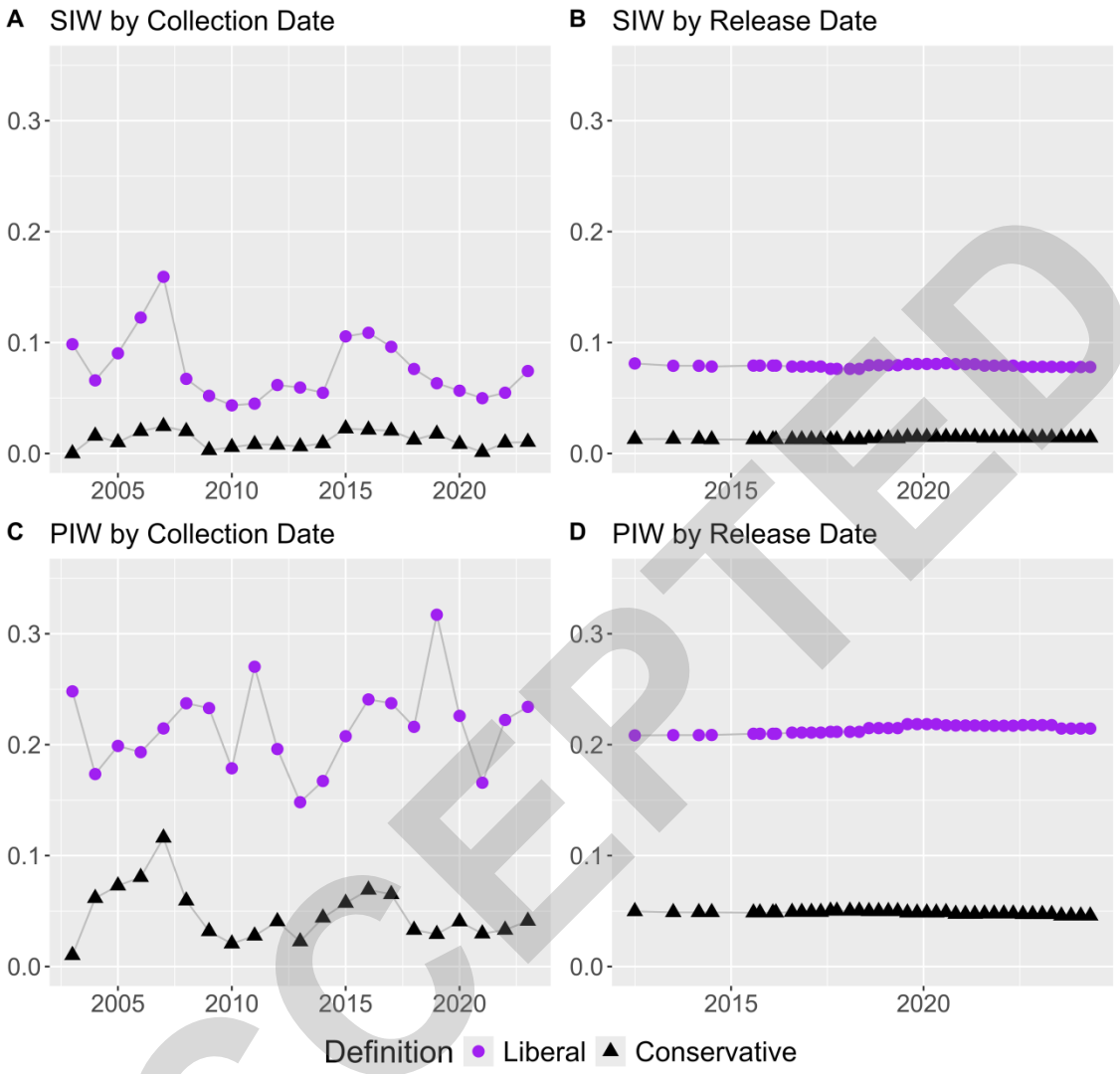


Note: The number of outliers by measure and category from left to right were: physical proximity (n=79, 23, 6, 1, 55), contact frequency (n=148, 39, 15, 3, 0)
Data source: O*NET 28.3 Database, May 2024 Release

ACCEPTED

Copyright © 2026 American College of Occupational and Environmental Medicine. Unauthorized reproduction of this article is prohibited.

Figure 2

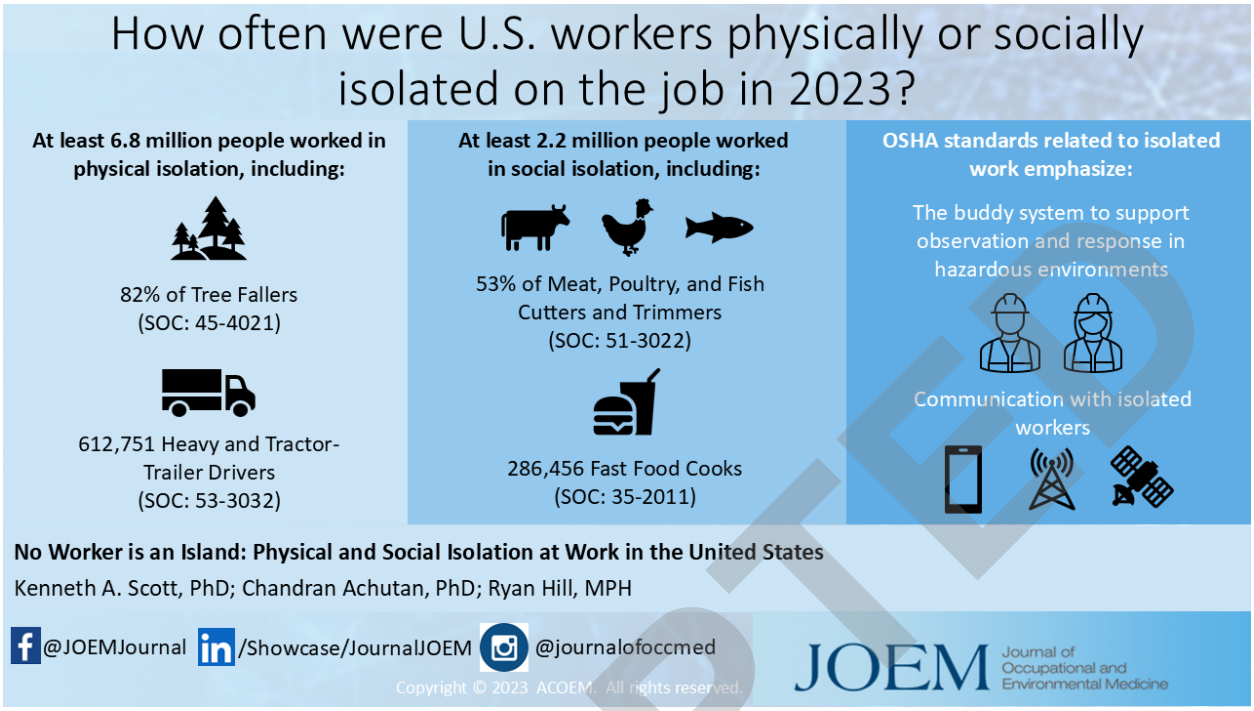


Data source:
*Each O*NET data release, v17.0-v28.3 (2012-2023)*

ACCEPTED

Copyright © 2026 American College of Occupational and Environmental Medicine. Unauthorized reproduction of this article is prohibited.

Graphical abstract



ACCEPTED

Copyright © 2026 American College of Occupational and Environmental Medicine. Unauthorized reproduction of this article is prohibited.