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Fatigue in the U.S. Workforce: Prevalence and Implications for Lost Productive Work Time

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Learning Objectives

- Recall the prevalence of fatigue in this national cross-sectional telephone survey of US workers, and how its presence affected workers' health status and quality of life.
- Outline the ways in which fatigue interacted with other health disorders to increase lost productive work time (the sum of self-reported absenteeism and presenteeism) and its monetary cost.
- List possible mechanisms by which fatigue may increase functional impairment caused by other adverse health conditions.

Abstract

Objective: *The objective of this study was to estimate fatigue prevalence and associated health-related lost productive time (LPT) in U.S. workers.* ***Methods:*** *Fatigue prevalence, LPT due to fatigue, and LPT for any health-related reason (in hours and dollars) were measured in a national cross-sectional telephone survey of U.S. workers.* ***Results:*** *The 2-week period prevalence of fatigue was 37.9%. Of workers with fatigue, 65.7% reported health-related LPT compared with 26.4% of those without fatigue. Workers with fatigue cost employers $136.4 billion annually in health-related LPT, an excess of $101.0 billion compared with workers without fatigue. Fatigue frequently co-occurs with other conditions and, when present, is associated with a threefold increase, on average, in the proportion of workers with condition-specific LPT.* ***Conclusions:*** *Fatigue is prevalent in the U.S. workforce. When occurring with other health conditions, it is associated with significantly more condition-specific LPT.* (J Occup Environ Med. *2007;49:1–10*)

Fatigue is a common symptom with reported prevalence in the population ranging from 7% to approximately 45%.[1–8] Fatigue is diagnostically nonspecific and associated with many health conditions.[2,5] Broadly defined as "a feeling of weariness, tiredness or lack of energy,"[9] fatigue is best viewed on a continuum.[5] At the milder end, fatigue occurs frequently and generally comprises acute circumstance-based episodes that can resolve quickly after intervention such as rest or the improvement of an environmental stressor. At the more severe end, it is less prevalent and potentially symptomatic of a more chronic and disabling condition such as major depressive disorder, fibromyalgia, or chronic fatigue syndrome.

Fatigue impairs work ability. Workers with fatigue are significantly more likely to miss work and experience long-term work absence than workers without fatigue.[10] In addition, health conditions in which fatigue is a primary symptom such as chronic fatigue syndrome[11] and depressive disorders[12] also negatively impact work ability. In economic terms, the total annual cost of lost labor force participation resulting from unemployment among individuals with chronic fatigue syndrome was estimated at $6.8 billion.[11] The total annual cost of lost productive work time among U.S. workers with depression was estimated at $31 billion.[12]

The prevalence of fatigue in U.S. workers and its relation to productive work time have not been studied previously. The Caremark American Productivity Audit provides data on a large nationally representative

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sample of U.S. workers with information linking health conditions, including fatigue, to health-related lost productive time (LPT). We describe the results of research to estimate the prevalence of fatigue among U.S. workers, characterize the health status and quality of life of workers with fatigue, and quantify worker health-related LPT and associated costs, including both time absent from work and reduced performance while at work.

Materials and Methods

The Caremark American Productivity Audit (or the audit) is a U.S. national population-based random-digit-dial telephone survey of the noninstitutionalized U.S. population that measures the relation between health and work productivity.[13] The Caremark Work and Health Interview (or the WHI) is the validated data collection instrument administered in the audit survey. Both the audit[13] and the WHI[14,15] have been described in detail elsewhere and are summarized briefly here.

Work and Health Interview and Measurement of Lost Productive Time

The WHI is a computer-assisted telephone data collection instrument that measures LPT and its health-related causes in the 2 weeks before interview.[14,15] The interview captures information on self-reported employment status, occupational characteristics, health conditions and symptoms, lifestyle factors, health-related quality of life, and demographic characteristics, including annual salary. LPT is measured as the sum of self-reported hours per week absent from work for a health-related reason (ie, absenteeism) and the hour-equivalent per week of self-reported health-related reduced performance while at work (ie, presenteeism). Presenteeism is quantified by measuring the average frequency of engaging in five specific work behaviors and the average amount of time between arriving at work and starting to work on days not feeling well. The five work behaviors included losing concentration, repeating a job, working more slowly than usual, feeling fatigued at work, and doing nothing at work. Response options are all of the time, most of the time, half the time, some of the time, and none of the time. The primary health-related reason for LPT was attributed directly by the respondent.

Sample Selection and Data Collection

Audit households were selected as a random sample of residences with telephones in the 48 contiguous states and the District of Columbia. Residents were eligible to participate if they were 18 to 65 years of age, reported in the affirmative to the Current Population Survey (CPS) question on employment status (ie, "Last week, did you do any work for either pay or profit?"),[16] and were a permanent member of the household contacted. Audit data collection began on August 1, 2001, and continued through May 31, 2003. Quality-of-life data were collected only between August 1, 2001, and August 24, 2002. During this period, interviews were completed at a rate of approximately 2500 per month with an estimated participation rate of 66%.[13] Up to two eligible respondents were interviewed per household. The Essex Institutional Review Board (Lebanon, NJ) approved the research protocol and data collection instrument. Oral informed consent was obtained from each participant before initiating the interview.

A two-step weighting method accounted for selective participation (ie, noncoverage and nonresponse).[13] In the first step, a weight was applied to individuals to account for the unequal probability of selecting households. In the second step, a population weighting adjustment accounted for selection bias due to incomplete coverage of the U.S. population and ensured that estimates of certain sample demographic subgroups' totals conformed to the CPS, an external database providing high-quality data on a nationally representative sample of the U.S. workforce. A raking method was used for the population weighting adjustment, benchmarking to four variables common to both the audit and the CPS. Benchmarking and weighting variables with missing data were imputed using a previously described procedure.[13]

Analysis

The sampling frame for this study included the 28,902 adults 18 to 65 years of age who participated in the first year of the audit survey and reported working for pay or profit in the week before interview. Because no standard definition or assessment method for fatigue currently exists,[17] we used an affirmative response to the following question: "Did you have low levels of energy, poor sleep, or a feeling of fatigue in the past 2 weeks?" to define the presence of fatigue in our sample. Applying this definition, 11,719 workers screened positive for fatigue in the previous 2 weeks.

Analyses were completed to estimate the prevalence of fatigue and cost of fatigue-related LPT in the U.S. workforce. Prevalence estimates were derived based on the sampling fraction of workers and projected to the U.S. workforce using the previously described benchmarking procedure.

Health-related LPT was derived from the Work and Health Interview as described previously.[13] LPT was examined in three ways. Initially, we estimated LPT attributed specifically to fatigue by workers with fatigue. Second, we estimated excess health-related LPT (ie, LPT attributed to fatigue in addition to other health conditions) in workers with fatigue compared with a 1:1 group-matched (by age and gender) random sample of workers without fatigue. Excess LPT was calculated as the difference in total annual hours of LPT for any health-related reason between the two groups. Third, we estimated ex-

cess condition-specific LPT in workers reporting one or more of nine other health conditions or symptoms co-occurring with fatigue in the previous 2 weeks (ie, pain, including headache and musculoskeletal pain, digestive problems, feeling sad or blue, cold or flu, allergies, asthma or chronic breathing problems, cancer, heart disease, and diabetes). Excess LPT was examined as the difference between workers with and without fatigue in 1) the percent of workers reporting any condition-specific LPT in the previous 2 weeks and 2) the mean hours of condition-specific LPT reported per week. Lost labor costs were estimated by converting hours of LPT into lost dollars using self-reported annual salary or wage. Lost labor costs were expressed in 2002 dollars.

Variation in the prevalence of fatigue and fatigue-related LPT was evaluated in relation to a number of demographic, health, and employment characteristics. Factors included gender, age, race, education, annual salary, number, and type of co-occurring health conditions in the previous 2 weeks; employment status; occupation type; and composite job-demand and -control category based on Karasek et al.[18] We analyzed the data using a generalized linear model framework in which we modeled the log of the expectation of the binary variables (ie, fatigue vs no fatigue and >0 LPT vs 0 LPT in persons with fatigue) as a linear function of the explanatory variable (ie, demographic, health, and employment characteristics). Log link was used so that parameters could be interpreted as prevalence ratios instead of odds ratios.

Health-related quality of life was measured using the SF-12 health interview and physical (PCS) and mental (MCS) component summary scores were derived.[19] The PCS score measures physical functioning, role limitations due to physical health problems, bodily pain, and general health. The MCS score assesses vitality, social functioning, and role limitations due to emotional problems and mental health.[19] Audit participants were randomly selected to receive job demand and control questions and the SF-12 based on number and type of health conditions reported during the interview. Observations were weighted using the inverse of the sampling fractions in the calculation of fatigue prevalence in the U.S. workforce by job demand/control category and mean PCS and MCS scores.

SAS version 8.2 (SAS Institute Inc., Cary, NC) and Wesvar version 4 (Westat, Rockville, MD) were used for the analyses. To determine statistical significance, $P < 0.05$ was used.

Results

A demographic profile of year-1 audit participants has been described previously.[13] In brief, the majority were female (56.1%), white (77.0%), formally educated beyond high school (66.6%), and earning less than $40,000 per year (70.0%). Respondents were equally distributed across four age groups (18–29, 30–39, 40–49, and 50–65 years).[13]

Workers with and without fatigue differed on all demographic and employment characteristics. Compared with workers without fatigue, workers with fatigue were more likely to be female (65.2% vs 34.8%; $P < 0.0001$), <40 years of age (49.7% vs 44.7%; $P < 0.0001$), white (81.4% vs 80.3%; $P = 0.0281$), and earn less than $30,000 per year (47.8% vs 40.2%; $P < 0.0001$) in a white collar occupation (67.8% vs 65.0%; $P < 0.0001$) described as high demand–high control (46.1% vs 39.9%; $P < 0.0001$). They were less likely to have a college degree (32.8% vs 35.6%; $P < 0.0001$) and to work full-time (79.8% vs 81.3%; $P = 0.0022$). Workers with and without fatigue also differed on health characteristics. Workers with fatigue were significantly ($P < 0.0001$) more likely to report at least one of nine other co-occurring health conditions (94.0% vs 59.9%). They were also significantly more likely than workers without fatigue to report the presence of each of nine individual health conditions in the previous 2 weeks.

We also examined the subset of 539 workers with fatigue who reported fatigue as their only health condition present in the previous 2 weeks. Compared with workers who had fatigue and at least one other health condition, those with fatigue only were significantly more likely to be male (50.7% vs 34.1%; $P < 0.0001$), under 40 years of age (56.6% vs 49.4%; $P = 0.006$), have at least a college degree (40.1% vs 32.4%; $P = 0.0007$), and report an annual income of $40,000 or greater (44.6% vs 32.8%; $P < 0.0001$) from a full-time job (84.0% vs 79.6%; $P = 0.0123$) described as high demand (81.9% vs 76.9%; $P = 0.0077$).

Prevalence of Fatigue. The estimated 2-week period prevalence of fatigue in the U.S. workforce was 37.9% (Table 1). After adjusting for demographic, health, and employment characteristics, fatigue was significantly more prevalent in women than men, workers under 50 years of age, white workers compared with black workers, and workers earning more than $30,000 per year from a job described as high control (Table 2). The prevalence of fatigue also differed significantly by health characteristics. It was significantly more prevalent in workers with two or more health conditions and in workers with each of the nine specific co-occurring conditions examined. The prevalence was lowest in workers with diabetes (46.0%) and highest in those feeling sad or blue (68.3%) (Table 2).

Lost Productive Time, Quality of Life, and National Cost Estimates. Overall, 9.2% of U.S. workers with fatigue reported losing productive work time specifically due to fatigue in the previous 2 weeks. After adjusting for demographic, employment, and health characteristics, the percent did not differ by gender, race,

TABLE 1
Two-Week Period Prevalence of Fatigue in the U.S. Workforce and Percent of Workers With Fatigue Who Reported Lost Productive Time (LPT) Due to Fatigue in the Previous 2 Wk by Demographic, Health, and Employment Characteristics*

Characteristic	Categories	Prevalence of Fatigue Percent (95% CI)	Percent With Fatigue-Related LPT Percent (95% CI)
U.S. workforce		37.9 (37.4–38.5)	9.2 (8.7–9.8)
Gender	Male	31.0 (30.0–31.9)	10.2 (9.2–11.1)
	Female	45.8 (45.1–46.5)	8.6 (7.9–9.2)
Age	18–29 yr	40.2 (38.9–41.4)	11.6 (10.3–12.8)
	30–39 yr	40.7 (39.4–42.0)	9.2 (8.0–10.3)
	40–49 yr	37.2 (36.0–38.3)	8.6 (7.5–9.8)
	50–65 yr	33.7 (32.6–34.9)	7.2 (6.1–8.3)
Race	White	38.1 (37.5–38.6)	9.5 (8.7–10.2)
	Black	34.4 (32.1–36.7)	8.2 (6.3–10.2)
	Other	36.9 (35.2–38.6)	9.8 (8.0–11.5)
Education	<High school diploma	37.9 (34.8–41.0)	7.1 (4.8–9.5)
	High school graduate or GED	37.0 (35.8–38.3)	8.0 (6.9–9.1)
	Some college or associate degree	40.0 (38.8–41.2)	9.1 (8.0–10.2)
	Bachelor degree	37.0 (35.4–38.5)	10.6 (9.1–12.0)
	Graduate degree	33.8 (31.8–35.9)	13.0 (10.1–15.8)
Annual salary	Under $10,000	42.7 (40.7–44.7)	9.0 (7.0–11.0)
	$10,000–19,999	42.7 (41.2–44.2)	9.4 (8.1–10.8)
	$20,000–29,999	40.8 (39.2–42.4)	8.7 (7.2–10.1)
	$30,000–39,999	38.1 (36.5–39.6)	9.7 (8.5–10.9)
	$40,000–49,999	37.0 (35.3–38.6)	11.1 (9.0–13.2)
	$50,000 or more	31.0 (29.5–32.4)	8.9 (7.4–10.5)
Number of co-occurring health conditions	0	9.1 (8.3–9.8)	17.7 (15.0–20.4)
	1	29.1 (28.0–30.3)	9.5 (8.2–10.8)
	2–3	55.1 (54.1–56.1)	8.4 (7.6–9.3)
	≥4	79.7 (78.2–81.3)	8.3 (7.2–9.5)
Co-occurring conditions†	Pain	55.7 (54.9–56.5)	8.5 (7.8–9.2)
	Digestive problems	65.4 (64.2–66.7)	8.6 (7.7–9.5)
	Feeling sad/blue	68.3 (67.2–69.3)	10.4 (9.5–11.4)
	Cold/flu	54.4 (52.9–55.9)	5.6 (4.6–6.5)
	Allergies	57.4 (56.2–58.6)	7.9 (6.9–8.9)
	Asthma/chronic breathing problems	60.6 (59.1–62.1)	7.9 (6.7–9.2)
	Cancer	59.3 (51.1–67.5)	6.6 (2.4–10.9)
	Heart disease	61.1 (55.4–66.9)	6.1 (2.4–9.9)
	Diabetes	46.0 (42.9–49.0)	8.1 (5.6–10.6)
Employment status‡	Full-time	37.6 (36.9–38.3)	9.7 (9.1–10.3)
	Part-time	39.6 (38.2–41.0)	7.6 (6.3–8.7)
Type of occupation§	White collar	39.5 (38.8–40.2)	9.7 (8.9–10.5)
	Blue collar	36.3 (35.3–37.4)	8.7 (7.5–9.9)
Job demand/control	High–high	42.0 (40.5–43.5)	9.7 (8.8–10.5)
	High–low	31.7 (30.3–33.1)	8.3 (7.3–9.3)
	Low–high	47.6 (44.9–50.4)	10.1 (8.5–11.7)
	Low–low	34.4 (31.6–37.2)	9.6 (7.3–11.8)

*Estimates are benchmarked to the Current Population Survey.

†Recall window was previous 2 wk for pain, digestive problems, feeling sad/blue, cold/flu, asthma, and cancer treatment; recall window was previous 12 mo for heart disease, chronic breathing problems, and diabetes.

‡Full-time was defined by ≥35 hr per week; part-time was defined by <35 hr per week.

§"White collar" jobs included professional, administrative, or support-type occupations; "blue collar" jobs included trade or labor occupations.[36]

CI indicates confidence interval; GED, General Education Development (Test).

education, annual salary, or type of occupation (Table 2). Significant differences, however, were observed by age, employment status, job demand–control, and number of co-occurring health conditions (Table 2). Workers under 40 years of age were significantly more likely than older workers to lose productive time from fatigue as were those working full-time compared with part-time in a job described by workers as low

TABLE 2
Adjusted Prevalence Ratios for Fatigue and Lost Productive Time (LPT) Due to Fatigue in the Previous 2 Wk in the Total Sample by Demographic, Health, and Employment Characteristics*

		Fatigue		LPT Due to Fatigue	
Characteristic	Categories	N	Adjusted PR (95% CI)¶	N†	Adjusted PR (95% CI)¶
Gender	Male	12,652	1.00	4073	1.00
	Female	16,143	1.15 (1.12–1.19)	7619	0.87 (0.76–1.00)
Age	18–29 yr	6435	1.07 (1.03–1.11)	2756	1.48 (1.22–1.80)
	30–39 yr	7021	1.13 (1.09–1.17)	3055	1.24 (1.03–1.50)
	40–49 yr	8385	1.08 (1.04–1.11)	3334	1.17 (0.97–1.41)
	50–65 yr	6954	1.00	2547	1.00
Race	White	22,173	1.05 (1.01–1.10)	8991	1.03 (0.83–1.29)
	Black	2572	1.00	971	1.00
	Other	2705	1.04 (0.99–1.10)	1078	1.08 (0.82–1.42)
Education	<High school diploma	1512	0.98 (0.92–1.04)	620	0.55 (0.39–0.78)
	High school graduate or GED	8109	1.00 (0.96–1.05)	3221	0.59 (0.47–0.74)
	Some college or associate degree	8526	1.02 (0.97–1.06)	3642	0.65 (0.53–0.80)
	Bachelor degree	6419	1.03 (0.99–1.08)	2533	0.75 (0.61–0.92)
	Graduate degree	3130	1.00	1123	1.00
Annual salary	Under $10,000	2410	1.05 (0.99–1.10)	1081	1.32 (0.98–1.76)
	$10,000–19,999	4158	1.06 (1.02–1.11)	1890	1.29 (1.02–1.63)
	$20,000–29,999	5378	1.04 (1.00–1.08)	2342	1.13 (0.91–1.40)
	$30,000–39,999	5093	1.07 (1.02–1.11)	2089	1.17 (0.95–1.43)
	$40,000–49,999	3600	1.08 (1.04–1.13)	1417	1.23 (0.99–1.52)
	$50,000 or more	6965	1.00	2297	1.00
Number of co-occurring health conditions	0	7557	1.00	707	1.00
	1	6116	0.93 (0.86–1.00)	2135	0.59 (0.48–0.74)
	2–3	10,118	1.67 (1.57–1.79)	6005	0.51 (0.42–0.62)
	≥4	5004	2.28 (2.14–2.44)	2845	0.52 (0.42–0.65)
Co-occurring conditions‡	Pain	13,869	1.63 (1.57–1.69)	9107	0.78 (0.68–0.90)
	Digestive problems	6618	1.48 (1.44–1.51)	4439	0.94 (0.83–1.07)
	Feeling sad/blue	7736	1.66 (1.62–1.70)	5410	1.27 (1.12–1.44)
	Cold/flu	4678	1.17 (1.13–1.20)	2685	0.49 (0.41–0.59)
	Allergies	7985	1.25 (1.22–1.29)	4736	0.78 (0.68–0.89)
	Asthma/chronic breathing problems	3797	1.26 (1.22–1.30)	2396	0.91 (0.78–1.07)
	Cancer	203	1.21 (1.09–1.36)	129	0.78 (0.38–1.60)
	Heart disease	418	1.32 (1.24–1.41)	271	0.75 (0.45–1.25)
	Diabetes	1028	1.09 (1.02–1.16)	521	1.18 (0.87–1.59)
Employment status§	Full time	23,232	1.00	9337	1.00
	Part time	5563	0.98 (0.95–1.01)	2355	0.79 (0.66–0.95)
Type of occupation‖	White collar	18,102	1.00	7609	1.00
	Blue collar	9277	0.99 (0.96–1.02)	3611	0.93 (0.80–1.09)
Job demand/control	High–high	10,015	1.13 (1.10–1.17)	5366	1.06 (0.92–1.23)
	High–low	8340	1.00	3615	1.00
	Low–high	2770	1.17 (1.14–1.22)	1641	1.26 (1.04–1.52)
	Low–low	2179	1.03 (0.99–1.08)	1017	1.27(1.01–1.59)

*Estimates are not benchmarked to the Current Population Survey.

†Workers who reported fatigue in the previous 2 wk.

‡Recall window was previous 2 wk for pain, digestive problems, feeling sad/blue, cold/flu, asthma and cancer treatment; recall window was previous 12 mo for heart disease, chronic breathing problems, and diabetes.

§Full time was defined by ≥35 hr per week; part time was defined by <35 hr per week.

‖"White collar" jobs included professional, administrative, or support-type occupations; "blue collar" jobs included trade or labor occupations.[36]

¶Adjusted for all other covariates included in this table except specific co-occurring conditions.

PR indicates prevalence ratio; CI, confidence interval; GED, General Education Development (Test).

demand. Because respondents were allowed to attribute LPT to only a single primary health condition, the percent that attributed LPT to fatigue was significantly lower in workers who reported other health conditions in addition to fatigue in the previous 2 weeks (Table 2). Workers with the cold or flu were the least likely to report LPT due to fatigue (5.6%), whereas workers feeling sad or blue were the most likely to report it (10.4%) (Table 1).

Workers reporting LPT due to fatigue lost an average of 4.1 (95% confidence interval = 3.8–4.4) productive work hours per week. Most (85.4%) of the productive time was lost as reduced performance while at work rather than as work absence. Fatigue impaired work performance primarily by impairing concentration and increasing time to accomplish tasks.

Quality of life, as measured by mean SF-12 physical and mental health component summary scores, was significantly lower in workers with fatigue compared with workers without fatigue (Table 2). Furthermore, using the presence of fatigue-related LPT as a proxy for fatigue severity, we observed that quality of life decreased as fatigue severity increased. Workers with fatigue-related LPT had significantly lower mean mental health scores (45.1) than workers with fatigue but no fatigue-related LPT (48.8). Mean physical health scores did not differ in workers with fatigue by presence or absence of fatigue-related LPT (Table 3).

The total annual cost of LPT attributed specifically to fatigue in the U.S. workforce was estimated at $330 million (Table 4) with 83.9% of this LPT due to reduced performance while at work, not absence time. The annual LPT cost represents 1.25 billion hours of LPT per year or the equivalent loss of approximately 600,000 workers employed 40 hours per week for a full year (Table 4).

Also examining LPT for any health-related reason (ie, fatigue in addition to other health conditions), we observed that 65.7% of workers with fatigue reported >0 hours of health-related LPT compared with 26.4% of workers in the nonfatigue comparison group (Table 5). In addition, among workers with >0 hours of health-related LPT, those with fatigue lost significantly more productive time (5.6 hours per week), on average, than their counterparts without fatigue (3.3 hours per week). Overall, workers with fatigue cost U.S. employers an estimated $136.4 billion per year in health-related LPT, an excess of $101.0 billion per year when compared with workers without fatigue (Table 5). The majority of the excess cost was due to reduced performance while at work.

To better understand the source of the excess health-related LPT in workers with fatigue, we examined LPT attributed to other health conditions in workers with and without fatigue (Table 6). For all nine conditions, after adjusting for age and gender, the presence of fatigue was associated with a significantly higher percentage of workers reporting LPT attributed to those health conditions. On average, the percentage of workers reporting any condition-specific LPT increased by a factor of three when fatigue was present. The greatest percentage increase was in workers reporting cancer-related LPT; the smallest was in those reporting LPT from the cold or flu. After adjusting for age and gender, mean LPT per week due to pain, digestive problems, feeling sad/blue, cold/flu, asthma/chronic breathing problems, and heart disease per week was significantly higher when fatigue was present (Table 6). On average, mean condition-specific LPT was approximately 80% higher in workers with fatigue than without it.

TABLE 3
SF-12 Physical and Mental Health Component Summary Scores of U.S. Workers by Fatigue Status and Amount of Lost Productive Time (LPT) Due to Fatigue in the Previous 2 Wk*

Fatigue Status	LPT Due to Fatigue	Physical Health Score Mean (95% CI)	Mental Health Score Mean (95% CI)
Absent	None	53.3 (52.9–53.6)	54.7 (54.2–55.2)
Present	None	48.5 (48.0–48.9)	48.8 (48.3–49.2)
Present	>0 hr	49.2 (47.8–50.7)	45.1 (43.4–46.8)
Present	≥2 hr	48.0 (46.1–49.8)	43.6 (41.6–45.7)

*Estimates are benchmarked to the Current Population Survey.
CI indicates confidence interval.

Discussion

This is the first study to estimate the prevalence and LPT cost of fatigue in the U.S. workforce. Fatigue is common and is associated with $101.0 billion per year in excess health-related LPT costs to U.S. employers. The majority of the LPT cost is due to reduced performance while at work, not work absence.

Less than 1% ($330.0 million) of this cost is attributed specifically to fatigue. It is likely that two sources account for the balance of the observed excess health-related LPT. One source is LPT due to health conditions in which fatigue is a primary symptom (eg, depression, anxiety, chronic fatigue syndrome). We reanalyzed our previously reported data on depression in the U.S. workforce[12] to estimate the prevalence of depression in workers with and without fatigue and found that workers reporting fatigue in the 2 weeks before interview were approximately four times more likely to meet study criteria for a depressive disorder than workers who did not report fatigue (18.0% vs 4.4%; $P < 0.0001$). In that study, we identified workers with depression based on the Diagnostic and Statistical Manual of Mental Disorders, Revised Third Edition[20] using the using the Primary Care Evaluation of Mental Disorders

TABLE 4
Total Annual Fatigue-Related Lost Productive Time (LPT) in the U.S. Workforce in Hours and U.S. Dollars by Demographic, Health, and Employment Characteristics*

		LPT		Cost Equivalent of LPT	
Characteristic	Categories	Percent	Hours (millions) (95% CI)	Percent	U.S. $ (millions) (95% CI)
Total U.S. workforce		100.0	1250.5 (1140.8–1360.2)	100.0	330.0 (294.7–365.2)
Gender	Male	46.8	585.0 (506.2–663.8)	52.5	173.3 (146.9–199.8)
	Female	53.2	665.5 (592.8–738.2)	47.5	156.6 (134.3–179.0)
Age (yr)	18–29	33.5	419.3 (346.6–492.1)	24.3	80.1 (66.1–94.1)
	30–39	26.7	333.7 (275.3–392.2)	30.5	100.8 (80.3–121.4)
	40–49	22.1	275.9 (225.9–325.8)	26.5	87.4 (70.1–104.6)
	50–65	17.7	221.6 (165.0–278.3)	18.7	61.7 (42.2–81.2)
Race	White	79.6	946.1 (838.5–1053.6)	82.4	268.8 (236.7–300.8)
	Black	8.6	101.6 (68.6–134.6)	7.5	24.5 (16.5–32.6)
	Other	11.8	140.5 (101.6–179.4)	10.1	32.9 (22.7–43.2)
Education	<High school diploma	6.5	77.3 (42.3–112.2)	4.1	13.5 (6.5–20.5)
	High school graduate or GED	27.5	329.3 (265.6–393.0)	21.3	70.3 (54.5–86.1)
	Some college or associate degree	31.2	374.1 (305.8–442.4)	26.7	88.0 (68.6–107.4)
	Bachelor degree	23.4	279.9 (226.4–333.4)	30.0	98.9 (79.7–118.0)
	Graduate degree	11.4	137.1 (104.2–170.0)	17.9	59.3 (44.2–74.4)
Annual salary	Under $10,000	7.7	91.9 (59.6–124.2)	1.9	6.3 (4.6–8.0)
	$10,000–19,999	17.8	213.3 (148.2–278.3)	9.1	30.1 (21.3–38.9)
	$20,000–29,999	22.9	273.7 (214.5–333.0)	16.8	55.4 (43.4–67.3)
	$30,000–39,999	19.1	227.7 (181.8–273.6)	19.5	64.2 (52.2–76.2)
	$40,000–49,999	13.5	161.7 (119.8–203.6)	16.0	52.9 (39.3–66.4)
	$50,000 or more	19.0	226.7 (168.3–285.1)	36.7	121.2 (89.4–153.0)
Number of co-occurring conditions	0	8.7	109.3 (76.0–142.6)	10.5	34.7 (23.1–46.2)
	1	20.4	255.2 (198.4–312.1)	21.9	72.4 (58.8–86.0)
	2–3	46.0	575.1 (495.3–654.8)	46.0	151.7 (126.8–176.6)
	≥4	24.9	310.9 (260.5–361.3)	21.6	71.3 (57.7–84.8)
Co-occurring conditions†‡	Pain	72.6	907.7 (819.7–995.7)	69.2	228.3 (201.8–254.8)
	Digestive problems	39.6	494.3 (413.9–574.6)	36.3	119.9 (96.2–143.5)
	Feeling sad/blue	55.5	693.5 (615.2–771.7)	52.5	173.0 (149.9–196.0)
	Cold/flu	16.6	205.6 (157.3–253.9)	13.6	44.4 (33.2–55.5)
	Allergies	35.7	443.6 (376.5–510.7)	32.7	107.6 (89.9–125.2)
	Asthma, chronic breathing problems	18.5	230.0 (172.7–287.3)	16.2	53.4 (40.3–66.5)
	Cancer	0.8	9.6 (1.4–17.7)	1.1	3.5 (0.0–8.0)
	Heart disease	2.7	33.8 (8.0–59.6)	2.5	8.3 (0.5–16.1)
	Diabetes	4.2	52.1 (26.4–77.8)	4.7	15.5 (4.5–26.5)
Employment status§	Full-time	89.7	1122.0 (1014.4–1229.6)	87.5	288.6 (255.0–322.2)
	Part-time	10.3	128.5 (99.2–157.8)	12.5	41.4 (30.7–52.2)
Type of occupation‖	White collar	66.9	810.0 (706.3–913.7)	72.9	235.3 (200.5–270.1)
	Blue collar	33.1	401.1 (328.6–473.5)	27.1	87.6 (70.9–104.3)
Job demand/control	High–high	46.5	580.4 (502.4–658.5)	48.2	158.8 (135.8–181.8)
	High–low	25.4	317.0 (257.6–376.4)	27.6	91.0 (71.5–110.5)
	Low–high	16.8	210.5 (160.1–260.8)	15.1	49.9 (36.7–63.1)
	Low–low	11.3	141.7 (93.7–189.7)	9.1	29.8 (18.7–40.8)

*Estimates are benchmarked to the Current Population Survey.

†Recall window was previous 2 wk for pain, digestive problems, feeling sad/blue, cold/flu, asthma and cancer treatment; recall window was previous 12 mo for heart disease, chronic breathing problems, and diabetes.

‡The percent column represents the percentage of total LPT (in hr or dollars) contributed by workers who reported each health condition. Percents do not total 100 because most workers reported having >1 health condition during the recall window.

§Full time was defined by ≥35 hr per week; part time was defined by <35 hr per week.

‖"White collar" jobs included professional, administrative, or support-type; "blue collar" jobs included trade/labor.[36]

CI indicates confidence interval; GED, General Education Development (Test).

Mood Module[21] and estimated that workers with depression cost U.S. employers $31 billion per year in excess LPT compared with workers without depression.[12] In this study, we did not collect data to identify workers with depressive disorders or quantify the cost of their LPT. If we assume, however, that $31 billion of the estimated excess LPT in workers with fatigue is due to depressive disorders, we are left with a balance

TABLE 5
Percent With Lost Productive Time (LPT) for Any Health-Related Reason, Mean Hours Lost Per Week, and Cost of LPT for Any Health-Related Reason in the Previous 2 Wk in U.S. Workers With Fatigue and a Nonfatigue Comparison Group*

Type of LPT	Measure	Nonfatigue Comparison Group	Workers With Fatigue
Total LPT	Percent with >0 total LPT (%, 95% CI)	26.4 (25.5–27.3)	65.7 (64.6–66.9)
	Mean hr lost (95% CI) in hrs/worker/wk†	3.3 (3.2–3.5)	5.6 (5.4–5.7)
	Mean cost (95% CI) in dollars/worker/wk†	51.0 (46.5–55.5)	86.1 (82.3–89.9)
	Total cost (95% CI) in $billions/yr	35.4 (31.9–39.0)	136.4 (129.3–143.5)
Absenteeism	Percent with >0 absenteeism (%, 95% CI)	6.1 (5.7–6.6)	17.3 (16.5–18.1)
	Mean hr lost (95% CI) in hrs/worker/wk†	1.1 (1.0–1.3)	1.5 (1.4–1.5)
	Mean cost (95% CI) in dollars/worker/wk†	17.0 (14.5–19.4)	23.8 (22.0–25.6)
	Total cost (95% CI) in $billions/yr	11.8 (10.0–13.5)	37.7 (34.7–40.7)
Presenteeism	Percent with >0 presenteeism (%, 95% CI)	25.0 (24.1–25.9)	63.5 (62.3–64.7)
	Mean hr lost (95% CI) in hrs/worker/wk†	2.2 (2.1–2.4)	4.1 (4.0–4.2)
	Mean cost (95% CI) in dollars/worker/wk†	34.0 (30.8–37.3)	62.3 (59.3–65.3)
	Total cost (95% CI) in $billions/yr	23.6 (21.1–26.2)	98.7 (93.2–104.2)

*Estimates are benchmarked to the Current Population Survey.
†Means only include respondents with >0 LPT for any health-related reason.
CI indicates confidence interval.

TABLE 6
Percent of the U.S. Workforce With Condition-Specific Lost Productive Time (LPT) and Mean Hours of Condition-Specific LPT in the Previous 2 Wk by Presence or Absence of Fatigue*

	Percent With LPT Due to Condition		Mean Condition-Specific LPT Per Week†	
Condition or Symptom	Fatigue Absent Percent (95% CI)	Fatigue Present Percent (95% CI)	Fatigue Absent Mean (95% CI)	Fatigue Present Mean (95% CI)
Pain	7.73 (7.24–8.23)	20.66 (19.72–21.60)	3.3 (3.0–3.7)	5.3 (5.1–5.6)
Digestive problems	1.93 (1.75–2.11)	4.82 (4.36–5.28)	3.3 (2.9–3.7)	5.0 (4.4–5.5)
Feeling sad/blue	0.60 (0.49–0.72)	2.01 (1.68–2.34)	3.0 (2.3–3.6)	7.0 (6.3–7.7)
Cold/flu	6.48 (6.15–6.82)	12.26 (11.55–12.97)	3.6 (3.3–3.9)	5.7 (5.3–6.0)
Allergies	1.86 (1.62–2.09)	3.64 (3.27–4.01)	2.3 (2.0–2.6)	4.7 (3.9–5.5)
Asthma/chronic breathing problems	0.42 (0.31–0.53)	1.71 (1.48–1.94)	4.5 (3.3–5.7)	7.8 (6.2–9.4)
Cancer	0.01 (0.00–0.01)	0.09 (0.04–0.15)	9.9 (0.0–24.8)	6.0 (3.7–8.2)
Heart disease	0.04 (0.01–0.07)	0.17 (0.09–0.25)	3.2 (0.7–5.8)	10.4 (5.1–15.7)
Diabetes	0.14 (0.08–0.20)	0.34 (0.24–0.45)	4.3 (1.0–7.6)	5.4 (3.8–6.9)

*Estimates are benchmarked to the Current Population Survey.
†Means only include respondents with >0 condition-specific LPT; LPT measured in hr per worker per week.
CI indicates confidence interval.

of approximately $70 billion in excess health-related LPT to explain in these workers.

The second source likely to account for the balance of the excess health-related LPT in workers with fatigue is the increase in reported LPT due to other health conditions that occurs when fatigue also is present. Fatigue, when it co-occurs with other conditions, is associated with significantly more reported LPT due to those conditions. Chen[2] previously documented the association between fatigue and conditions such as asthma, arthritis, emphysema, anemia, depression, anxiety, and emotional stress in the U.S. general population. Fishbain and colleagues reported the relation between fatigue and chronic low back pain and chronic neck pain,[22] and Franssen and colleagues demonstrated the relation between fatigue and chronic diseases in a working population.[23]

Our findings support these associations and raise the question as to the mechanism by which fatigue interacts with other health conditions to increase functional impairment due to those other conditions. Several explanations are possible. One is that co-occurring fatigue is a surrogate for disease or symptom severity in which the presence of fatigue indicates greater severity. Another is that co-occurring fatigue is associated with psychiatric comorbidity, a relationship that has been documented previously.[22] Third, fatigue, when present, could restrict an individual's ability to compensate physically or mentally for functional impairment from other health conditions. It is also possible that fatigue lowers an

individual's threshold of work impairment such that fewer or less severe symptoms of other health conditions result in LPT due to those other health conditions. Additional research is required to examine these and other explanatory hypotheses.

Our fatigue prevalence estimate of 37.9% in the U.S. workforce is consistent with prevalence estimates from other community studies of working-aged individuals (ie, 18–65 years). One population-based study of women in Sweden reported that 40% experienced general fatigue in the 3 months before study participation.[3] Another smaller study of workers employed by two different organizations in England found that 47% reported feeling tired or having a lack of energy during the previous week.[1] With respect to gender-specific differences in fatigue prevalence, our observation of a higher prevalence of fatigue in women than men has been reported previously.[2,24] However, our finding that fatigue prevalence varied significantly by age has not been demonstrated consistently in previous studies.[5]

Fatigue may be linked to physical and psychologic disorders such as anemia, chronic pain, endocrine disease (eg, diabetes, hypothyroidism), infection, sleep disorders, depression, and anxiety.[25,26] It may also be related to lifestyle factors, including obesity and insufficient physical activity,[2] environmental stressors (eg, personal relationships), and psychosocial work characteristics (eg, job demand, decision latitude, social support, and job strain).[26] Although we did not gather information on environmental and lifestyle factors in this study, we did find that workers in high-control (ie, high decision latitude) jobs had a higher prevalence of fatigue than workers in low-control jobs. One explanation is that the increased job stress that can come with a high-control job is linked to a higher prevalence of fatigue. The cross-sectional design of our study and the lack of more descriptive information on job characteristics such as job strain limit our ability to more fully explore the observed relationship.

Adverse consequences of severe and persistent forms of fatigue have been documented previously, most often as unemployment.[11,27] Our results indicate that fatigue is a source of impairment even in an employed population. Fatigue was associated not only with increased LPT, but also with reduced quality of life. Fatigue impaired work ability primarily by increasing workers' time to accomplish tasks and impairing their concentration. Furthermore, based on SF-12 PCS and MCS scores, workers with fatigue reported more physical health problems, bodily pain and role limitations, and poorer general health, vitality, and social functioning than workers without fatigue.

In general, patients view fatigue as an important symptom because it is disabling.[25] Healthcare providers, on the other hand, can overlook the importance of fatigue in patient reports because it is diagnostically nonspecific.[25] Of patients reporting fatigue in primary care settings, fatigue was the main reason for consulting a provider in 5% to 10% of cases and a secondary complaint in an additional 10% to 20% of cases.[28–34] Our findings suggest that intervention efforts targeting workers with fatigue, particularly women, could have a marked positive effect on the quality of life and productivity of affected workers. Potential strategies to improve the health of employees and reduce the fatigue-related LPT burden on employers include increasing access to employer-sponsored work life programs for individuals struggling to balance work and personal responsibilities and ensuring that the subgroup of workers with fatigue co-occurring with other health conditions receives optimal assessment and treatment.

This study has several limitations. First, our fatigue case definition was based on a single question and additional information to further characterize fatigue by frequency, duration, or severity was not gathered. We also were unable to discern the reasons for or causes of fatigue. This made it difficult for us to differentiate nonhealth-related fatigue from health-related fatigue and, in the latter case, primary fatigue from fatigue secondary to other disease processes in estimating prevalence and associated LPT costs. It would be interesting in future studies to distinguish between the costs of occupationally induced fatigue (eg, shift work, extended work hours) and fatigue due to other health- and nonhealth-related reasons. Furthermore, the cross-sectional research design limited our ability to discern the direction of observed associations, particularly with respect to fatigue and occupational and employment characteristics. For example, given the significantly higher prevalence of fatigue observed among workers in high-control occupations, at least two explanations are possible. In one, workers could self-select for employment in high-control occupations to accommodate their fatigue (or the reason underlying the fatigue). In another, high-control occupations often associated with managerial responsibilities and higher stress could be a contributing factor causing employee fatigue. Longitudinal studies are required to define the direction of these associations. Finally, our research did not fully account for all labor costs associated with fatigue. Our LPT estimates did not take into consideration other costs such as the hiring and training of replacement workers, impact of coworkers' productivity, and employees' potentially forfeited leisure time.[35]

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