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The prevalence of functional limitations in the US workforce

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This research paper investigates the prevalence of functional limitations among employed adults in the United States and the association between these limitations and medical conditions. The authors administered a survey adapted from the Dutch *Functional Abilities List* to a nationally representative sample of US adults ages 22 and older, finding that nearly three-quarters of working adults report at least one functional limitation, with an average of nearly six functional limitations per working adult. The most common limitations were in upper body strength and torso range of motion, and with respect to the ambient environment. The study also found that mental illness, arthritis, and substance use disorder are associated with the greatest number of functional limitations in working adults. The findings have implications for economic performance, workforce planning, and social policies to support displaced and vulnerable workers with significant functional limitations. Identifying the occupations and industries with large numbers of workers with functional limitations is critical to addressing short-term labor supply disruptions (e.g., public health crises) and preparing for longer-term workforce needs (e.g., long-term care workers for an aging population).

functional limitations | medical conditions | work capacity | workforce

Significance

A country's economic performance depends in large part on the health and productivity of its workforce. This research provides critical insights into the health and functional abilities of American workers. It reveals that a significant proportion of working adults have work-related functional limitations, often due to chronic medical conditions like mental illness, arthritis, and substance use disorder. The findings highlight occupations and industries where health-related factors have the potential to constrain labor force and productivity growth. Policy initiatives designed to support workers with health-related limitations might consider targeting these occupations and industries.

The health and productivity of a country's workforce affect its economic performance (1, 2). In the United States, chronic disease rates among middle-aged adults are much higher than in England and Europe (3, 4), and even among younger Americans who are working (ages 25 to 54), approximately one-half have one or more chronic medical conditions (5–7), including conditions associated with presenteeism, absences, and premature labor force exit (8–10). Although striking, disease prevalence estimates provide an incomplete picture of the functional capacity of the US workforce since a given illness may cause widely varying functional limitations—that is, limitations in the physical, cognitive, and emotional abilities individuals need for independent functioning in daily work activities. Little is known about which functional limitations are most prevalent among American workers and which medical conditions impose the greatest number of functional limitations on the workforce.

To estimate the prevalence of functional limitations among employed US adults and the association between functional limitations and medical conditions, we administered a survey of work-related functional abilities to a nationally representative sample of US adults. The survey was adapted from the Dutch *Functional Abilities List* (Dutch acronym FML) (11). The FML is used in the Netherlands to measure the work capacity of applicants for disability insurance benefits. The FML is a notable example of direct assessment of work capacity due to its data-driven link between functional abilities and work requirements (12–14). In other words, FML functional abilities map directly to job requirements in the national economy. Disability assessors identify specific jobs an individual can and cannot feasibly do by comparing the individual's FML ratings to a large database of entry-level job requirements. The process is automated for most FML items, but some items require manual review (e.g., general abilities needed for most jobs). The FML measures functional abilities in 16 domains relating to: the ambient environment; arm movements; body movements; hand and finger movements; head and neck movements; the immune system; knee movements; memory, attention, and cognition; mobility; pace; sensory abilities; sitting time; social skills and emotional regulation; standing; upper body strength and torso range of motion; and verbal and written communication (see *SI Appendix*, Table S1 for individual limitations in each domain). Most of these domains are not found in US surveys, which use the federal government's standard six questions to measure general disability status (15).

We administered the adapted FML to participants in the RAND American Life Panel (ALP) during April–June of 2019. The ALP is an ongoing, nationally representative panel of US adults and intended for social science research. To ensure representativeness, panel members were recruited by mail, telephone, or in-person contact using probability-based sampling and provided computing technology and internet access as needed. We invited

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3,396 ALP respondents to take our survey, titled *Health and Functional Capacity Survey* (HFCS) (16). The survey had a completion rate of 87% (N = 2,657), comparable to other ALP surveys.

The HFCS began by presenting respondents with a list of 57 chronic medical conditions and asked them to indicate which they currently had, if any. Respondents could use free text fields to record any medical conditions not listed. Next, we asked questions to screen out respondents with a terminal illness, those with a serious mental illness limiting daily activities, those who are largely dependent on others to perform activities of daily living (ADLs), or who were residing in an institutional care setting. The FML items were not administered to these respondents, since such applicants are deemed to have no work capacity and are eligible for full disability benefits in the Netherlands. Next, respondents were presented with questions corresponding to 103 FML items, 97 of which were functional abilities (the other items included questions about working hours, handedness, and need for mobility aids). Most questions had binary response options indicating presence/absence of a functional limitation, though some had multiple response options. For example, a question about sitting ability asked: "What is the total amount of sitting you can do in an 8 hour working day?" The response options were "I can sit for at least 8 hours," "I can sit for most of the working day, but no more than 8 hours," "I can sit for at least 4 hours," and "I cannot sit for more than 4 hours." The threshold for limitation is the last option—unable to sit for more than 4 h, following practice in the Netherlands. *SI Appendix*, Table S1 lists each functional ability and the threshold defining functional limitation. We categorized individuals as having an ability limitation if their response met or exceeded the threshold for limitation. The survey closed with questions about educational attainment, employment, health insurance, and disability program participation.

To estimate the prevalence of functional limitations and their association with medical conditions among employed US adults, we restricted our analysis sample to HFCS respondents aged 22 or older who were currently working and who passed the screening questions (N = 1,477). We first estimated the overall prevalence of any functional limitation and then the prevalence of functional limitations in each of the 16 functional domains. We then calculated the mean number of limitations for the sample overall and by demographic and job characteristics. Next, we consolidated the reported medical conditions into 30 major conditions and we used linear regression to estimate the association between individuals' number of functional limitations and each medical condition, controlling for all other medical conditions, age and sex, and compared to the reference category of no medical conditions. Finally, we used the regression coefficient on each medical condition multiplied by the condition's prevalence to calculate the expected increase in functional limitations per 100 working adults associated with each medical condition.

Our approach assigns all functional abilities equal weight when, in practice, some are required by a large share of jobs while others are required by a small share. If few jobs require a given ability, a limitation of that ability may be inconsequential for a person's work capacity. We therefore explore the sensitivity of our results to an alternative weighting scheme where we weight each ability by its prevalence among job requirements, calculated separately for jobs that do and do not require a Bachelor's degree. Because it is not possible to calculate prevalence rates for abilities subject to manual review (conceptually, they are general abilities needed for most jobs), we test two ways of handling these: The first assigns them a prevalence of 0 (relevant for no jobs), while the second assigns them a prevalence of 1 (relevant for all jobs).

Results

Table 1 presents summary statistics for our analysis sample, where col. 1 shows unweighted means, col. 2 shows weighted means, and col. 3 shows corresponding statistics from the 2018 Current Population Survey (CPS). Comparing cols. 1 and 3, we see that compared to the CPS, HFCS respondents were more likely to be female (57.2 vs. 46.8%), ages 50 to 64 (45.4 vs. 29.2%), and hold a Bachelor's degree (55.3 vs. 40.2%). After applying ALP's sample weights (constructed to match the CPS on sex, age, education, race/ethnicity, household income level, and number of household members), the HFCS sample (col. 2) matches the sex, age, and education distribution of the CPS. However, HFCS respondents, all of whom were employed, were less likely to be working full time compared with workers in the CPS (81.0 vs. 86.8%, $P < 0.01$) and were more likely to work in service-producing industries (86.4 vs. 80.3%, $P < 0.01$). The distribution of HFCS respondents across occupations in the weighted sample (occupation was not used to construct the sample weights) matches the CPS distributions reasonably well. However, the HFCS has more clerical support workers (13.8 vs. 9.2%, $P < 0.01$) and fewer workers in craft and related trades (5.7 vs. 9.9%, $P < 0.01$) and elementary occupations (6.8 vs. 8.5%, $P < 0.01$) compared to the CPS. Overall, workers in professional occupations account for the largest share of the sample (23.5%), followed by technicians and associate professionals (16.0%), services and sales workers (14.2%), and clerical support workers (13.8%). Just 13.6% work in a goods-producing industry, while 86.4% work in a service-producing industry. Almost two-thirds (65.4%) of respondents work in essential occupations (defined according to government guidance about "essential critical infrastructure workers" during the COVID-19 pandemic), and 51.4% work in occupations that can feasibly be done through telework (17, 18).

Table 1 also presents the means of our outcome variables, which are similar across the unweighted and weighted samples (but not available in the CPS). We find that 66.7% of working adults had at least one medical condition and 74.2% had at least one functional limitation. The mean number of functional limitations across respondents was 5.6 (out of 97 possible) and the median number was 3.

Fig. 1 presents the prevalence of functional limitations among working adults by the functional domain affected. The most prevalent types of functional limitations were in upper body strength and torso range of motion (38.2% of working adults had at least one limitation in this category). The most common limitations in this domain concern handling heavy loads (17.1%), bending the upper body (13.4%), pulling or pushing (13.3%), and performing activity when bending/twisting (13.0%) (see *SI Appendix*, Table S1 for prevalence and 95% CI of each separate functional limitation). The second most common type of functional limitation, as shown in Fig. 1, was with respect to the ambient environment (36.8% of working adults had at least one limitation in this category). The most frequently reported limitations related to the ambient environment were the inability to tolerate reduced air quality (21.5%), vibrations (18.5%), low temperatures (18.0%), high temperatures (17.1%), skin contact (17.2%), noise (16.8%), and air movements (13.5%) (see *SI Appendix*, Table S1 for details). Fig. 1 shows the next most common limitation types by functional domain were concerning knee movements (29.6%), followed by immune system (26.8%), sitting (23.9%), arm movements (22.2%), mobility (19.7%), head and neck movements (19.4%), social skills and emotional regulation (16.7%), hand and finger movements (15.4%), memory, attention, and cognition (12.8%), standing (10.5%), pace (10.3%), sensory (8.6%), and verbal and written communication (5.9%).

Table 1. Descriptive statistics for the HFCS analysis sample

	Percentage (unweighted sample) (1)	Percentage (weighted sample) (2)	Percentage (2018 CPS Working Population) (3)
Sex			
Male	42.8	52.9	53.2
Female	57.2	47.1	46.8
Age			
22–34	10.8	29.4	30.4
35–49	31.1	35.2	33.6
50–64	45.4	28.3	29.2
65+	12.6	7.1	6.8
Education			
BA	55.3	39.0	40.2
No BA	44.7	61.0	59.8
Hours of work			
Full time	79.9	81.0***	86.8
Part time	20.1	19.0***	13.2
Industry			
Goods-producing	9.7	13.6***	19.7
Service-producing	90.3	86.4***	80.3
Occupation			
Managers	11.2	12.9*	11.2
Professionals	31.3	23.5	22.8
Technicians and associate professionals	18.6	16.0	15.8
Clerical support workers	14.1	13.8***	9.2
Services and sales workers	13.1	14.2*	15.8
Craft and related trade workers	4.0	5.7***	9.9
Plant and machine operators and assemblers	3.7	6.8	6.3
Elementary occupations	3.8	6.8**	8.5
Occupation type			
Essential	62.2	65.4	66.4
Nonessential	37.4	34.0	33.6
Teleworkable	58.4	51.4***	42.9
Nonteleworkable	41.2	47.8***	57.1
Health outcomes			
At least one medical condition	70.3	66.7	.
At least one functional limitation	77.2	74.2	.
Mean number of functional limitations (max 97)	5.3	5.6	.
Median number of functional limitations	3.0	3.0	.

This table provides descriptive statistics for our analysis sample, weighted and unweighted, and compares these to the 2018 CPS. Our analysis sample consists of 1,477 HFCS respondents who were aged 22 and older, currently working, and passed the screening questions. ALP provided sampling weights constructed to match the 2018 CPS on age, sex, race/ethnicity, education level, household income, and the number of household members for those aged 22 to 96. The CPS sample was also restricted to respondents aged 22 and older and currently working. Full-time work was defined as working 35 or more hours per week. Occupation category is based on the first digit of ISCO-08 codes; two categories had fewer than five respondents and were excluded from the table (Agricultural, forestry and fishery workers, and Armed forces occupations). Industry classification is an aggregation of NAICS supersectors. There were three respondents who did not provide industry information and 16 who did not provide occupational information. These respondents were retained in the sample but excluded from the calculation of summary statistics for the occupation/industry category with missing information. A *t* test was used to compare the weighted HFCS sample (col. 2) and 2018 CPS working population (col. 3). Significance stars $^*P < 0.10$, $^{**}P < 0.05$, $^{***}P < 0.01$ indicate where there were statistically significant differences between cols. 2 and 3.

At the level of individual limitations (as opposed to functional domains), the five most common functional limitations overall were allergies that limit tolerance to physical environments (25.1%); inability to sit for most of the working day (i.e., unable to sit for more than 4 h) (22.9%); inability to be routinely exposed to dust, smoke, gas, or steam (21.5%); inability to be routinely exposed to vibrations or jolts (18.5%); inability to be routinely exposed to temperatures lower than 5 degrees Fahrenheit for at least 5 min at a time (18.0%) (see *SI Appendix*, Table S1 for prevalence and 95% CI).

We also compared the prevalence of functional limitations for workers in essential vs. nonessential and teleworkable vs.

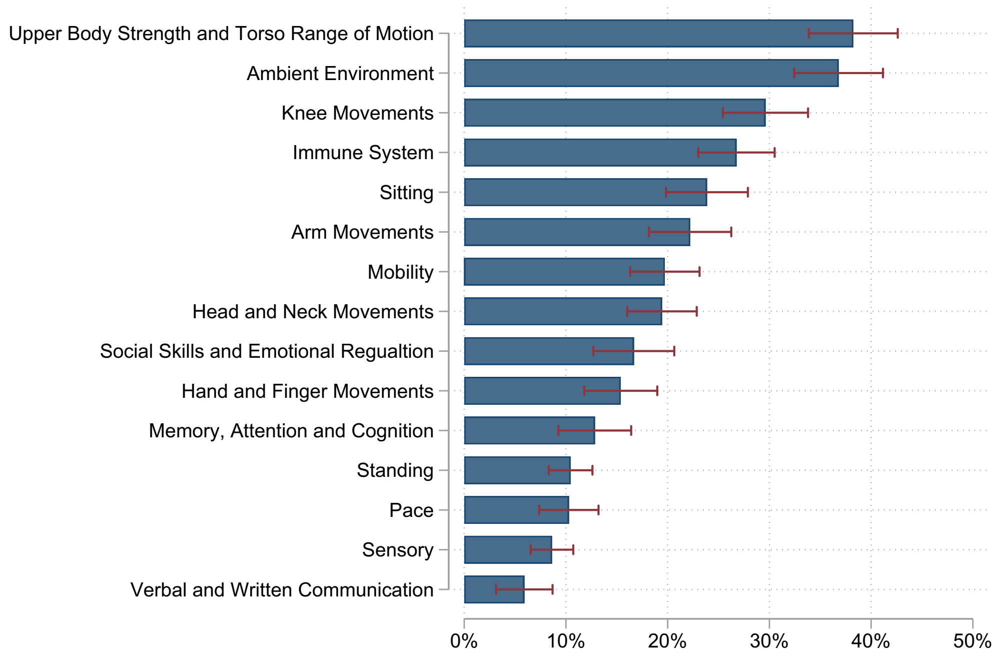

Fig. 1. Prevalence of any limitation in functional domain. This figure shows the population prevalence (%) of any limitation in the listed functional domain in the analysis sample (N = 1,477). Error bars represent 95% CI. Authors grouped functional abilities into 16 functional domains (see *SI Appendix*, Table S1 for a full listing of functional abilities by functional domain). One domain, *Body Function, Not Elsewhere Classified* is excluded from the figure due to very low prevalence (< 0.1%).

nonteleworkable occupations. Essential occupations include workers in hospitals, food manufacturing plants, and utilities, among others, who are usually required to work in person (19). Functional limitations were more prevalent for those in essential occupations (compared to nonessential) across almost all functional groups (statistically significant differences in 9/16 domains). The only functional domain where the prevalence of functional limitations was lower for essential occupations was Standing (9.5 vs. 12.5%), though the difference was not statistically significant. Conversely, functional limitations were less prevalent for those in teleworkable occupations (compared to nonteleworkable), with statistically significant differences in 10 of the 16 functional domains. However, those in teleworkable occupations were more likely to report having a limitation in the Immune System domain (29.8 vs. 24.2%, $P < 0.01$) (see *SI Appendix*, Table S2 for prevalence and 95% CI).

Fig. 2 presents the mean number of functional limitations among working adults by sex, age, education level, industry type, and measures of occupation type. On average, women had 6.0 functional limitations while men had just 5.2, a statistically significant difference ($P < 0.05$). The mean number of functional limitations was lowest among workers aged 22 to 34 (5.0 limitations) but did not vary significantly across workers aged 35 to 49, 50 to 64, and 65+, who had 5.7, 6.0, and 6.0 limitations, respectively. Working adults without a BA had substantially more functional limitations than those with a BA (6.7 vs. 3.8, $P < 0.01$). The mean number of limitations was similar for workers in goods-producing industries as for those in service-producing industries (5.5 vs. 5.6 limitations).

Fig. 2 shows large and statistically significant differences in the mean number of functional limitations among workers in different occupations. The mean number of functional limitations was lowest among craft and related trade workers (2.9 limitations), managers (3.6 limitations), and professionals (3.9 limitations), and notably higher among services and sales workers (8.3 limitations) and those in elementary occupations (11.3 limitations). We find that workers in essential occupations had significantly more functional limitations than those in nonessential occupations (6.2 vs. 4.5 limitations, $P < 0.01$). The pattern is similar for workers in nonteleworkable vs. teleworkable occupations (6.7 vs. 4.6, $P < 0.01$).

In supplemental analyses, we regressed the number of functional limitations on demographic and job characteristics simultaneously. We find that the differences in the number of limitations by sex and age (but not education) are explained by occupational and industry differences across the demographic groups (*SI Appendix*, Table S3).

Finally, Table 2 presents the ten medical conditions most associated with functional limitations among working adults. Col. 1 gives the estimated marginal increase in the number of functional limitations associated with each medical condition (compared to having no medical conditions). Col. 2 reports the prevalence of each medical condition in the analysis sample. Col. 3 is the expected increase in the number of functional limitations per 100 working adults associated with a specific condition, which is the product of cols. 1 and 2, multiplied by 100. The top 10 medical conditions are presented in descending order based on col. 3.

Of the top 10 medical conditions presented, col. 1 of Table 2 shows that structural heart disease is associated with the largest increase in functional limitations (15.4 additional limitations), followed by other neurological disorders (5.2 additional limitations) and substance use disorder and related complications (5.0 additional limitations). These results are similar with and without demographic controls (*SI Appendix*, Table S4). Certain medical conditions are highly disabling but uncommon, as shown in col. 2. Blindness, for example, is associated with the second largest increase in limitations (14.8 additional limitations), but its prevalence is only 0.4%, so blindness does not rank in the top 10 highest-impact medical conditions (see *SI Appendix*, Table S4 for full list). In contrast, highly prevalent disorders, such as back pain (22.3%) and diabetes and obesity (18.2%), are associated with (statistically insignificant) increases of only 0.4 and 0.7 functional limitations, respectively. Finally, col. 3 shows that at the workforce level, the largest number of functional limitations are attributed to mental illness (73.8 limitations per 100 working adults),

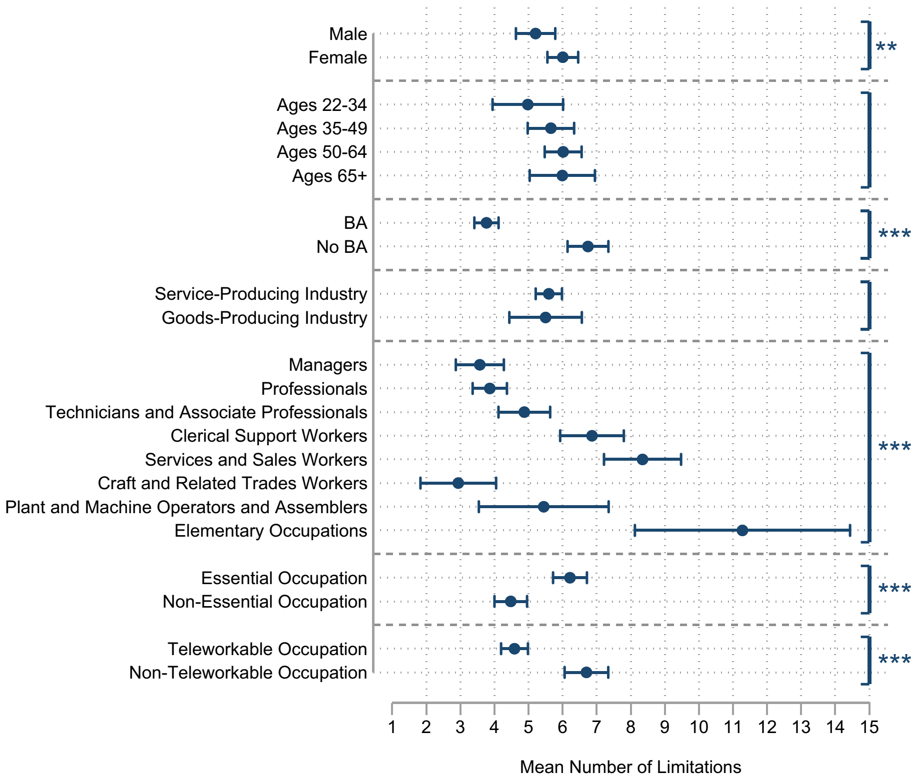

Fig. 2. Mean number of limitations by demographic and job characteristics. This figure shows the mean number of limitations for different demographic, industry, and occupation groups in the analysis sample (N = 1,477). Error bars represent 95% CI. The maximum number of limitations is 97. The ISCO-08 occupation classification results are limited to civilian occupations with more than five respondents. Industry is an aggregation of NAICS supersectors. There were 16 respondents who did not provide occupational information and three who did not provide industry information. One-way ANOVA was used to test for differences in the mean number of limitations across all groups within a demographic or job characteristic category. Significance stars *$P < 0.10$, **$P < 0.05$, *** $P < 0.01$ indicate where there were statistically significant differences.

followed by arthritis and other joint disease (66.7 limitations per 100 working adults), substance use disorder and related complications (30.0 limitations per 100 working adults), and asthma and chronic obstructive pulmonary disease (COPD) (26.7 limitations per 100 working adults). See *SI Appendix*, Table S4 for the full list of medical conditions ranked by population impact.

Table 2. Top ten highest-impact medical conditions, ranked by population impact (col. 3)

Medical condition	Increase in number of functional limitations (1)	Prevalence of medical condition (2)	Increase in number of functional limitations X prevalence of medical condition X 100 (3)
1. Mental illness	2.66**	0.278	73.79***
	(0.88)	(0.012)	(27.30)
2. Arthritis and other joint disease	3.24***	0.206	66.72**
	(1.20)	(0.011)	(26.82)
3. Substance use disorder and related complications	4.97*	0.060	30.05
	(2.91)	(0.006)	(23.43)
4. Asthma or chronic obstructive pulmonary disease	2.67***	0.100	26.73**
	(0.94)	(0.008)	(11.68)
5. Structural heart disease	15.39***	0.011	16.33
	(3.40)	(0.003)	(10.78)
6. Other neurologic disorder	5.24***	0.025	13.22**
	(1.53)	(0.004)	(6.15)
7. Diabetes and obesity	0.71	0.182	12.98
	(0.57)	(0.010)	(10.89)
8. Neck pain	0.95	0.110	10.47
	(0.72)	(0.008)	(8.29)
9. Fibromyalgia and neuropathic pain and fatigue	1.18	0.083	9.79
	(0.80)	(0.007)	(7.03)
10. Back pain	0.39	0.223	8.61
	(0.73)	(0.011)	(16.40)

This table shows regression coefficients measuring the increase in the number of functional limitations (dependent variable) associated with the listed medical condition (compared to having no medical conditions) in the analysis sample (N = 1,477) (col. 1); the prevalence of the listed medical condition in the analysis sample (col. 2); and the product of the regression coefficient and the prevalence estimate multiplied by 100 (col 3.). Medical conditions are listed in decreasing order on col. 3. The regression model includes indicators for each of the 30 medical conditions (see *SI Appendix*, Table S4 for full model with complete listing of medical conditions), age group dummies, and an indicator for gender. *$P < 0.10$, **$P < 0.05$, ***$P < 0.01$. SE are in parentheses. The SE in col. 3 are estimated by nonparametric bootstrap.

Last, we explore the sensitivity of our results to an alternative weighting scheme where we weight each ability by its prevalence among job requirements, calculated separately for jobs that do and do not require a Bachelor's degree. The job requirement prevalence rates for each ability are shown in *SI Appendix*, Table S1 (last two cols.). The table shows that ability requirements vary significantly across jobs and by required education. For example, the ability to tolerate skin contact with substances is a common requirement in jobs that do not require a Bachelor's degree (73.1%) but not in jobs that do require a Bachelor's degree (23.9%). In *SI Appendix*, Table S5, we provide examples of US jobs and their associated tasks that require skin contact with substances. Nevertheless, accounting for the prevalence of ability requirements across job profiles does not appreciably alter our estimates of the mean number of limitations (*SI Appendix*, Table S6) or the top 10 most impactful medical conditions (*SI Appendix*, Table S7). Similarly, different assumptions about the relevance of the manual review items result in similar population prevalence rates of any limitation by functional domain (*SI Appendix*, Fig. S1) and similar patterns across demographic groups and job characteristics (*SI Appendix*, Fig. S2).

Discussion

This study examined the prevalence of functional limitations among American workers and identified the medical conditions that contribute most to functional limitations among US working adults. We find that many workers have medically related functional limitations: Almost three-quarters of working adults report at least one functional limitation, and the average working adult has 5.6 functional limitations. The most common types of limitations are in the domains of upper body strength and torso range of motion, with respect to the ambient environment, and knee movements. Although there are differences in the number of reported functional limitations by sex and age, these are explained by differences in education, occupation, and industry composition across the demographic groups. Workers in clerical support, service and sales, and elementary occupations report the greatest numbers of functional limitations, as do those who work in essential and nonteleworkable occupations. The medical conditions associated with the greatest number of functional limitations across the workforce are mental illness, arthritis and other joint diseases, substance use disorder and related complications, and asthma and chronic obstructive pulmonary disease.

Notably, the share of working adults with at least one functional limitation (79.9%) exceeds the share reporting at least one medical condition (66.7%). The prevalence of functional limitations may exceed the prevalence of reported medical conditions because individuals may have functional limitations that result from undiagnosed medical conditions, that are sequelae of prior resolved health problems (e.g., prior injury), or that are nonspecific and not clearly attributable to a particular underlying medical condition.

Our findings indicate that there are many opportunities for individuals with functional limitations—even those with numerous limitations—to participate in the workforce across different categories of occupations and industries. That so many workers with functional limitations can maintain employment is a strength of the US labor market. At the same time, if workers with significant medical conditions and related functional limitations are at greater risk of adverse health events or more susceptible to public health threats, this could represent a source of labor supply vulnerability for the occupations and industries in which they are employed. The COVID-19 pandemic illustrated this challenge: Essential workers had a high prevalence of underlying medical conditions that increased the risk of severe COVID-19 disease, raising concerns about potential labor supply disruptions in the occupations and industries in which they worked (e.g., food production) (20, 21). Our study identifies clerical support, services and sales, and elementary occupations as occupations where functional limitations are more prevalent, and many are classified as essential. Understanding which occupations and industries employ large numbers of individuals with functional limitations is critical for understanding potential constraints on economic growth and for workforce planning, both to address short-term labor supply disruptions (e.g., public health crises) and prepare for longer-term workforce needs (e.g., the growing need for long-term care workers for an aging population).

Our findings also have implications for the design of policies to support displaced workers. Economic shocks that disrupt occupations and industries where the prevalence of functional limitations is high will displace workers with limited labor market opportunities. These workers may require additional support as they seek new employment opportunities, including assistance identifying jobs they can perform despite their functional limitations.

Finally, our analysis reveals that workers who are already more vulnerable to job loss and labor market disruption—namely, workers with lower educational attainment and those in services and sales occupations—also report a higher prevalence of functional limitations (22). Health-related risk factors for job loss and difficulty with job reentry, therefore, tend to cluster with other factors that independently influence labor force participation. Policies to support employment among these more vulnerable workers must, therefore, consider not only the educational background and skills needed to succeed in the labor market but also the health-related demands of different jobs. Our analysis also finds that workers in nonteleworkable jobs report a higher prevalence of functional limitations than workers in more flexible, teleworkable jobs. This suggests a potential mismatch between the need for work flexibility (to accommodate health problems) and employers' willingness or ability to provide such flexibility.

Our study has several limitations. First, we ask respondents to self-report their functional limitations, and their self-assessments may differ from clinical assessments, particularly with respect to psychiatric and cognitive disorders. Reassuringly, the literature suggests that even in cases of severe mental illness, individuals can often accurately self-report their symptoms and functioning (23). Relatedly, respondents are asked about their ability to perform actions that might not be required in their daily life and that, therefore, might be challenging to estimate. In future research, it would be valuable to determine whether respondents can accurately assess capabilities that they do not frequently use. In addition, there may be differences in what is considered a relevant functional limitation for the purposes of job performance between the United States and the Netherlands. Although our results are not sensitive to weighting each ability by its prevalence across job profiles in the Netherlands, alternative weighting schemes including those based on prevalences across US occupations could produce different results. Further, our survey was conducted before the COVID-19 pandemic. As such, we cannot assess how Long COVID compares to other medical conditions or whether COVID infections exacerbated functional limitations associated with existing medical conditions (above and beyond the effects of COVID infection in those without medical conditions). Last, our analyses do not speak to the causal relationship between functional limitations and employment. There is the potential for health-based selection in jobs but also for the demands of jobs to contribute to the development of functional limitations and the deterioration of health (24, 25). Notwithstanding these limitations, our study examines the prevalence of such a broad and detailed set of functional limitations among working adults in the United States. Our study has policy implications for workforce planning and for supporting displaced and vulnerable workers with significant health-related limitations.

Materials and Methods

RAND ALP. The RAND ALP is a nationally representative panel dataset of US individuals aged 18 and older who regularly complete surveys online. Respondents receive payment for surveys they complete, based on survey length. To ensure representativeness, panel members were recruited using multiple modes (mail, telephone, in-person contact) and were provided computing technology and internet access if needed. Surveys may be completed on various devices, are Section 508 compliant, and meet Web Content Accessibility Guidelines. We invited all ALP participants who were 18+ to take the HFCS. Those who responded were 22+. ALP provided sampling weights constructed to match the 2018 CPS on age, sex, race/ethnicity, education level, household income, and the number of household members for those aged 22 to 96 (26). Deidentified HFCS data are publicly available on the ALP website (16).

The FML and Dutch Disability Determination Process. The FML is a standardized instrument used by the Dutch Social Security Administration [Uitvoeringsinstituut Werknemersverzekeringen (UWV)] since 2002 to measure the functional abilities of individuals who have applied for disability insurance benefits. FML items are multiple-choice questions, each with two to four answer options. In the Netherlands, the FML is completed by a physician based on a review of medical records and a structured 1 h interview with the applicant but no physical examination (13, 14). If the applicant has a terminal illness, severe limitations in ADLs, or resides in an institutional setting, the applicant is presumed to have no work capacity (and is therefore eligible for full benefits) and is not assessed using the FML. The UWV has adapted the FML for applicant self-administration at home as part of a workload reduction initiative but has not yet changed current practice.

In the disability determination process, disability assessors identify specific jobs an individual can and cannot feasibly do by comparing an applicant's FML ratings to a large database of job profiles, which enumerate job requirements for entry-level jobs present in all regions of the country. The UWV's job profile database is maintained by a group of occupational analysts, who are trained to collect and document job requirements. These occupational analysts conduct establishment site visits where they directly observe workers performing their tasks and conduct interviews with workers, supervisors, and HR representatives. The analysts use this information to construct job profiles detailing discrete levels of the job requirements and narrative explanations. The process of identifying feasible jobs is automated for 56 FML items (labeled "algorithm items"), but manual review is required if the applicant has limitations on any of 41 general abilities needed for most jobs ("nonalgorithm items"). Once any potential jobs are identified, these define the applicant's residual earnings capacity, which is compared to the applicant's predisability earnings and used to calculate their disability-related loss in earnings capacity. The disability benefit payment is a function of the loss in earnings capacity.

As a robustness check, we weight abilities by the prevalence of the corresponding job requirement. The prevalence of each job requirement is the percentage of job profiles in the UWV database where a functional limitation relating to that job requirement may result in a flag or a rejection of the job profile, depending on an applicant's functional ability.* The prevalence rates are calculated separately based on whether or not a job profile requires the equivalent of a Bachelor's degree, and respondents' limitations are weighted based on the prevalence rates that correspond to their observed educational attainment (see *SI Appendix*, Table S1 for prevalence rates by educational requirement). There are 5,479 job profiles, of which 4,674 (85.31%) do not require the equivalent of a Bachelor's degree and 805 (14.69%) do require a Bachelor's degree. Since the prevalences are constrained to be <1 by construction, we scale the prevalence weight for each ability by the average prevalence rate across all 97 abilities to preserve the maximum number of potential limitations across models (i.e., 97). Because it is not possible to calculate job requirement prevalences for the general abilities subject to manual review, we test two ways of handling these: The first assigns them a prevalence of 0 (relevant for no jobs), while the second assigns them a prevalence of 1 (relevant for all jobs). The first scheme implicitly removes the 41 manually assessed, nonalgorithm items from our analyses and the scale factor on the ability weights is the average prevalence among the 56 algorithm items. To understand the effect of this data decision, we re-estimated our (unweighted) main analyses with just the 56 items included in the automated algorithm. *SI Appendix*, Fig. S1 displays the prevalence by functional domain for the algorithm items, and *SI Appendix*, Fig. S2 shows the mean number of algorithm limitations by demographics and job characteristics. As we expected, the limitation counts are somewhat lower when examining a subset of FML items. Yet, the decrease is not as great as one might expect, as the 56 algorithm items account for the majority of the functional limitations of HFCS respondents. Job requirement weights are incorporated in *SI Appendix*, Tables S6 and S7. Summary statistics of the number of limitations by imputed job requirement prevalence for nonalgorithm items and by weighting scheme are presented in *SI Appendix*, Tables S6 and S8 shows the distribution of weights under each scheme. Last, *SI Appendix*, Table S7 shows the ten most impactful medical conditions by imputed prevalence scheme and by weighting scheme. The medical conditions identified as being most associated with functional limitations in working adults are not sensitive to assumptions regarding the relevance of nonalgorithm items or the weighting scheme.

HFCS. To construct the HFCS, FML items were translated into English by a native Dutch speaker on our research team and minimally rephrased to be suitable for self-administration. HFCS questions were then further refined after pilot testing and cognitive interviews.

The HFCS began by asking respondents to report their medical conditions from a predefined list of 57 conditions, which we subsequently consolidated into 30 medical conditions (*SI Appendix*, Table S9 summarizes correlation coefficients of medical conditions). Respondents could use free text fields to record any medical conditions not listed. Respondents were next asked screening questions about the presence of a terminal illness, a serious mental illness limiting daily activities, dependency on others to perform ADLs, or residence in an institutional setting. Consistent with practice in the Netherlands, 196 respondents who said yes to any of the screening questions were screened out of the survey. Respondents who passed the screening questions were continued to the next set of questions about their functional abilities, adapted from the FML.

We asked respondents questions corresponding to 103 FML items. Our analysis focuses on 97 functional abilities related to occupational performance requirements and excludes items related to working hours, handedness, and need for mobility aids.

Most items (71 out of 97) used a binary response scale (indicating the presence/absence of a functional limitation). The remainder used a discrete ordinal scale, with between three and five response options indicating the degree of functional limitation. For example, when respondents were asked, "Do you have any difficulties bending your upper body forward?" the response options were "I can bend forward to an angle of 90 degrees," "I can bend forward to an angle of 60 degrees," "I can bend forward to an angle of 45 degrees, and "I cannot bend forward at all." Respondents were instructed "if your ability level falls between two answer choices, select the answer corresponding to the lower level of ability." Those who indicated they could only bend forward to an angle of 45 degrees or not at all were considered to have a limitation of this ability, following practice in the Netherlands to use the label "limited" for these options. We dichotomized all nonbinary questions in this manner. *SI Appendix*, Table S1 lists the thresholds for determining a limitation. For ease of presentation, we grouped the ability questions into 16 functional domains.

ALP respondents were paid \$5 to complete the first part of the survey (health and screening questions) and an additional \$15 if they completed the second part (FML questions). Average completion time was 24 min. This study was approved by the Harvard Medical School and RAND Corporation Institutional Review Boards.

Occupation Types. Each HFCS respondent who was working was asked to provide the job title and a description of their usual duties and responsibilities for their main paid job. Our team used this information to assign a 6-digit Standard Occupational Classification (SOC) code. We converted the SOC codes to International Classification of Occupations (ISCO-08) codes using a crosswalk produced by BLS (27). Table 1 and Fig. 2 list major occupation groups from ISCO-08. We designated SOC codes as "essential" or "nonessential" using the taxonomy of "critical occupations" produced by the Council for Community and Economic

*Each job profile in the UWV database is weighted equally. A further refinement of the weighting scheme might incorporate occupation shares to represent how common a job is in the economy, but this data is not available.

Research (C2ER) and the Labor Market Information Institute (LMI), which was based on the Department of Homeland Security's Cybersecurity and Infrastructure Security Agency's (CISA) list of "essential critical infrastructure workers" during the COVID-19 pandemic (17, 28). We considered "critical occupations" to be essential occupations. We designated SOC codes as teleworkable or nonteleworkable using the coding scheme proposed by Dingel and Neiman (18). Respondents were also asked to select the industry of their main paid job from a list of 20 North American Industry Classification System supersectors, which we then grouped into goods and service-producing industries.

Regression Model. To estimate the association between functional limitations and specific medical conditions (shown in Tables 2 and *SI Appendix*, Tables S4 and S6), we estimated a linear regression model of the following form:

$$Y_i = \alpha + \beta' \boldsymbol{Conditions}_i + \gamma' \boldsymbol{AgeGroup}_i + \delta Female_i + \varepsilon_i.$$

where Y_i is the number of functional limitations individual i has, α is the intercept, $\boldsymbol{Conditions}_i$ is a vector of binary indicators for each of 30 medical conditions (listed in *SI Appendix*, Table S4), $\boldsymbol{AgeGroup}_i$ is a vector of age group dummies, $Female_i$ is a binary indicator for female gender (as reported at the time of the survey, two response categories possible), and ε_i is an idiosyncratic error term. The elements of $\boldsymbol{\beta}$ give the number of functional limitations associated with a given medical condition relative to the number present among those with no reported medical conditions (the reference category), controlling for the effects of all other reported medical conditions, age, and gender.

Data, Materials, and Software Availability. GitHub Code Repository data have been deposited in Zenodo: https://doi.org/10.5281/zenodo.15150473 (29). Previously published data used for this work are available in RAND American Life Panel (ALP): https://alpdata.rand.org/index.php?page=data&p=showsurvey&syid=522 (30); U.S. Bureau of Labor Statistics: https://www.bls.gov/emp/tables/occupations-largest-job-declines.htm#BLStable_2024_4_11_10_22 (22); Standard Occupational Classification Policy Committee ISCO-08 x SOC 2010 Crosswalk: https://www.bls.gov/soc/ISCO_SOC_Crosswalk.xls (27); US Bureau of Labor Statistics 2010: https://www.bls.gov/cps/cenocc2010.xlsx (31); US Bureau of Labor Statistics 2018: https://www.bls.gov/cps/2018-census-occupation-classification-titles-and-code-list.xlsx (32); The Council for Community and Economic Research (C2ER) and The Labor Market Information Institute (LMI): https://www.lmiontheweb.org/wp-content/uploads/sites/4/2020/03/SOC-Codes-CISA-Critical-Infrastructure-Workers-with-OES-Data-Rev-1.xlsx (17); Github: https://github.com/jdingel/DingelNeiman-workathome/blob/master/occ_onet_scores/output/occupations_workathome.csv. (33); and IPUMS: https://doi.org/10.18128/D030.V11.0 (34).

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